1.0 EXECUTIVE SUMMARY

A feasibility study of managing spill events to provide boating opportunities was completed on three target boating runs, the Florence Lake Run, the Tied-for-First Run and the Chawanakee Gorge Run. The 7-mile Florence Lake Run is located on the South Fork San Joaquin River (SFSJR) downstream of Florence Lake, extending from the Jackass Meadow Campground to the Mono Hot Springs Campground. The 7-mile Tied-for-First Run is on the San Joaquin River (SJR), and extends from the Mammoth Pool Dam to just below the Mammoth Pool Powerhouse. The 8.3-mile Chawanakee Gorge Run begins at the base of Dam 6 and extends to the Italian Bar Bridge at the upper end of Redinger Reservoir.

In high snowpack years when reservoirs spill in the Big Creek system, there is potential to provide boating opportunities prior to the spill. Spill flows from reservoirs do not normally occur until the reservoirs are at maximum capacity and are uncontrollable and most-often times, above the boatable range. Pre-spill releases offer the possibility of controlled boatable releases before reservoirs are completely full.

Southern California Edison (SCE) obtained information about acceptable[1] boating flows on these three target runs from single flow studies conducted in association with the REC 3, Whitewater Recreation Assessment Study Boating Opportunities Analysis (SCE 2003). The acceptable boating flows ranged from 350 to 2,000 cfs on the Florence Lake Run, 700 to 2,000 cfs on the Tied-for-First Run, and 350 to 1,000 cfs on the Chawanakee Gorge Run.

Historic hydrologic data was evaluated to examine the rate of change, frequency, duration, and magnitude of stream flows during spill events at the diversion dams mentioned above. The hydrologic data indicates that enough water may be available to provide boating opportunities prior to spill events (pre-spills) during certain years, depending on various factors, such as storage in reservoirs, inflow from tributaries, air temperature variations, snowpack, and precipitation runoff. Another factor that must be considered is that the characteristics of spill events, such as the rate of the rise and fall of the spill hydrograph, vary considerably between years and target reaches.

The provisions of the “Operating Contract Relating to Southern California Edison Company’s Mammoth Pool and Existing Projects on the San Joaquin River” commonly known by the shortened title of “Mammoth Pool Contract” (MPC), were also examined and do not substantially affect SCE’s ability to provide pre-spill releases.

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[1] Acceptable flow refers to the range of flows between the Minimum Acceptable and Maximum Acceptable Flow Thresholds estimated during the single flow studies completed in 2003 for each reach. Refer to REC 3, Whitewater Recreation Assessment Study Boating Opportunity Analysis (SCE 2003) for details of those studies.

2.0 STUDY OBJECTIVE

The study objective was identified in the REC 2, Manage Spill Event Feasibility Study Work Plan, as follows:

- Determine the feasibility of managing spill events to provide boatable flows in target reaches.

3.0 STUDY IMPLEMENTATION

3.1 STUDY ELEMENTS COMPLETED

- Target stream reaches on which to evaluate the feasibility of managing spill events were identified.
- Preliminary boatable flow ranges (target flows) for the various whitewater runs were estimated.
- Historical hydrological data was analyzed to determine the rate of change, frequency, duration, and magnitude of stream flows during spill events on target stream reaches.
- The hydrologic data and existing project infrastructure information were used to determine the ability to manage spill events to provide target flows in specific stream reaches. This element included reviewing the operational constraints imposed by the MPC.
- The potential need for additional hydrologic data to increase whitewater boating opportunities through the management of spill events was examined.

3.2 OUTSTANDING STUDY ELEMENTS

- Identify Project improvements that increase whitewater boating opportunities through the management of spill events.

4.0 STUDY METHODOLOGY

This report focuses on three "target" reaches, which are depicted on Figures REC 2-1a, REC 2-1b and REC 2-1c and include:

- <u>Florence Lake Run</u>. This run is located on the SFSJR and extends 7 miles, starting at Jackass Meadow Campground and ending at the Mono Hot Springs Campground. Acceptable boatable flows for this run range from approximately 350 to 2,000 cfs.
- <u>Tied-for-First-Run</u>. This run is located on the SJR and extends 7 miles from the Mammoth Pool Dam to just beyond the Mammoth Pool Powerhouse. Acceptable boatable flows for this run range from approximately 700 to 2,000 cfs.

- Chawanakee Gorge Run. This run is located on the SJR and extends 8.3 miles, starting at the base of Dam 6 and ending at the Italian Bar Bridge at the upper end of Redinger Reservoir. Acceptable boatable flows for this run range from approximately 350 to 1,000 cfs.

These runs were evaluated as part of a whitewater recreation assessment study completed in 2003. The selection process for the whitewater target reaches, discussion of the single flow studies conducted for each run, estimation of acceptable boating flow ranges, and opportunities for boatable flows are discussed in detail in the REC 3, Whitewater Recreation Assessment Study Report (SCE 2003).

4.1 HISTORIC FLOW DATA METHODS

The boating flow ranges were used along with historical hydrology information to examine the rate of change, duration, magnitude, and frequency of flows within the boating range during spill events in the three target reaches.

Historic mean daily flow data for the three target reaches was compiled from available USGS records for the period between 1983 and 2002 from four gages, identified as follows:

- Florence Lake Run. South Fork San Joaquin River below Hooper Diversion, USGS Gage No. 11230215 (SCE Gage No. 129).

- Tied-for-First Run. San Joaquin River above Shakeflat Creek, USGS Gage No. 11234760 (SCE Gage No. 157).

- Chawanakee Gorge Run. San Joaquin River above Stevenson Creek USGS Gage No. 11238600 (SCE Gage No. 124) *and* Stevenson Creek USGS Gage No. 11241500 (SCE Gage No. 131).

Spill events within each target reach were identified from mean daily flow data measured at the four stream gages below the reservoirs. The spill events were identified as periods when instream flows measured at the four stream gages below the reservoirs were 100 cfs or greater than the applicable minimum instream flow requirements (spill criteria threshold). The minimum instream flow requirements associated with each reach are provided below, by water year (WY) type.

- Florence Lake Run. During Normal WYs, minimum instream flow requirements are: 17 cfs (Oct), 15 cfs (Nov-Apr), and 27 cfs (May-Sept). During Dry WYs, the requirements for minimum instream flows are: 13 cfs (Oct), 11 cfs (Nov-Apr), and 20 cfs (May-Sept).

- Tied-for-First Run. During Normal WYs, the minimum instream flow requirements are: 25 cfs (Sept 16-Oct), 10 cfs (Nov-Apr 15), 25 cfs (Apr 16-Jun), and 30 cfs (Jul-Sep 15). During Dry WYs, the minimum instream flow requirements are: 12.5 cfs (Sept 16-Oct), 10 cfs (Nov-Apr 15), 12.5 cfs (Apr 16-Jun), and 30 cfs (Jul-Sept 15).

- Chawanakee Gorge Run. The minimum instream flow requirement is 3 cfs for all WY types throughout the year.

Spill events were examined by WY type, based on the California Department of Water Resources (DWR) WY classification. The WYs between 1983 and 2002 were classified into Wet, Above Normal, Below Normal, Dry, and Critically Dry years. For the period of record, seven years were classified as Wet, three years as Above Normal, three years were Dry, and seven years were Critically Dry. No years were classified as Below Normal during the period of record, as summarized below:

- Wet WY. 1983, 1986, 1993, 1995, 1996, 1997, 1998 (7 years).
- Above Normal WY. 1984, 1999, 2000 (3 years).
- Below Normal WY. None.
- Dry WY. 1985, 2001, 2002 (3 years).
- Critically Dry WY. 1987, 1988, 1989, 1990, 1991, 1992, 1994 (7 years).

The mean daily instream flows during the spill events were graphed in relation to the boating range. The duration of the spill event and mean daily peak magnitudes were determined.

Electronic fifteen-minute data was used to evaluate historical flow patterns in more detail prior to and during spill events. The electronic data was available for each reach in the years listed below.

- Florence Lake Run: 1993 - 2002, except 1997
- Tied-for-First Run: 1993 - 2002, except 1997
- Chawanakee Gorge Run: 1996 - 2002

For this report, the 15-minute data analyses focused only on the spill events and the period of time when the flows passed through the boating range, rather than on the full year and entire rising/falling limbs of the hydrograph.

4.2 FEASIBILITY OF MANAGING SPILL EVENTS METHODS

SCE monitors and reassesses its water management daily during the runoff period. The ability to forecast and manage reservoir inflow and outflow is dependent on many changing variables, including conducting necessary project maintenance and repair activities. SCE hydrographers were consulted to assess project operations related to managing spill events and to describe the process and data needed to forecast runoff and identify spill events.

The existing infrastructure at the Project diversion dams that may control the flows for each run was evaluated and summarized to identify the current operating procedure during spill events at the three applicable dams and to examine options for spill event operations that could potentially provide additional boating opportunities.

The MPC was reviewed to determine reservoir storage requirements and minimum/maximum flow constraints that potentially could affect the management of spill events to provide whitewater boating opportunities.

5.0 RESULTS

The results of the historical spill event analyses are summarized below for each target boating run and summary tables and graphs are provided in Appendices A, B, and C for the Florence, Tied-for-First, and Chawanakee runs, respectively. The available data as described in Section 4.1 was evaluated and additional hydrologic data is not needed to evaluate whitewater boating opportunities within the three reaches through the management of spill events.

5.1 HISTORIC FLOW DATA RESULTS

5.1.1 FLORENCE LAKE RUN

Mean daily flows within the SFSJR between 1983 and 2000 are graphed in Appendix A, Figure REC 2-A-1. Between 1983 and 2002, spill events occurred during 8 years, identified from mean daily flows (Appendix A, Table REC 2-A-1). The spill events occurred in all Wet WYs and in 2000, an Above Normal WY (Appendix A, Table REC 2-A-1). These spill events are depicted graphically in Figures REC 2-A-2 through Figure REC 2-A-8 in Appendix A. Spill events did not occur during Critically Dry, Dry, and two of the three Above Normal WYs. Florence Lake spill events typically occur between June through August. The duration of the spill events ranged from 3 days in 1995 and 2000 to 85 days in 1983.

Electronic fifteen-minute data are available for the 1993, 1995, and 1998 spill events during which spill flows occurred within and/or exceeded the boatable range. The gage was not operational from 10/1/96 to 11/22/96 (outage) and 1/2/97 to 9/30/97 (high flow damaged gage). Flows during 1996 and 2000 spill events remained within the acceptable boating range through the duration of the spill event. Spill events during all years occurred after Kaiser Pass is typically opened on Memorial Day. Spill events also occurred while Kaiser Pass is typically closed due to snow in January 1997, 4/23/98, and 5/22/00 to 5/24/00.

Evaluations of the 15-minute data for the 1993, 1995, and 1998 spill events indicate two different flow patterns during the ascending limb of the spill hydrograph, which is related to the rate of runoff inflow into the reservoir during spill. During 1993, flows rose relatively gradually before exceeding the acceptable boating range. The ascending limb of the spill hydrographs was markedly different during the 1995 spill event, when flows quickly rose through the boating range. Last, in 1998, flows quickly rose into the boating range, and remained within the acceptable range for the duration of the spill. Typically, flows gradually receded through the boating range.

5.1.2 Tied-for-First Run

Mean daily flows within the SJR below Mammoth Pool Dam between 1983 and 2002 are graphed in Appendix B, Figure REC 2-B-1. Between 1983 and 2002, spill events occurred during eleven years, identified from mean daily flows (Appendix B, Table REC 2–B-1). Spill events occurred during all of the seven Wet and three Above Normal WYs, and one Dry WY during the period of record (Appendix B, Table REC 2-B-1). These spills are depicted graphically in Figures REC 2-B-2 through REC 2-B-10 in Appendix B. Spill events did not occur during Critically Dry and two of three Dry WYs. Mammoth Pool Reservoir typically spills between March and early June during periods of high runoff.

The duration of continuous flows greater than the spill criteria threshold ranged from two days in 1986 and 1999 to 191 days in 1995. The highest mean daily flow (26,000 cfs) was recorded at the SJR above Shakeflat Creek on January 3, 1997. An instantaneous peak was estimated at 65,000 cfs on January 2, 1997.

Electronic fifteen-minute data are available for the 1993, 1995, 1996, 1998, 1999, and 2000 spill events during which flows occurred within the boatable range. Fifteen-minute data is not available for the spill event that occurred during 1997 because the gages were not operational due to damage from high flows. In general, flows gradually receded through the boating range. However, the flow patterns during the ascending limb varied considerably between spill events, reflecting the inter-annual variability in reservoir storage capacity and inflow volumes and rates into the reservoir prior to and during spill events. For example, flows quickly exceeded the boating range during the initial peak of the 1993 spill event. In comparison, during an initial rise in flow of the 1995 spill event, flows gradually increased through the boating range. Flows during the main 1995 peak, however, quickly rose through the boating range. The pattern of the 1996 and 1999 spill events was similar, with flows quickly rising through the boating range. In comparison, flows during the 1998 and 2000 spill events rose relatively slowly before exceeding the maximum boating threshold. Last, during the 2000 spill event, flows initially rose slowly through the boating range, then quickly increased in response to an increase in runoff inflow into the reservoir.

5.1.3 Chawanakee Gorge Run

The spill flows over Dam 6 into the Chawanakee Gorge Run are normally the result of high flows from Mammoth Pool Reservoir, but may also include flows from Stevenson Creek, Powerhouse No. 8 (BC PH8), and Big Creek. The forebay at Dam 6 has a minimal impoundment of 993 acre-feet. As shown in Appendix C, Figure REC 2-C-1, Dam 6 always spills when Mammoth Pool Reservoir spills. Figure REC 2-B-1 in Appendix B summarizes the mean daily flows from Mammoth Pool Reservoir showing the spill events. Project operations at Powerhouse No. 3 (BC PH3), and BC PH8 may cause Dam 6 to occasionally spill independently from Mammoth Pool Reservoir spills.

Figures REC 2-C-1 through Figure REC 2-C-7 in Appendix C show a comparison of flows from Mammoth Pool Reservoir and Dam 6.

Based on the gaging station records at Dam 6, spill events occurred during eleven years between 1983 and 2002, identified from mean daily flows. Spill events occurred during all of the seven Wet (although flow data is not available for 1995) and three Above Normal WYs, and two of the Dry WYs during the period of record (Appendix C, Table REC 2-C-1). The spill event occurring in each of these years are depicted graphically in Figures REC 2-C-8 through Figure REC 2-C-18. Spill events did not occur during Critically Dry and the other one of the three Dry WYs. Spill events often began in early spring and continued through the summer in this reach.

The duration of flows during a spill event that meet the spill criteria threshold (100 cfs greater than minimum instream flow requirements) ranged from one day (for example in 1997, 1998, 1999, and 2000) to 214 days in 1983. The highest mean daily discharge (32,000 cfs) was recorded in January 1997. An estimated instantaneous peak flow over Dam 6 of 72,400 cfs occurred on January 3, 1997.

Flows within the lower portions of the Chawanakee Gorge Run are also supplemented by water from various tributaries, including Big Creek (which joins the San Joaquin River just above Dam 6 and therefore is included in the Dam 6 flow data), and Stevenson Creek[2]. Flows from Stevenson Creek are at minimum instream flow release except during years when water is released from Shaver Lake into Stevenson Creek when runoff is extremely high. The relatively high flows within Stevenson Creek during 1997 (214 to 374 cfs from June 17 to June 24) and 1998 (134 to 390 cfs from June 2 to August 11) were in part due to water released from Shaver Lake in response to forecasted high runoff volumes. These additional releases through Stevenson Creek increased the flows within Chawanakee Gorge Run into the boating range for approximately 40 hours in January 1997, approximately five and 21 days in March and April 1997 (Figure REC 2-C-13, Appendix C), respectively, and at least six days in late March and early April 1998 (Figure REC 2-C-14 Appendix C). The additional inputs from Stevenson Creek also increased flows within the Chawanakee Gorge Run when they exceeded the boating range during March and June 1997.

Fifteen-minute flow data is available for 1996 through 2002. Analysis of mean daily flows indicate that flows can either increase sharply through the boating range or gradually rise through the range, depending on the reservoir capacity and the rate of inflow of the runoff into the reservoir. For example, flows were within the boating range for multiple days during the rising limb of the 1996 spill event in early March and the 1997 spill event in January. Similarly, flows were within with the boating range during the initial rise of spill flows in late March 1998. Flows pulsed for short periods of time

[2]Generally, except when moving water intentionally out of the backcountry, the reach of Stevenson Creek below the Shaver Lake Dam does not contribute large flows into the Chawanakee reach, as there is minimal local runoff, and the minimum instream flow release requirements are 3 cfs (Oct–Nov 15), 2 cfs (Nov 16–Mar), and 3 cfs (Apr–Sep).

through the boating range as the spill receded in 1998. In comparison, flows rose quickly through the boating range during the 1999 spill event. Flows pulsed within the boating range for short periods of time (hours) during the rise of the 2000 spill event. Flows during the descending limb tended to fall quickly through the boating range.

5.2 FEASIBILITY OF MANAGING SPILL EVENTS

This study considers two primary options for managing spill events to provide boating flows. SCE could (i) manage flows once an involuntary spill event has begun or (ii) release water in advance of forecasted spill events (a pre-spill release). The feasibility of managing a spill event and pre-spill release, and the provisions of the MPC, are discussed below.

5.2.1 Feasibility of Managing Flows during a Spill Event

Once the capacity of the reservoir is reached and the inflows into the reservoir exceed the maximum diversion conduit capacity for power generation, an uncontrolled spill event (spill) occurs. If the flows of the spill event are greater than the acceptable boating flow range, SCE does not have the ability using the existing infrastructure to control or manage the spill to decrease flows into the acceptable boating range.

The only spill circumstance during which SCE could possibly have the ability to manage spill and provide flows in the acceptable boatable range would occur when the spill event flow is lower than the minimum acceptable boating flow threshold. In this situation, SCE could increase flow into the bypassed reaches by reducing powerhouse generation and releasing water which would otherwise have been used for generation into the bypass reach. While this scenario is technically feasible, it may not be practicable. An attempt to raise the flows into the boatable range by this means would happen during the ascending limb of a spill event. Typically, the ascending limb of the hydrograph is steep and flow rates increase quickly. Therefore, the duration of a boating flow that could be provided under this scenario would be short. In addition, another factor that must be considered is SCE’s limited ability to provide advance notice of this boating opportunity to the boating community and a likely inability to predict the duration of boatable flows that could be provided. Moreover, if the notice is very short, then it could cause problems with SCE’s requirements to deliver energy as promised to the California Independent System Operator.

Safety of boaters and other individuals (i.e. anglers, search and rescue personnel) is another factor that must be considered when providing boatable flows using the scenario described above. The factors that influence the slope of the hydrograph include precipitation, current and forecasted temperature, and snowpack water content. These factors are highly variable on a daily, and potentially on an hourly basis and are discussed in detail in the sections below. Based on this variability, the daily and possibly hourly spill or flow conditions could quickly change. Such rapid changes in spill may result in increased flows well above the acceptable boating range placing boaters using the river at risk.

5.2.1 FEASIBILITY OF MANAGING A PRE-SPILL RELEASE

SCE's ability to release water prior to a spill event is highly dependent upon a number of factors. The most important of these factors is SCE's ability to forecast the rate of increase of reservoir inflows and resulting storage in sufficient time to provide useable information to potential boaters before and during the runoff period.

If the spill events were able to be accurately forecasted, it would be possible under certain circumstances to manage the spill events by providing pre-spill boatable flows within target reaches. These pre-spill releases would release water from a reservoir prior to the reservoir receiving the inflows that are forecast to be in excess of the combined reservoir storage capacity and diversion intake capacity. Optimally, the amount of water released into the bypass reach would be equal to the amount of inflow in excess of the sum of the target reservoir's storage capacity plus the amount of flow which can be utilized for generation until spill stops. However, due to the uncertainties associated with forecasting the timing and magnitude of spill events, and the variability and changes in the rate and volume of tributary inflows into the reservoirs, the exact amount of pre-spill releases that may be provided without affecting Project operations cannot be accurately estimated. Pre-spill releases that provide too much flow could result in loss of generation capacity. In addition, the flow release infrastructure (spill gate capacities and controls) may limit SCE's ability to provide pre-spill flows or to modify spill events as they occur at the diversion dams. These factors are discussed in the following sections.

There are three primary considerations with respect to managing for pre-spill releases to provide boatable flows. They are:

- Forecast of timing, magnitude, rate, and duration of spill event;
- Storage availability at target reservoir; and
- Reservoir instream flow release infrastructure.

FORECASTING PROCESS

Each year, snowpack and precipitation data is collected at various intervals and is used to produce a runoff forecast, which assumes median precipitation and temperature conditions through the end of the water year (September 30). The snowpack and precipitation data is shared with the California DWR and the US Bureau of Reclamation (USBR), who also use the data to forecast runoff volumes and to determine types of water years (Critically Dry, Dry, Below Normal, Above Normal, or Wet).

As the spring runoff season approaches, SCE forecasts that year's runoff volume. The forecast includes an estimate of both the timing and quantity of water that will enter the reservoirs. The forecasted runoff is based on:

- Seasonal runoff-to-date;

- Previous season runoff;
- Precipitation-to-date; and
- Projected median precipitation and temperature conditions from date of forecast to end of the water year.

As meteorological conditions stabilize during the year, SCE makes an estimate of the watershed yield, and as a result, evaluates the probability of Project reservoirs spilling. Due to the highly variable meteorological conditions characteristic of the High Sierra, early season projections of watershed yield and probability of spill are subject to major revisions as the runoff season approaches. If meteorological conditions stabilize, the capability to project water runoff and spill events is enhanced as the runoff season progresses. However, the forecasts still are not completely accurate.

To forecast a spill event at any specific reservoir, SCE considers the following factors:

- Precipitation-to-date;
- Project reservoir elevation (storage), compared to maximum storage capacity;
- Current and forecasted temperatures;
- Snowpack water content in sub-watershed tributary to that reservoir; and
- Generation hydraulic capacity and unit availability.

These five factors are integrated by SCE and a forecast of the probability of spill event timing, duration, and magnitude at any particular reservoir is made. These factors are discussed below.

Forecast of Timing, Magnitude, Rate, and Duration of Spill Event

Spill events from spring runoff typically occur in April through June in the High Sierras. However, it is difficult to forecast the timing of a spill event much in advance of the commencement of runoff as the probability of a spill event is based on the weather and the snowpack at a given time, which changes through the runoff period and varies among years.

The magnitude (total amount of water in excess of reservoir storage, power generation diversion, and instream release requirements) and rate of the spill event are critical factors affecting the ability to manage pre-spill releases for boating opportunities. The magnitude and rate at which inflow to the target reservoir increases directly affects SCE's ability to manage the duration of pre-spill releases. Spill events occur once the maximum operating capacity of the reservoir is approached and inflow rates exceed the combined instream flow release rate and diversion intake capacity. If inflow increases at a rapid rate, the ability to provide a boatable flow range by a pre-spill release would be diminished because maximum reservoir storage capacity would be approached quickly.

SCE has limited ability to forecast the duration, rate of change, and magnitude of a spill event in advance. If the magnitude of an event is large, and the spill event duration is short (moderate to heavy snowpack and warm spring weather), inflow will rapidly exceed flow release capabilities and spill will likely exceed the acceptable boating range. When this happens, the ability to manage pre-spill releases is not practicable. Conversely, when the duration of a spill event is forecast to be long and the magnitude of the spill event is low or moderate, with high snowpack and cool weather, flow release strategies could be explored to provide pre-spill boatable flows.

Storage Availability

The amount of reservoir storage capacity that is available is an important consideration for determining the ability to manage a forecasted spill event for a pre-spill release. Storage in the reservoir will increase if the rate and volume of runoff flows into the reservoir exceed that of the boating flows released from the reservoir. A spill event will occur once reservoir capacity is reached, and inflows exceed the maximum diversion conduit capacity for power generation. Therefore, the duration of a managed pre-spill release is largely dependent on the differential between the runoff inflow rates and the rate of the pre-spill release, and the amount of reservoir storage capacity available prior to runoff inflows.

The amount of water that can be released to provide boating opportunities in the three target reaches is determined by the existing flow release infrastructures at their respective reservoirs. The ability to release the Minimum Acceptable Boating Flow[3] for a target reach is a pre-requisite for providing boating opportunities through pre-spill releases.

With the existing Project infrastructure, SCE has the ability to move water from high elevation reservoirs to lower elevation reservoirs and powerhouses. This is accomplished through water management into and out of Project tunnels, penstocks, lower reservoirs, and powerhouses, or by releasing flow into the river channels. Project reservoirs are thereby managed to minimize spill events, or conversely, control the timing, duration, and magnitude of a spill event as much as possible, at specific Project reservoirs to maximize Project generation throughout the Big Creek System.

Florence Lake and Mammoth Pool Reservoir are the two primary water sources to provide flows in the target stream reaches. The Chawanakee Gorge Run is downstream of Dam 6, which has minimal impoundment capacity. Flows within this reach are controlled by releases from Mammoth Pool Reservoir to a significant degree.

[3]Minimum Acceptable Flow is the lowest flow at which a boater would be willing to return to recreate on the river/reach. Refer to REC 3, Whitewater Recreation Assessment Study Boating Opportunity Analysis (SCE 2003) for details of studies that determined the acceptable flow ranges.

Existing Infrastructure and Spill Event Management Operations

Pertinent operational considerations and the existing infrastructure at Florence Lake, Mammoth Pool Reservoir, and Dam 6 are described below.

Florence Lake

Florence Lake has a storage capacity of 64,406 acre-feet and stores water from the SFSJR and other small tributaries (e.g. Crater and Hooper Creek). Florence Lake spills relatively infrequently even though it has small storage capacity relative to a large drainage area. The large capacity of the ward tunnel allows water entering Florence to be transferred and stored in Huntington and Shaver reservoirs. Spills at Florence typically occur only after all three reservoirs exceed capacity. Florence Lake storage is kept low during the winter months to avoid water freezing on the dam face, and secondarily to create storage capacity for spring runoff. Storage usually begins to increase in late April from spring runoff. During the spring runoff, water that is collected and stored in Florence Lake is diverted into the Ward Tunnel and transferred to Huntington Lake and Shaver Lake to fill those reservoirs where it is used to maintain reservoir recreation water surface levels and for power generation. Once inflows into Florence Lake exceed the capacity of the Ward Tunnel diversion, the reservoir will begin to fill and spill will usually begin when the reservoir storage capacity is exceeded at Huntington Lake and Shaver Lake as well as at Florence Lake. Spill will continue until inflows into the reservoir decrease below the diversion capacity of the Ward Tunnel. If a spill event occurs, it typically happens when the water year exceeds 100% of normal.

During the recreation season SCE maintains a high reservoir water surface elevation in Florence Lake. From July 1 to August 31 of each year, the minimum storage requirement at Florence Lake is 21,000 acre-feet, which is a FERC and USDA-FS recreation condition. However, the storage level during this period is normally considerably higher. After the peak storage level is reached, the reservoir elevation gradually declines until it again reaches the minimum storage level in the late fall, after the recreation season ends with the closure of Kaiser Pass Road.

Water can be released from Florence Dam into the downstream reach by two means. The first is the use of two 12 foot high floating spill gates that can be raised or lowered as needed to release water into the downstream reach. However, the spill gates are only operational once the reservoir reaches 53,178 acre-feet, at elevation 7,315.5 feet. The spill gates are operated by balancing the inflow and outflow of water to a bladder that allows the gates to float. The position of the spill gates is manually set, and adjusts in response to changes in reservoir water surface elevations. As a result, actual flow releases can fluctuate considerably as the gates adjust to inflows and outflows, which limits the ability of SCE to precisely control pre-spill releases. Florence Dam also has a fish release structure consisting of an 8 inch diameter cast iron pipe at the base of arch 53 at elevation 7,200 feet mean sea level (msl). This pipe allows for 70 cfs release, which, alone, is not large enough to pass the Minimum Acceptable boating flow of 350 cfs into the downstream reach. At the same location but at elevation 7,214 feet msl are two 36 inch cast iron drain pipes, each capable of releasing 450 cfs when the reservoir elevation nears the spillway at 7,315.5 feet.

If the 36 inch drain pipes are not usable or sufficient for releases then pre-spill releases from Florence Dam would include the operation of the floating spill gates. Water releases through these gates cannot be made until the storage in Florence Lake reaches 53,178 acre-feet, which is the water level at the bottom of the spillway gates (7,315.5 feet msl). Once this storage capacity is reached, the remaining storage capacity available to accommodate additional inflows is limited to 11,228 acre-feet (the difference between maximum reservoir capacity and 53,178 acre-feet). Therefore, the ability to manage pre-spill releases at Florence Lake is contingent upon the rate of inflows and the volume of water that is above the bottom of the spill gates prior to and during a pre-spill whitewater release. If runoff is faster and greater than initially forecasted, the maximum capacity of the reservoir may be approached, causing a spill from the reservoir. Once reservoir capacity is exceeded, then SCE could no longer control or manage spill through the operation of the floating spill gates.

Mammoth Pool Reservoir

Mammoth Pool Reservoir has a storage capacity of 119,940 acre-feet. It spills during all Wet and Above Normal WYs because the storage capacity is small relative to the drainage area. In most cases, spill at Mammoth Pool Reservoir will also result in spill at Dam 6. In an average spill scenario, storage increases from minimum storage level to spill in less than a week. Under these conditions, the flexibility and time to manage spill events is limited. Ideally, minimum storage at Mammoth Pool Reservoir will occur just prior to the beginning of spring runoff in order to maximize storage space availability. After spill has passed, storage at Mammoth Pool Reservoir declines at a rate necessary to ensure compliance with the September 30 storage requirement in the MPC.

Pre- spill release flows from Mammoth Pool Dam would be provided by a Howell Bunger (HB) valve that can release water into the bypassed reach. SCE can safely release up to 800 cfs through the HB value.

Dam 6

With an impoundment of 993 acre-feet, this diversion dam is operated as run-of-the-river project. Spill occurs when the water rises above the level of the dam. Dam 6 serves as an afterbay to BC8 PH and MPPH and a forebay to BC3 PH. The flow capacity of BC8 PH plus MPPH exceeds the capacity of BC3 PH. When BC8 PH and MPPH are at full capacity, Dam 6 will spill approximately 300 cfs. Dam 6 may also spill independently of spills at Mammoth Pool. For example, during heavy rainstorms in the winter months, or during the early spring runoff period, significant local inflows from Big Creek and other tributaries may cause Dam 6 to spill.

Dam 6 has four low-level drains and a fish water release valve to provide minimum instream flows. However, these release valves are not capable of releasing whitewater flows. Although each low-level valve can release 1,700 cfs when the reservoir is at full capacity, the gates are designed to be operated only as completely opened or closed, for sediment management. Opening one of these drain gates at 1,700 cfs would completely empty the Dam 6 impoundment of 993 acre-feet in 3.4 hours. This drainage time would be lengthened by additional inflows from MPPH, SJR, Big Creek and BC PH8, but would disrupt the operations of BC PH 3. Therefore, pre-spill boating flows downstream of Dam 6 would have to be created by releases from Mammoth Pool Reservoir, as described above. However, flow within the Chawanakee Gorge Run may also be affected by inflows from Stevenson Creek and Big Creek, as well as additional inflows from local tributaries.

5.2.2 Mammoth Pool Contract

The USBR is responsible for delivering water from Millerton Lake (Friant Dam) to downstream water right holders. When Mammoth Pool Reservoir was constructed in 1957, SCE entered into a contract with the USBR (Mammoth Pool Contract (MPC)). The MPC affects the diversion, storage, and use of waters of the SJR and its tributaries associated with SCE's Big Creek hydroelectric facilities. Specifically, the MPC includes minimum and maximum storage requirements and flow constraints. The MPC supersedes all previous agreements associated with SCE's diversion, storage, or use of water, and places certain seasonal constraints on the net aggregate storage of water in SCE's Big Creek reservoirs.

The MPC specifies annual and seasonal timing and volume of releases (depending upon certain factors), the minimum flow annually past Dam 7 (Redinger Reservoir), and storage levels at the Big Creek project reservoirs. The storage requirements are tied to the computed water-year natural runoff at Friant Dam. The MPC includes provisions regarding minimum and maximum total Big Creek Project storage targets. It does not appear that the MPC would inhibit SCE's ability to make pre-spills.

5.3 Conclusions

Spill event flow magnitude and duration are contingent upon the rate and volume of inflow into the associated reservoir. The factors that affect the rate and volume of inflow into the reservoirs are highly variable. The hydrologic analyses and evaluation of the existing infrastructure indicate that once a spill event begins, SCE has a limited ability to manage spill to provide flows within the acceptable boating ranges.

Hydrologic data suggests that under certain conditions, such as a forecasted low to moderate long-lasting spill-event with high snowpack and stable climatic patterns, SCE technically may be able to provide pre-spill flow releases within the target whitewater boating flow ranges. Pre-spill releases would be made using the dam structure release gates or HB valve.

For reaches below Florence Lake flow could be released through the operation of the floating gates. While this is possible, SCE personnel would be required to continually adjust the gates for the duration of the flow release to provide stable flows within the target flow.

Below Mammoth Pool Reservoir the maximum release possible would be constrained by the ability to safely access and operate the HB release valve. The maximum release that could safely be made is 800 cfs.

Uncertainties in the forecasting process of runoff timing and volume and the high inter-annual variability in runoff patterns preclude SCE's ability to accurately forecast spill events. If pre-spill releases were provided, SCE could not guarantee the precise flow amount, specific timing of the releases, or duration of the pre-spill release. As such, SCE could not provide a dependable number of whitewater boating days, in a specific WY type, at a given time.

6.0 LITERATURE CITED

Southern California Edison (SCE). 2003. 2002 Technical Study Report Package for the Big Creek Hydroelectric System Alternative Licensing Process. Draft published in October 2003. December 2003.

FIGURES

Placeholder for Figures

Non-Internet Public Information

These Figures have been removed in accordance with the Commission regulations at 18 CFR Section 388.112.

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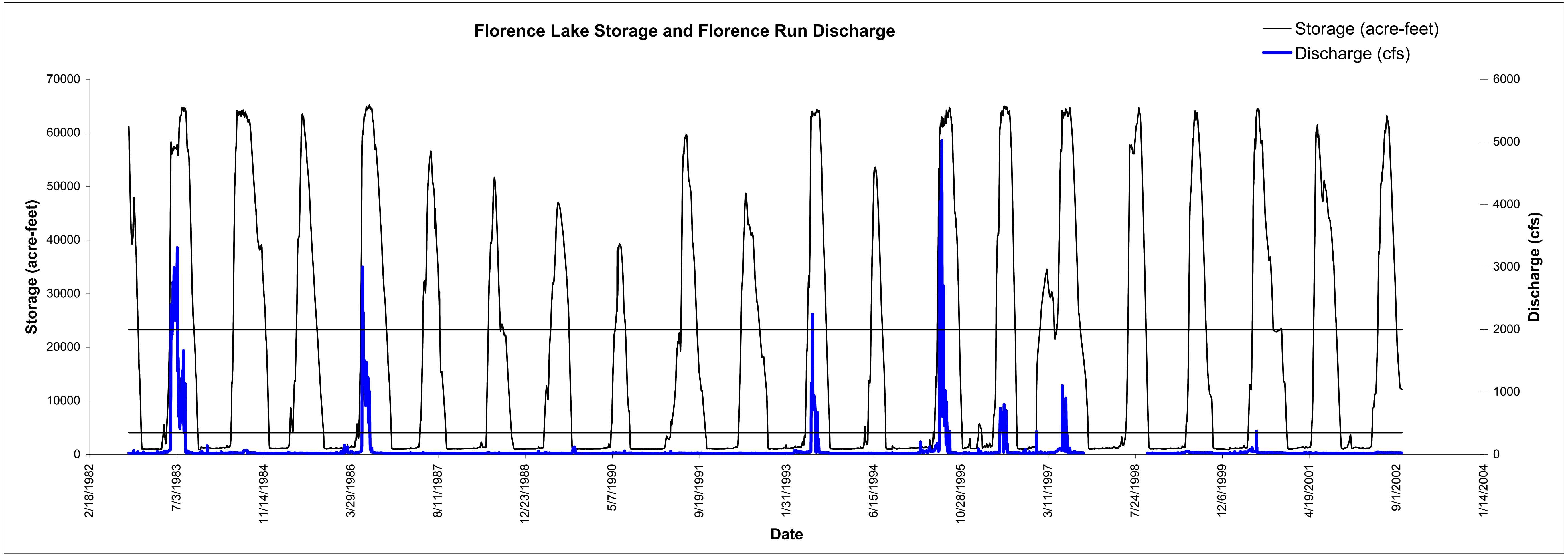
APPENDIX A

Florence Lake Run Spill Event Information

Figure REC 2-A-1: Spill Events: Florence Run Flow and Florence Lake Storage from 1983-2002[1, 2]



[1]Average-daily disharge recorded at USGS Gage No. 11230215 (SFSJR below Hooper) and average daily reservoir storage recorded at Station No. 11229600.
[2]The boating range is between 350 and 2,000 cfs (black lines)

Table REC 2-A-1: Summary of Florence Run Spill Events (1983-2002)[1,2]

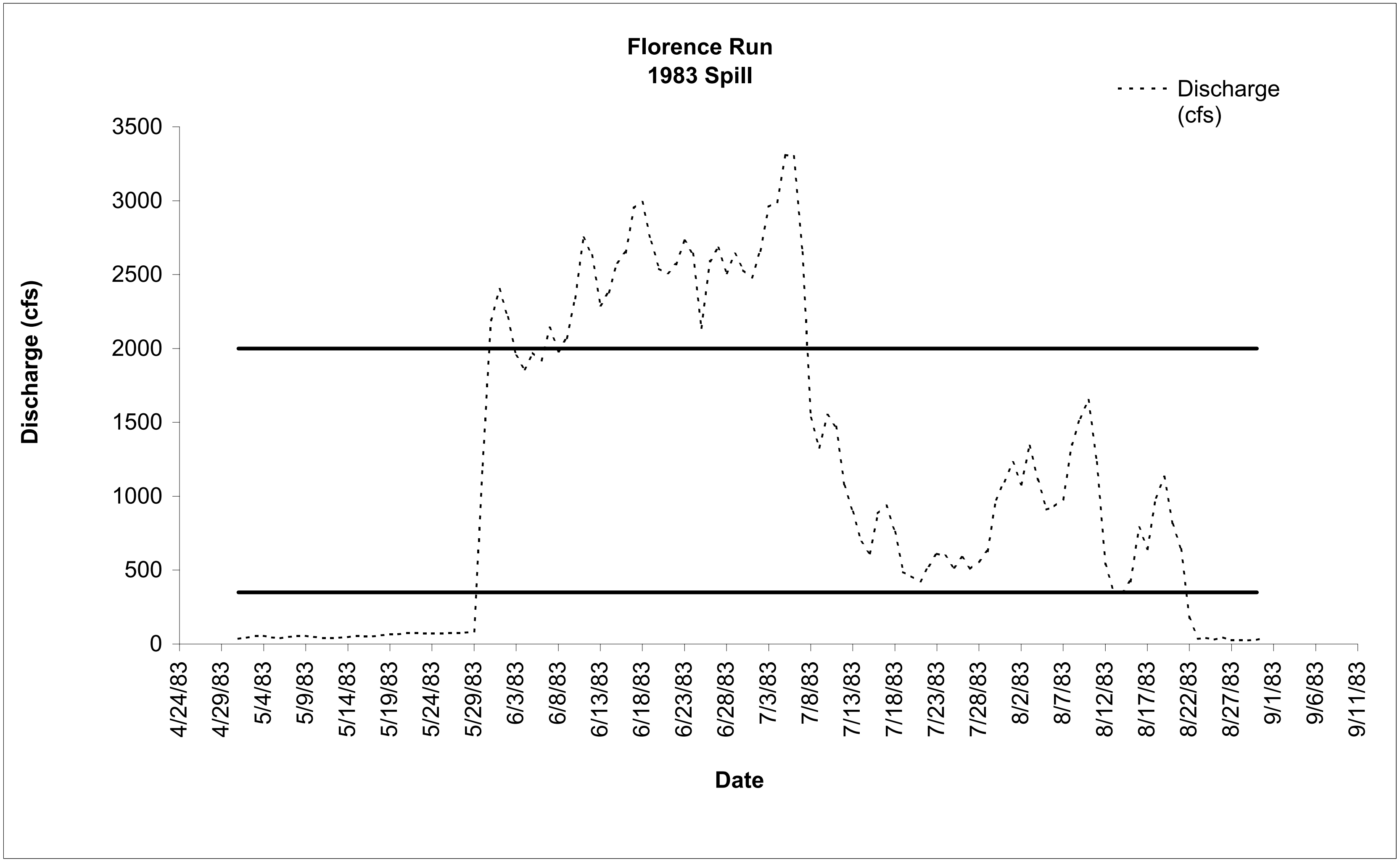
Mean Daily Discharges

Date	Water-year Type	Spill Duration (days)	Mean Daily Peak Spill Discharge (cfs)
5/30/83-8/22/83	Wet	85	3,310
5/31/86-7/26/86	Wet	57	3,000
6/19/93-7/14/93	Wet	26	2,240
7/23/93-8/1/93	Wet	10	667
6/3/95-6/16/95	Wet	12	181
6/26/95-8/10/95	Wet	46	5,020
8/21/95-8/25/95	Wet	3	366
6/6/96-6/25/96	Wet	20	738
6/29/96-7/19/96	Wet	21	800
1/1/97-1/3/97	Wet	3	366
5/31-6/6, 6/9-6/10, 6/12-6/29/97	Wet	25	1,100
4/23/1998	Wet	1	1,576
6/16/98-7/8/98	Wet	38	
8/4/98, 8/9/98-8/11/98, 8/14/98-8/15/98	Wet	6	303
5/22/00-5/24/00	Above Normal	3	112
6/17/00-6/18/00,6/20/00	Above Normal	3	371

[1]Defined as when daily mean discharges are 100 cfs or greater than minimum instream flow requirements (spill criteria threshold).

[2]Spills did not occur during 1984, 1985, 1987, 1988, 1989, 1990, 1991, 1992, 1994, 1999, 2001, and 2002.

Figure REC 2-A-2: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Florence Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 2,000 cfs)[1].



[1]Spills did not occur during 1984, 1985, 1987, 1988, 1989, 1990, 1991, 1992, 1994, 1999, 2001, and 2002.

Figure REC 2-A-3: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Florence Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 2,000 cfs) (continued).

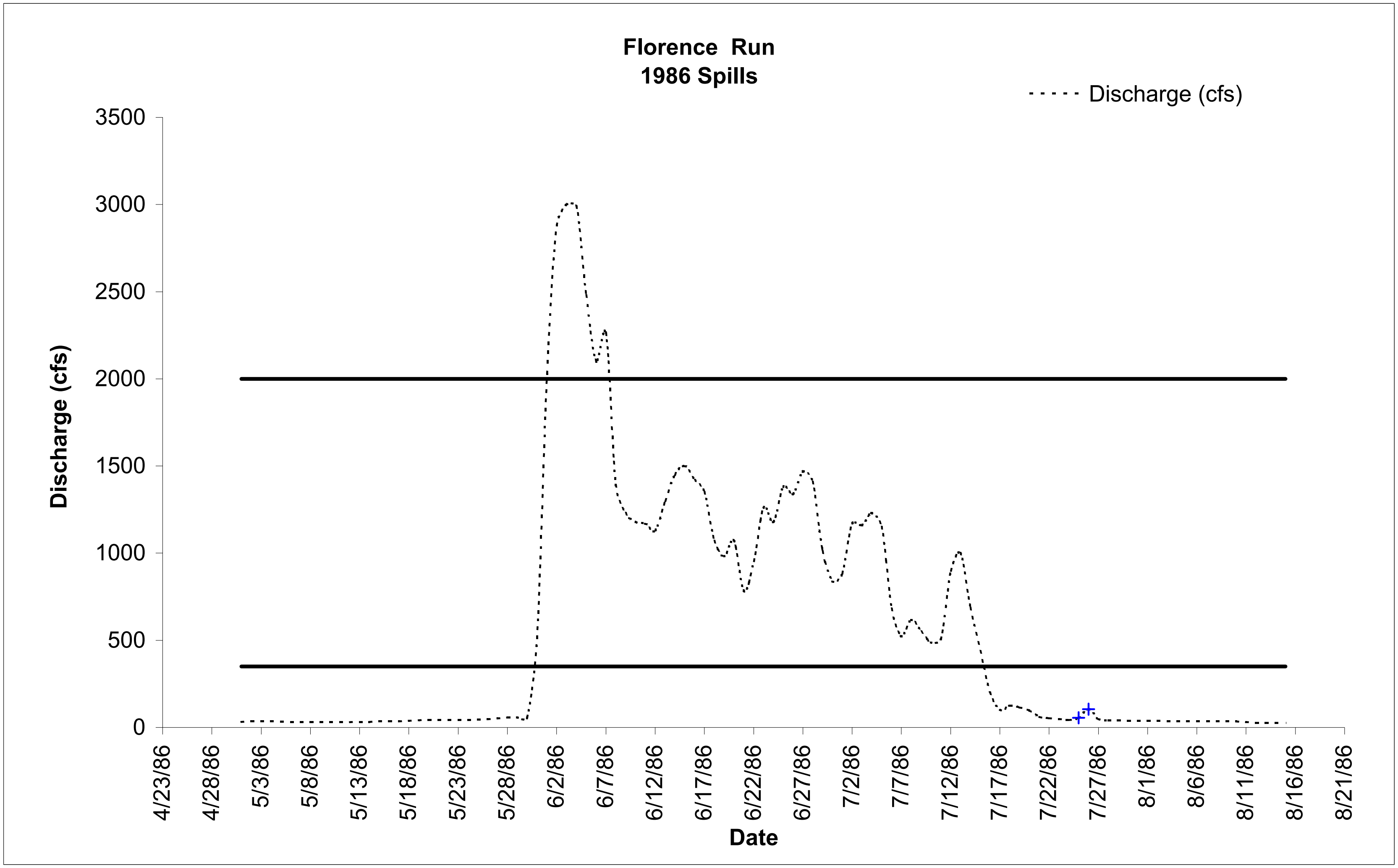


Figure REC 2-A-4: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Florence Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 2,000 cfs) (continued).

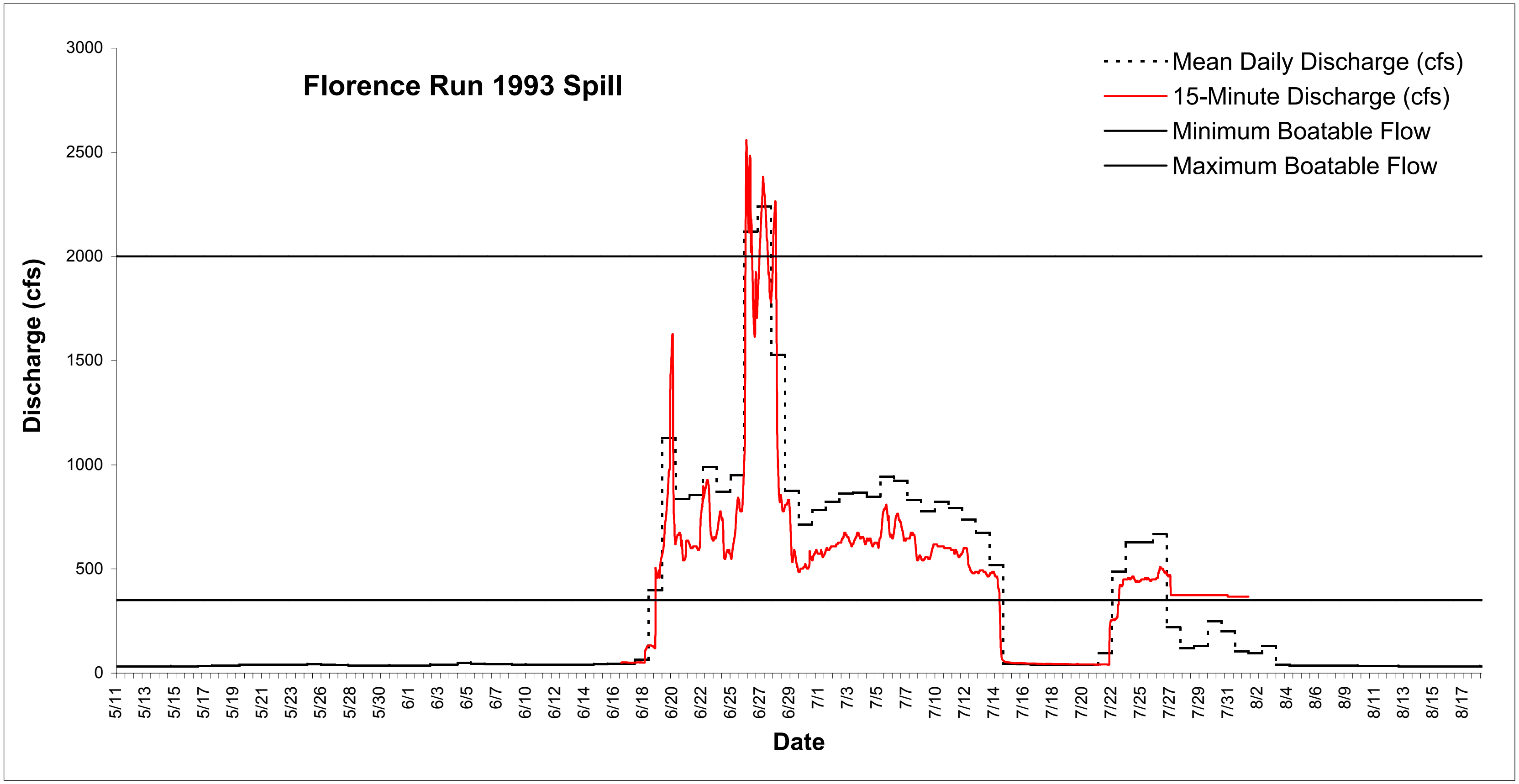
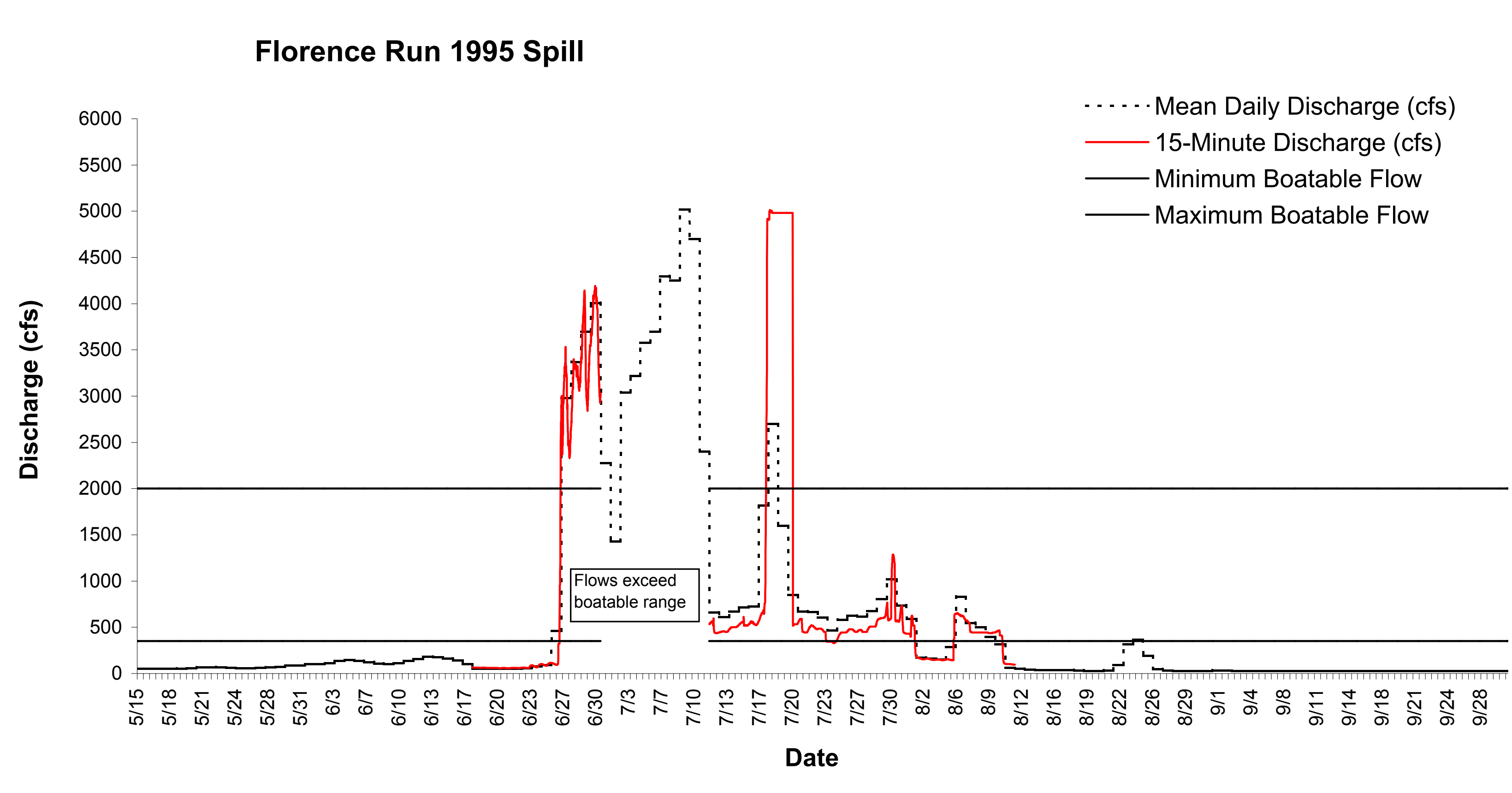


Figure REC 2-A-5: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Florence Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 2,000 cfs) (continued).



NOTE: 15-minute flows the greatly exceed the Maximum Boatable Flow are not shown on the graphs and are noted as 'Flows exceed boatable range'.

Figure REC 2-A-6: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Florence Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 2,000 cfs) (continued).

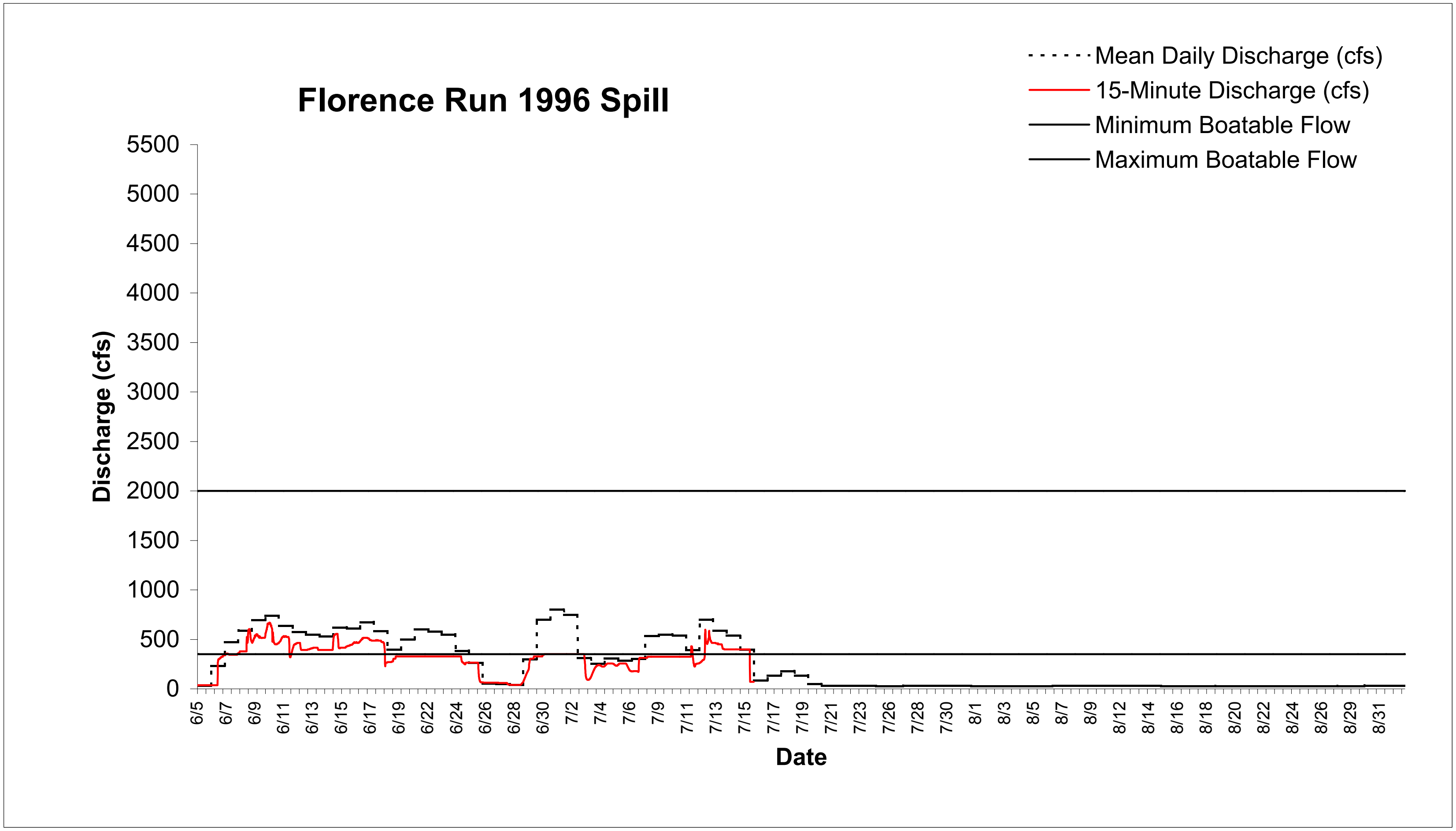


Figure REC 2-A-7: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Florence Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 2,000 cfs) (continued).

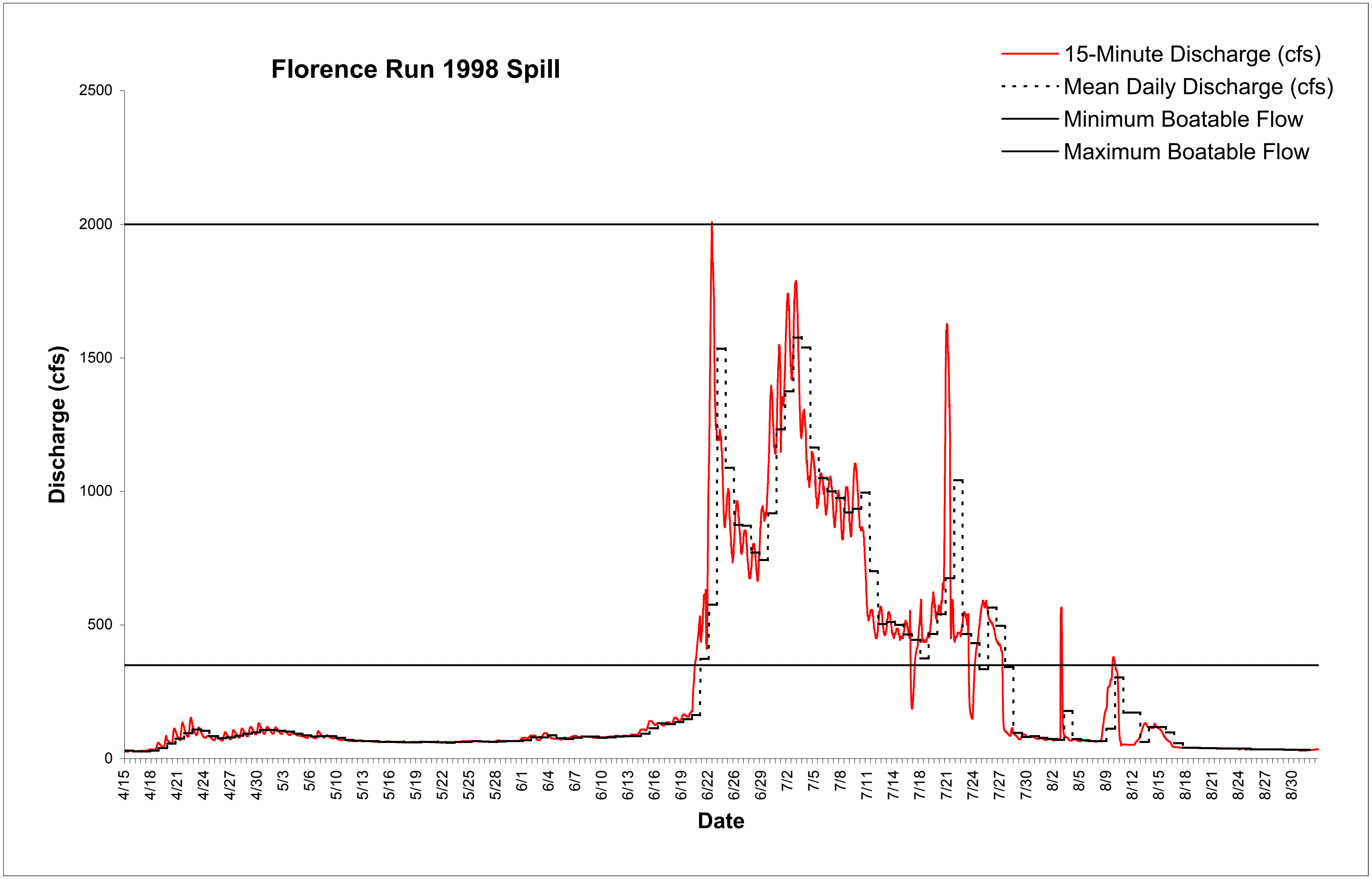
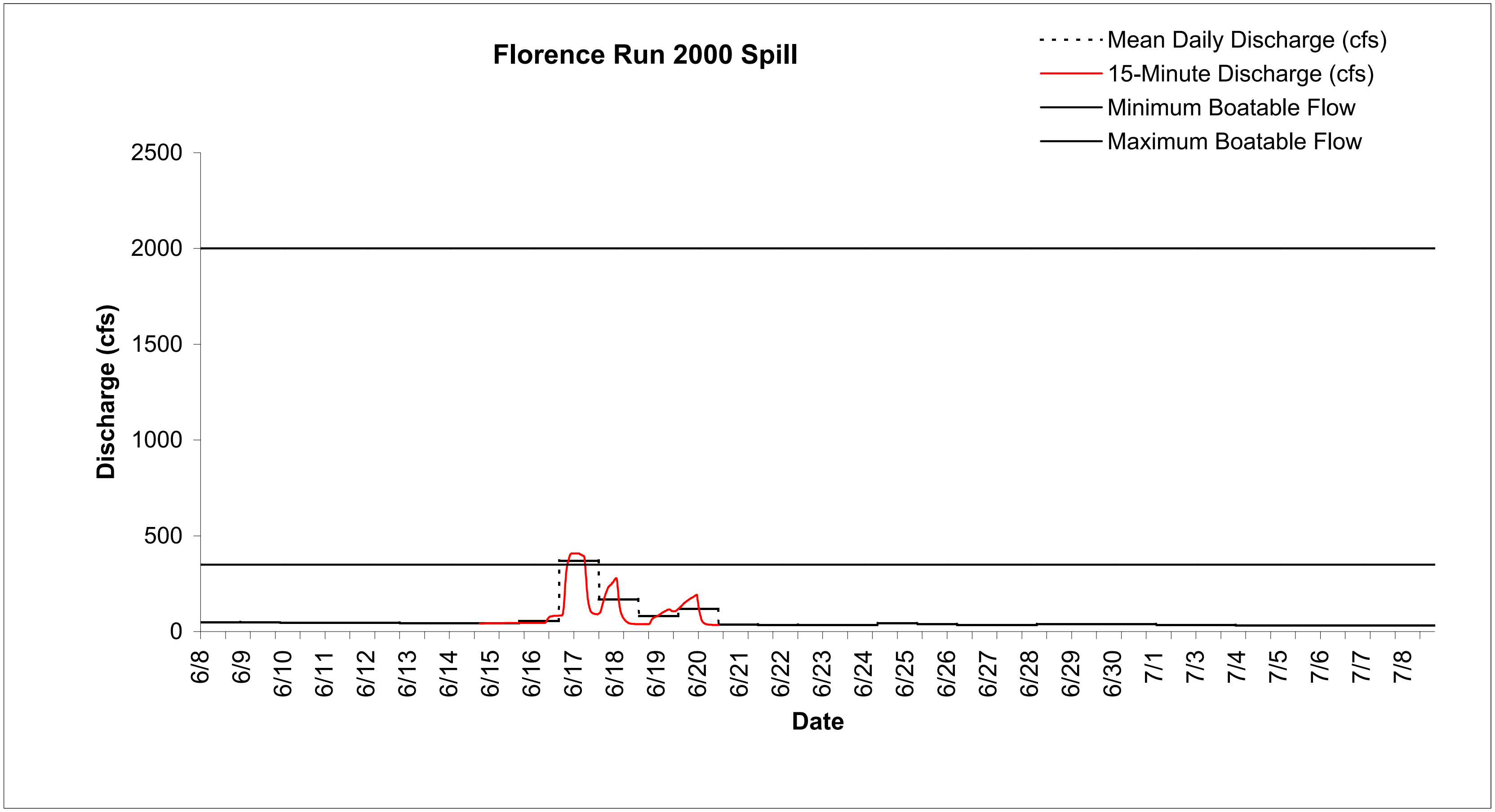


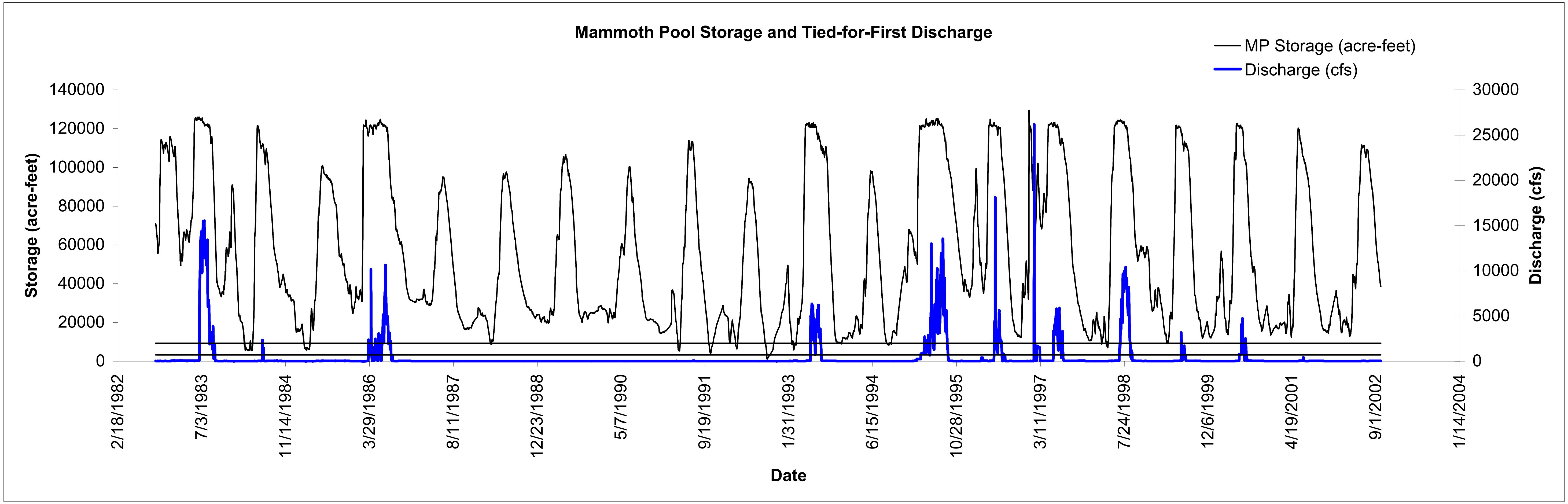
Figure REC 2-A-8: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Florence Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 2,000 cfs) (continued).



APPENDIX B

Tied-for-First Run Spill Event Information

Figure REC 2-B-1: Spill Events: Comparison of Mammoth Pool Reservoir Storage and Tied-for-First Run Flow from 1983-2002[1,2]



[1]Average-daily disharge recorded at USGS Gage No. 11234760 (SJR above Shakeflat) and average daily reservoir storage recorded at Station No. 11234700.
[2]The boating range is between 700 and 2,000 cfs (black lines).

Table REC 2-B-1: Summary of Tied-for-First Spill Events (1983-2002)[1,2]

Mean Daily Discharges

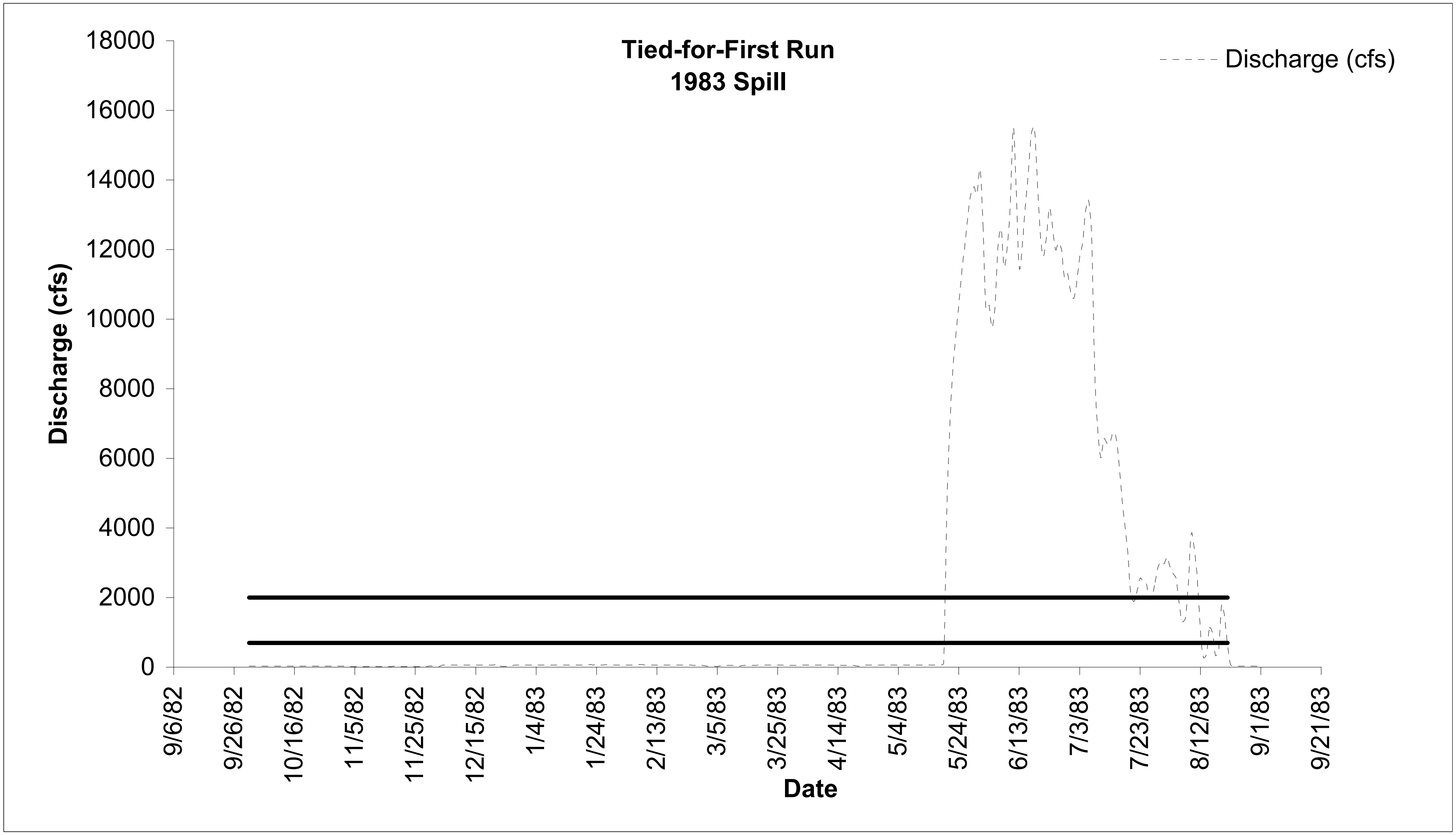
Date	Water-year Type	Duration (days)	Mean Daily Peak Spill Discharge (cfs)
5/19/83-8/21/83	Wet	95	15,500
5/29/84-6/6/84	Above Normal	9	2,300
2/20/86-3/15/86	Wet	24	10,100
3/28/86-4/15/86	Wet	19	2,450
4/21/86-5/7/86	Wet	17	3,050
5/9/86-7/8/86	Wet	61	10,600
7/13/86-7/14/86	Wet	2	624
5/10/93-7/15/93	Wet	67	6,330
2/2/95-8/11/95	Wet	191	26,000
2/22/96-3/4/96	Wet	12	396
5/8/96-6/26/96	Wet	50	18,100
7/2/96-7/13/96	Wet	12	795
1/2/97-1/12/97[3]	Wet	12	26,000
5/26/98-8/10/98	Wet	75	10,400
5/28/99-6/25/99	Above Normal	2	976
5/22/00-6/24/00	Above Normal	48	4,730
5/26/01-5/27/01	Dry	3	416

[1] Defined as when daily mean discharges are 100 cfs or greater than minimum instream flow requirements (spill criteria threshold).

[2] Spills did not occur during 1985, 1987, 1988, 1989, 1990, 1991, 1992, 1994, and 2002.

[3] Gage was not operational following the January peak flow through the remainder of the year. Estimated flows are available, and are not included in the analyses.

Figure REC 2-B-2: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Tied-for-First Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (750 to 2,000 cfs)[1].



[1]Spills did not occur during 1985, 1987, 1988, 1989, 1990, 1991, 1992, 1994, and 2002. Gage was not operational following the January 1997 peak flow through the remainder of the year. Estimated flows are available, and are not included in the analyses.

Figure REC 2-B-3: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Tied-for-First Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (750 to 2,000 cfs) (continued).

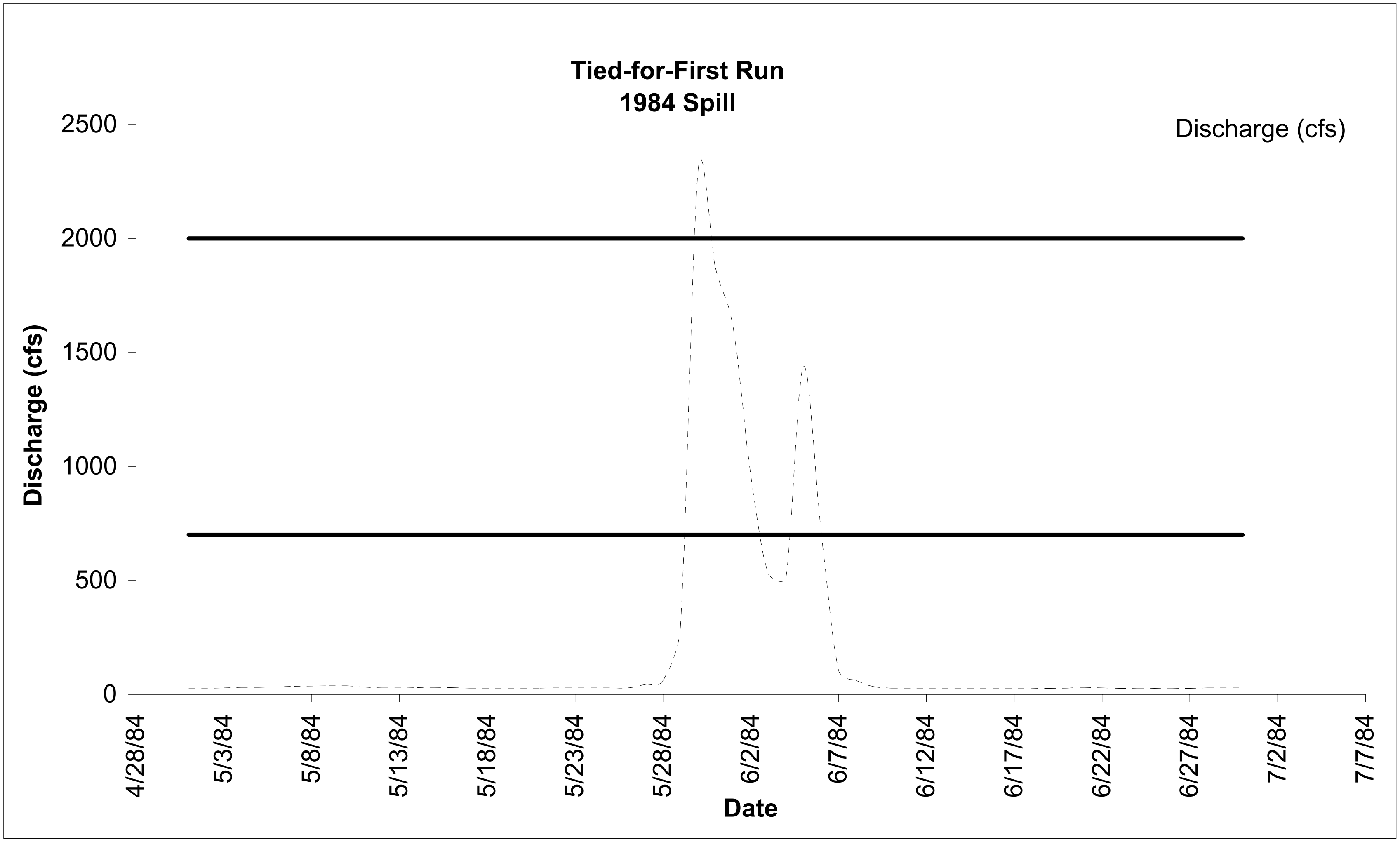


Figure REC 2-B-4: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Tied-for-First Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (750 to 2,000 cfs) (continued).

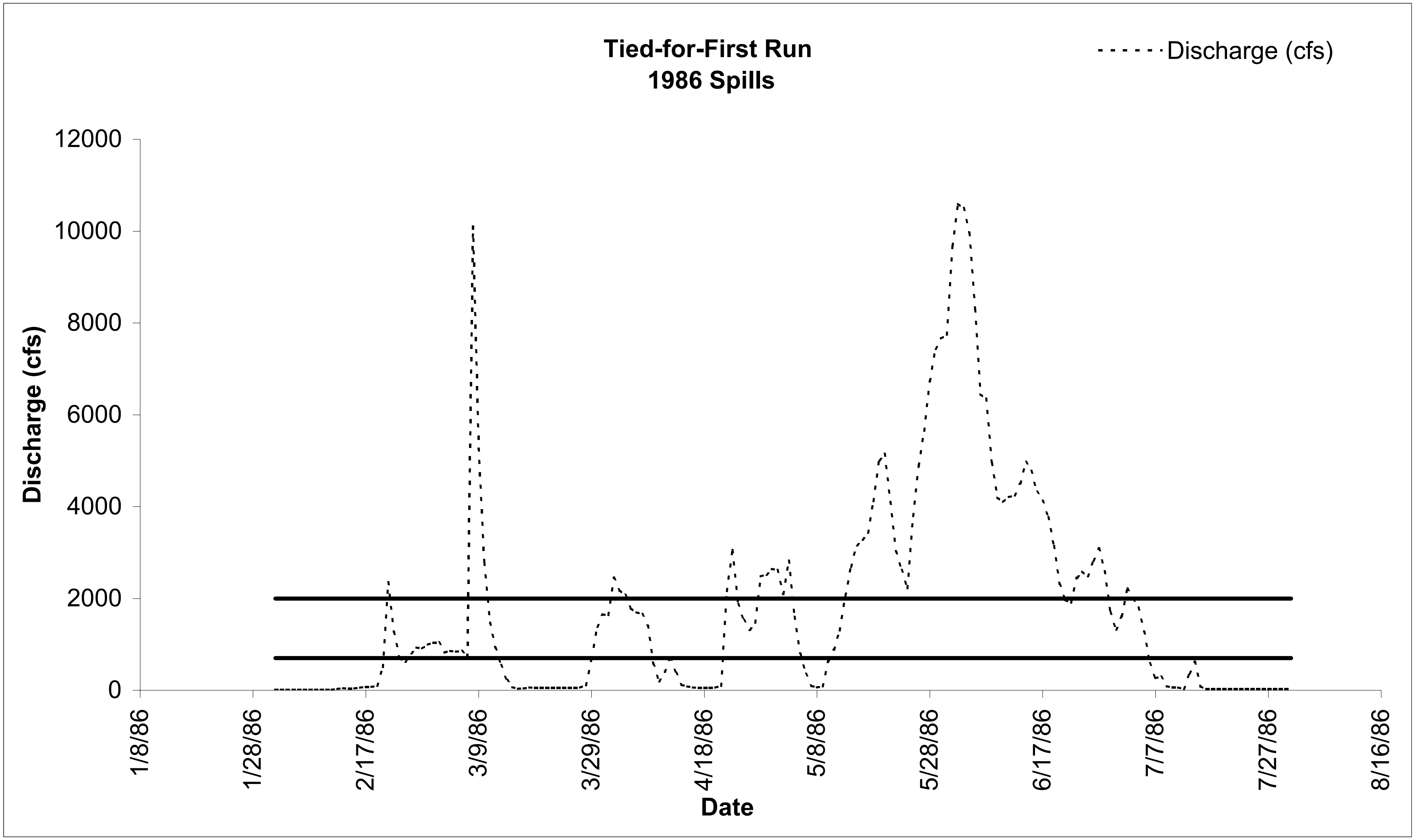
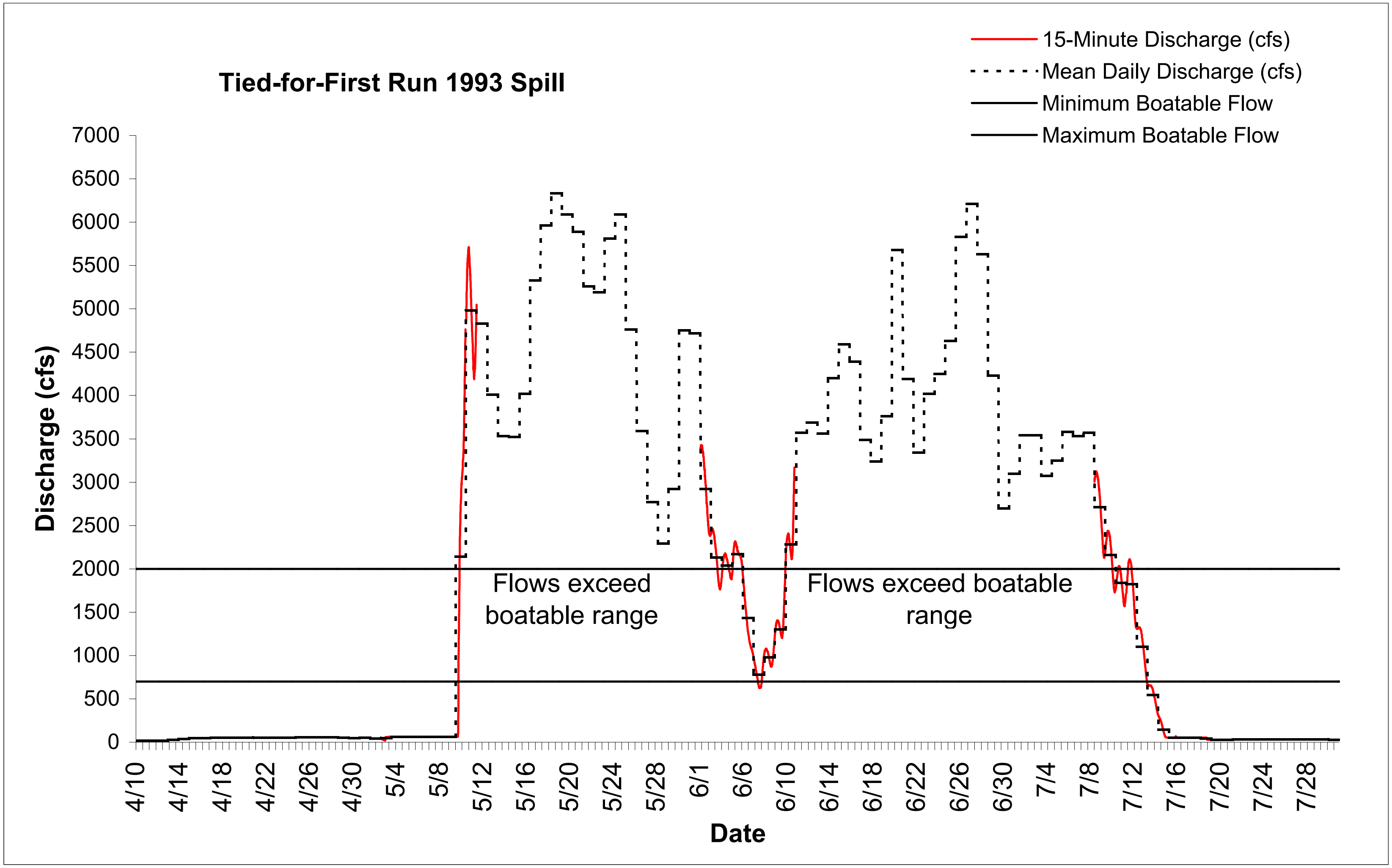


Figure REC 2-B-5: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Tied-for-First Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (750 to 2,000 cfs) (continued).



NOTE: 15-minute flows the greatly exceed the Maximum Boatable Flow are not shown on the graphs and are noted as 'Flows exceed boatable range'.

Figure REC 2-B-6: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Tied-for-First Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (750 to 2,000 cfs) (continued).

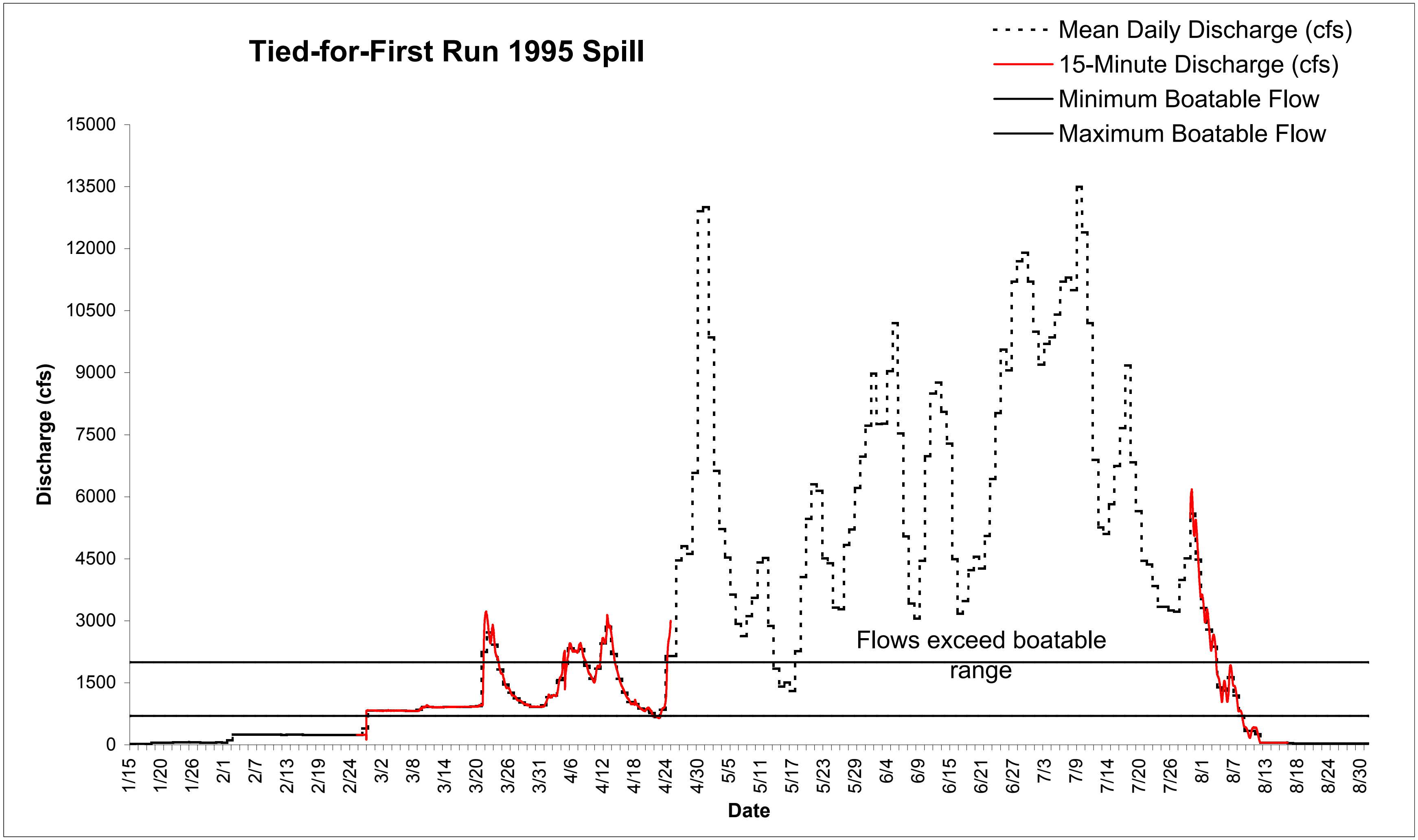


Figure REC 2-B-7: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Tied-for-First Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (750 to 2,000 cfs) (continued).

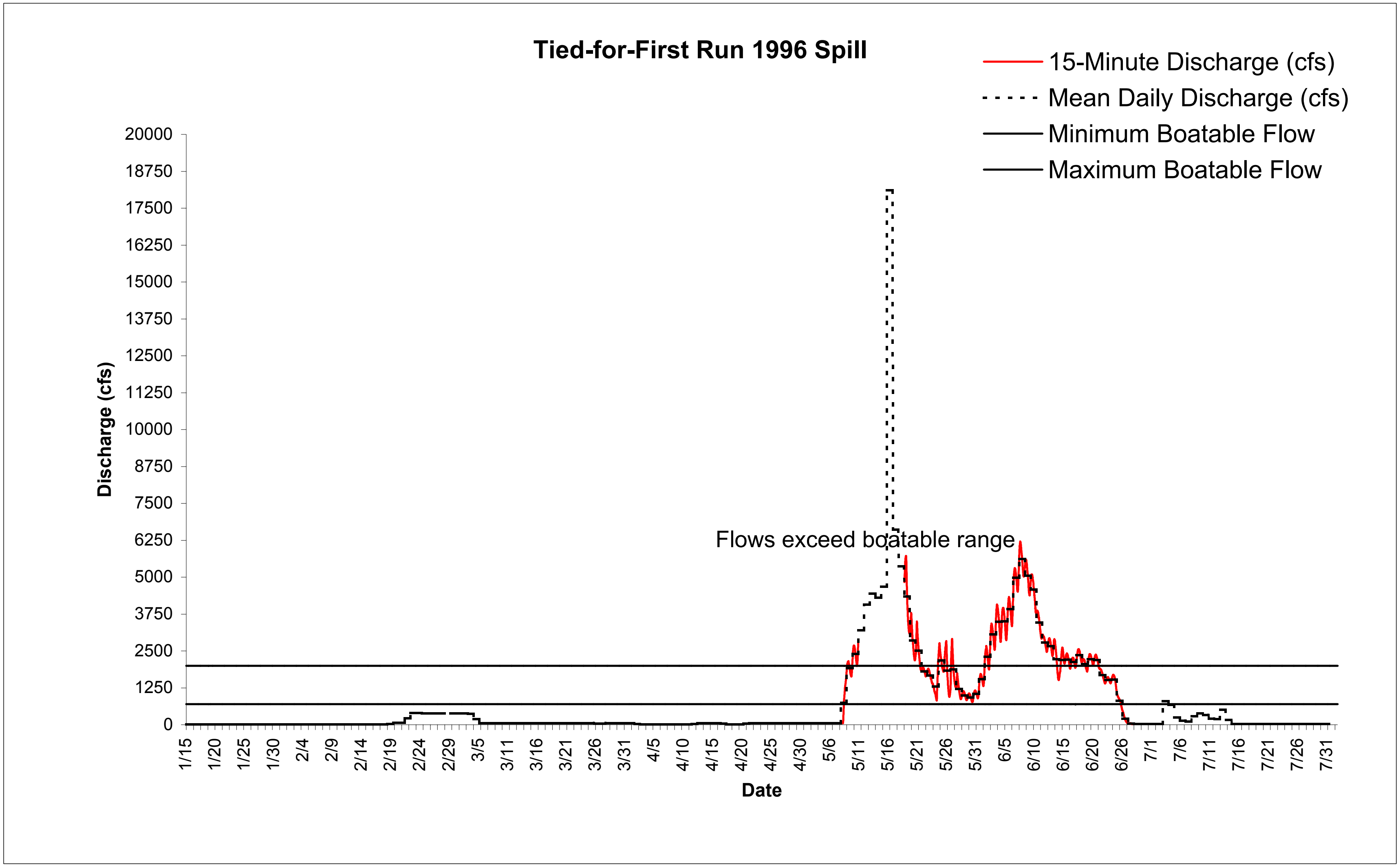


Figure REC 2-B-8: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Tied-for-First Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (750 to 2,000 cfs) (continued).

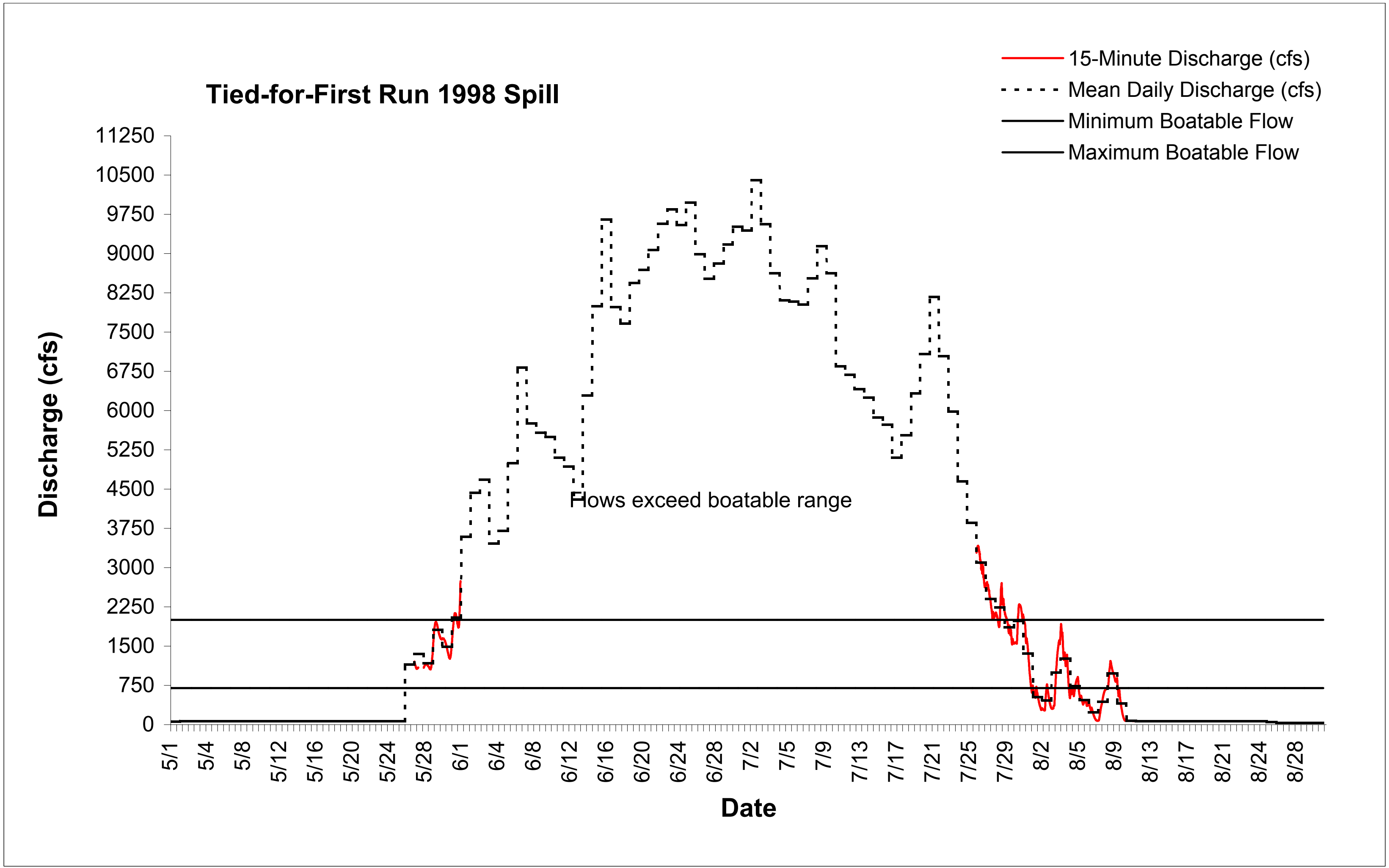


Figure REC 2-B-9: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Tied-for-First Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (750 to 2,000 cfs) (continued).

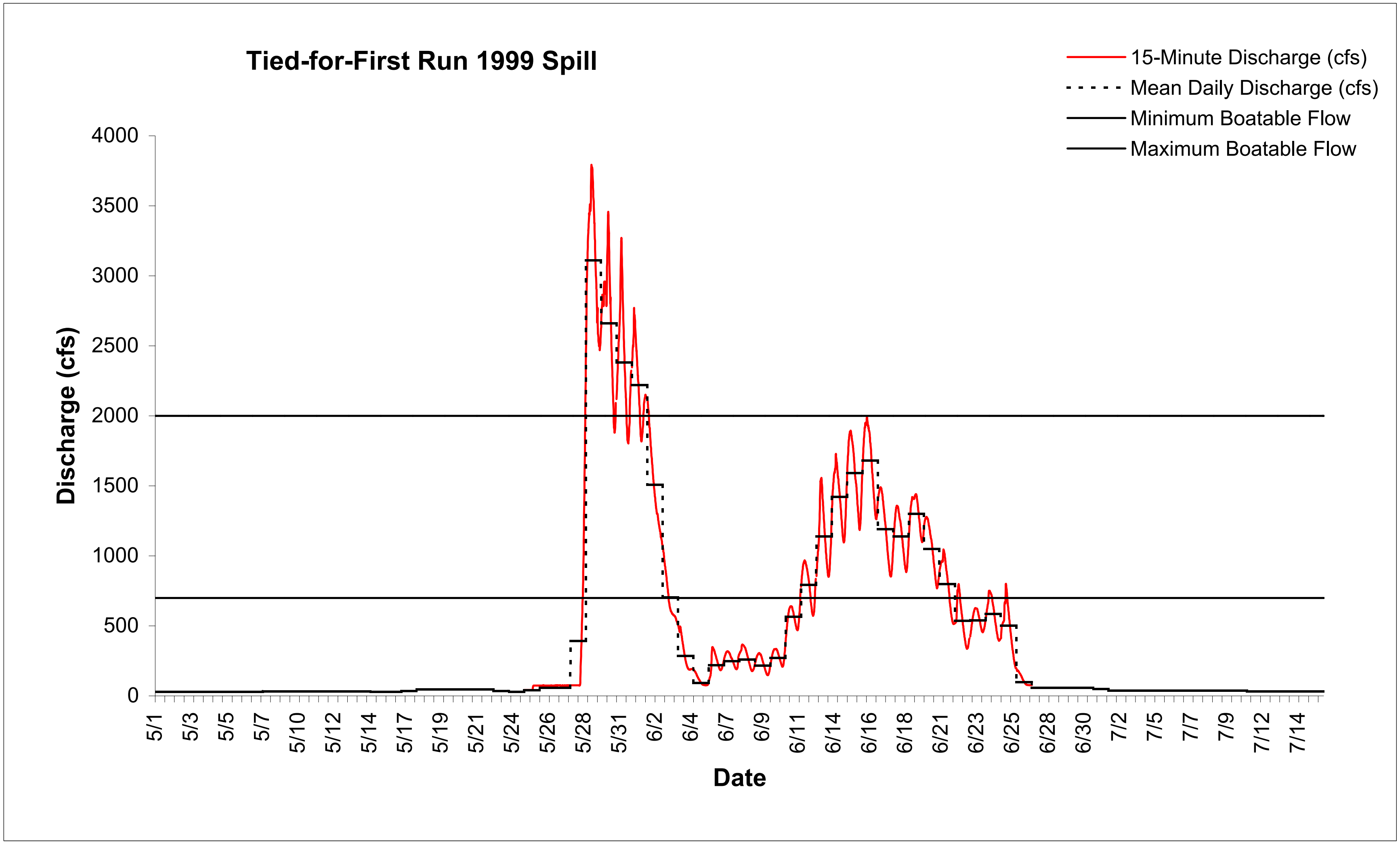
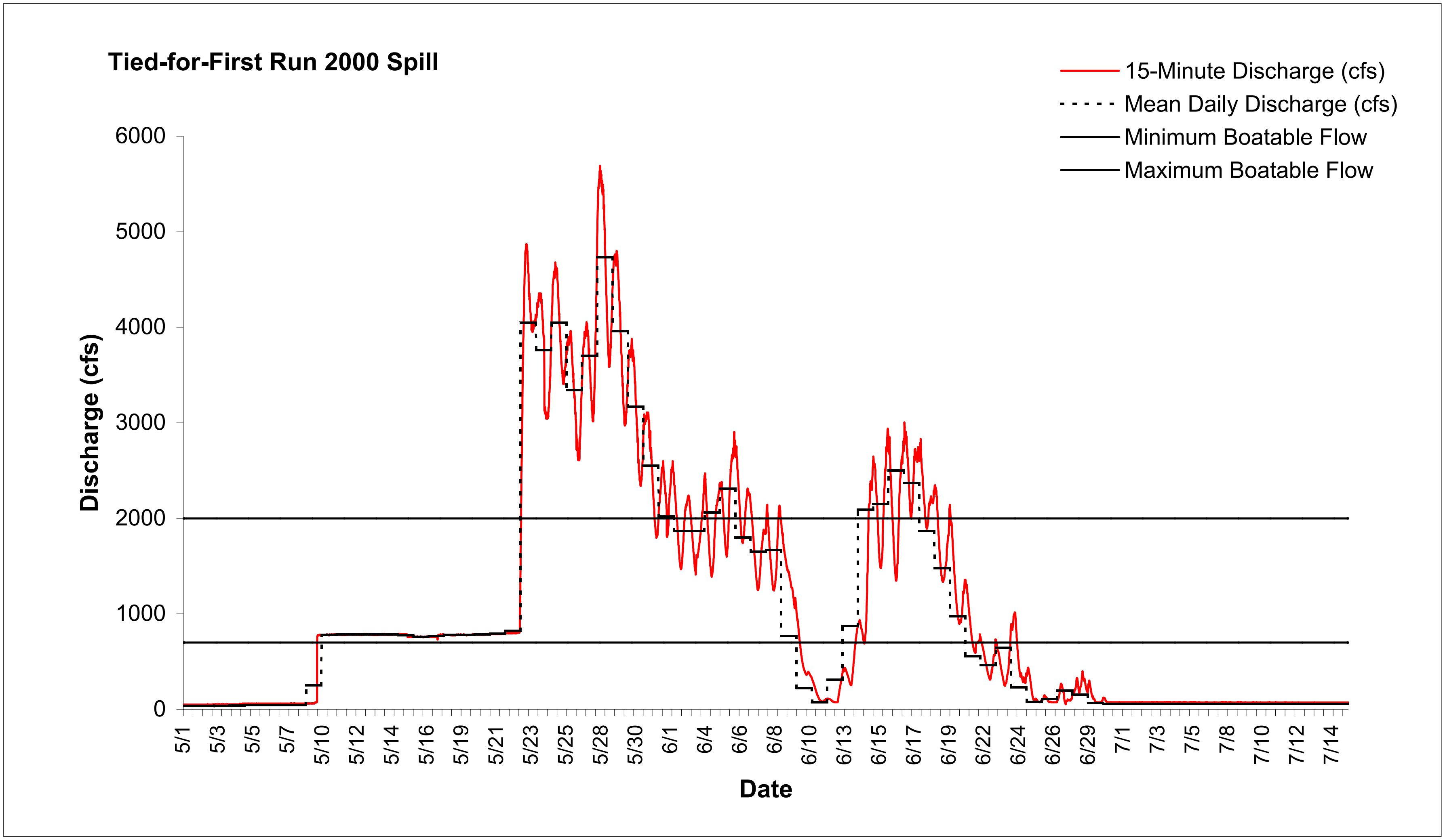


Figure REC 2-B-10: Mean daily (1983 to 2002) (black dashes) and 15-minute (1993 to 2002) (red) flows within Tied-for-First Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (750 to 2,000 cfs) (continued).



APPENDIX C

Chawanakee Gorge Run Spill Event Information

Figure REC 2-C-1: Comparison of Flows at Mammoth Pool Reservoir (Tied-for-First Run) and Dam 6 (Chawanakee Gorge Run) from 1997-2002. The boating range for Chawanakee Gorge Run (350 to 1,000 cfs) is indicated in the thick black lines.

REC 2-C-1A

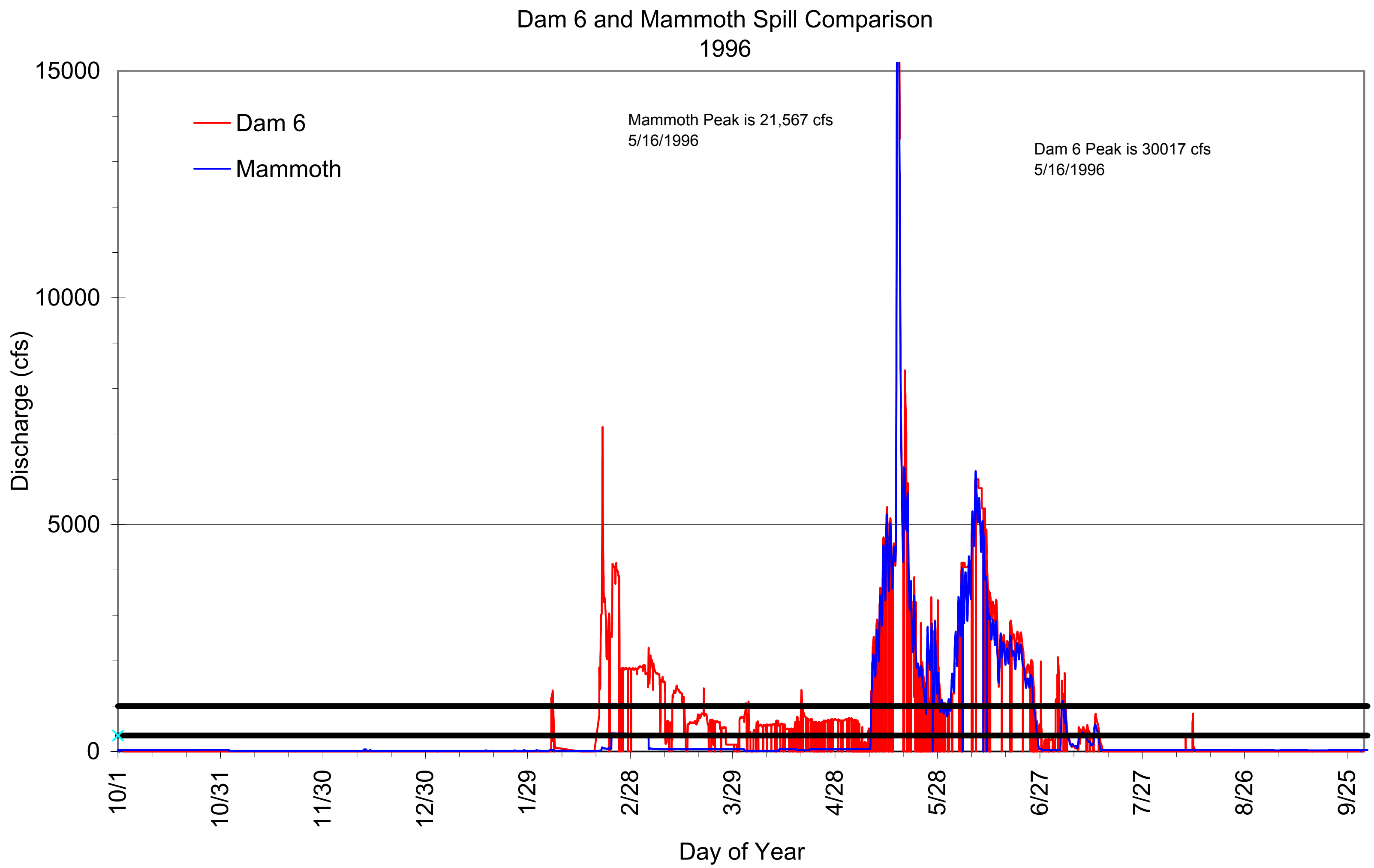


Figure REC 2-C-2: Comparison of Flows at Mammoth Pool Reservoir (Tied-for-First Run) and Dam 6 (Chawanakee Gorge Run) from 1997-2002. The boating range for Chawanakee Gorge Run (350 to 1,000 cfs) is indicated in the thick black lines (continued).

REC 2-C-1B

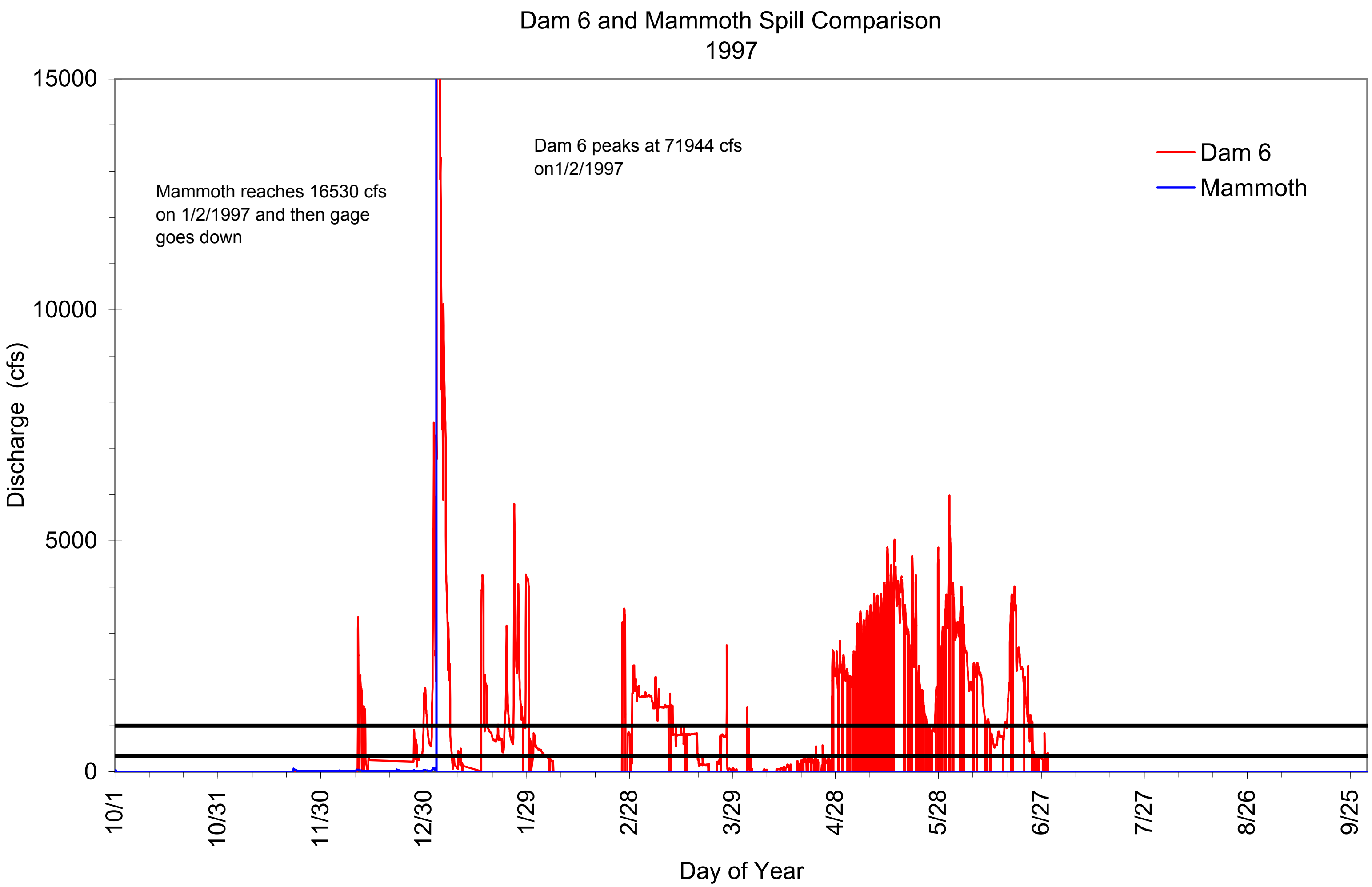


Figure REC 2-C-3: Comparison of Flows at Mammoth Pool Reservoir (Tied-for-First Run) and Dam 6 (Chawanakee Gorge Run) from 1997-2002. The boating range for Chawanakee Gorge Run (350 to 1,000 cfs) is indicated in the thick black lines (continued).

REC 2-C-1C

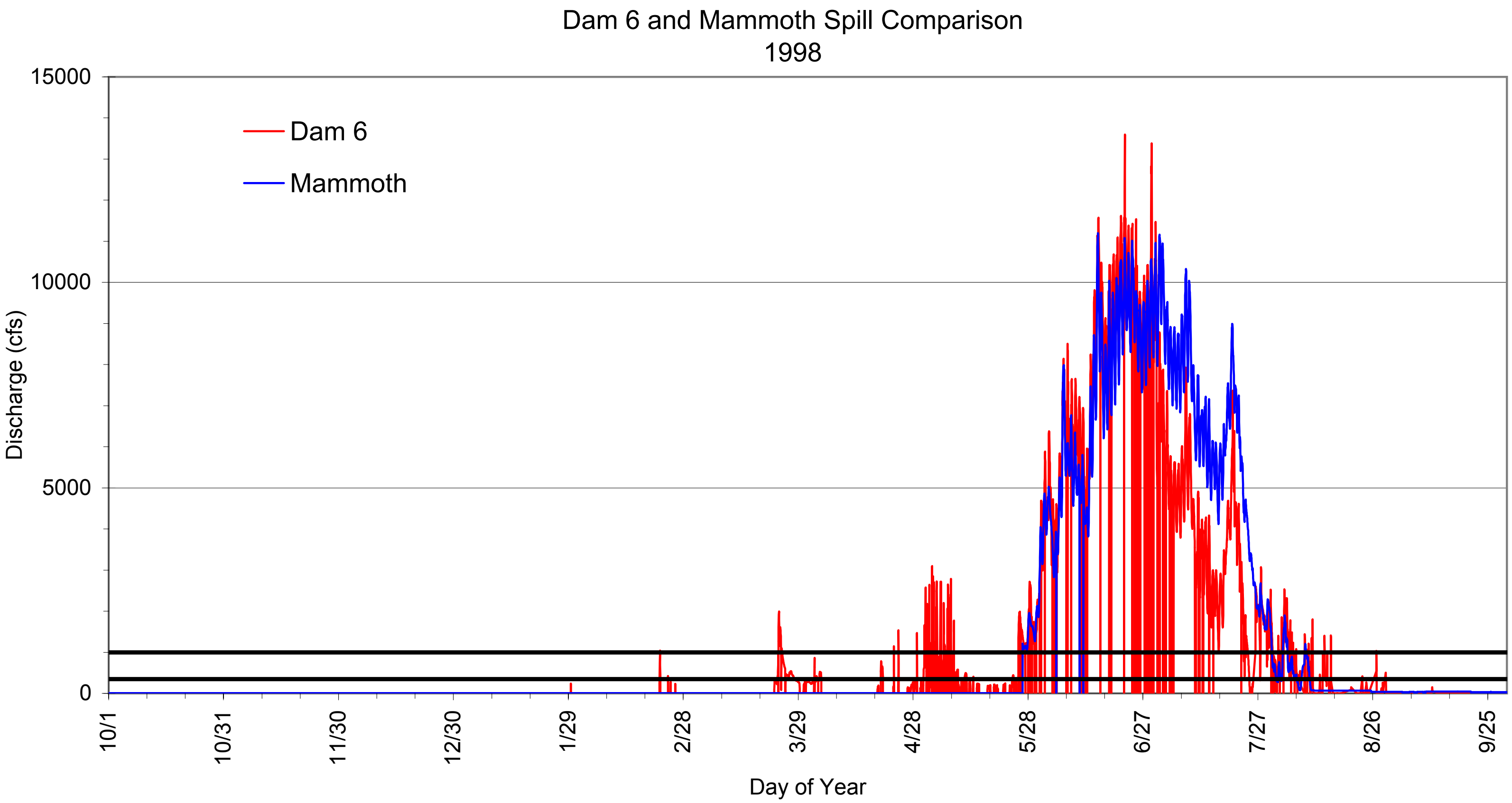


Figure REC 2-C-4: Comparison of Flows at Mammoth Pool Reservoir (Tied-for-First Run) and Dam 6 (Chawanakee Gorge Run) from 1997-2002. The boating range for Chawanakee Gorge Run (350 to 1,000 cfs) is indicated in the thick black lines (continued).

REC 2-C-1D

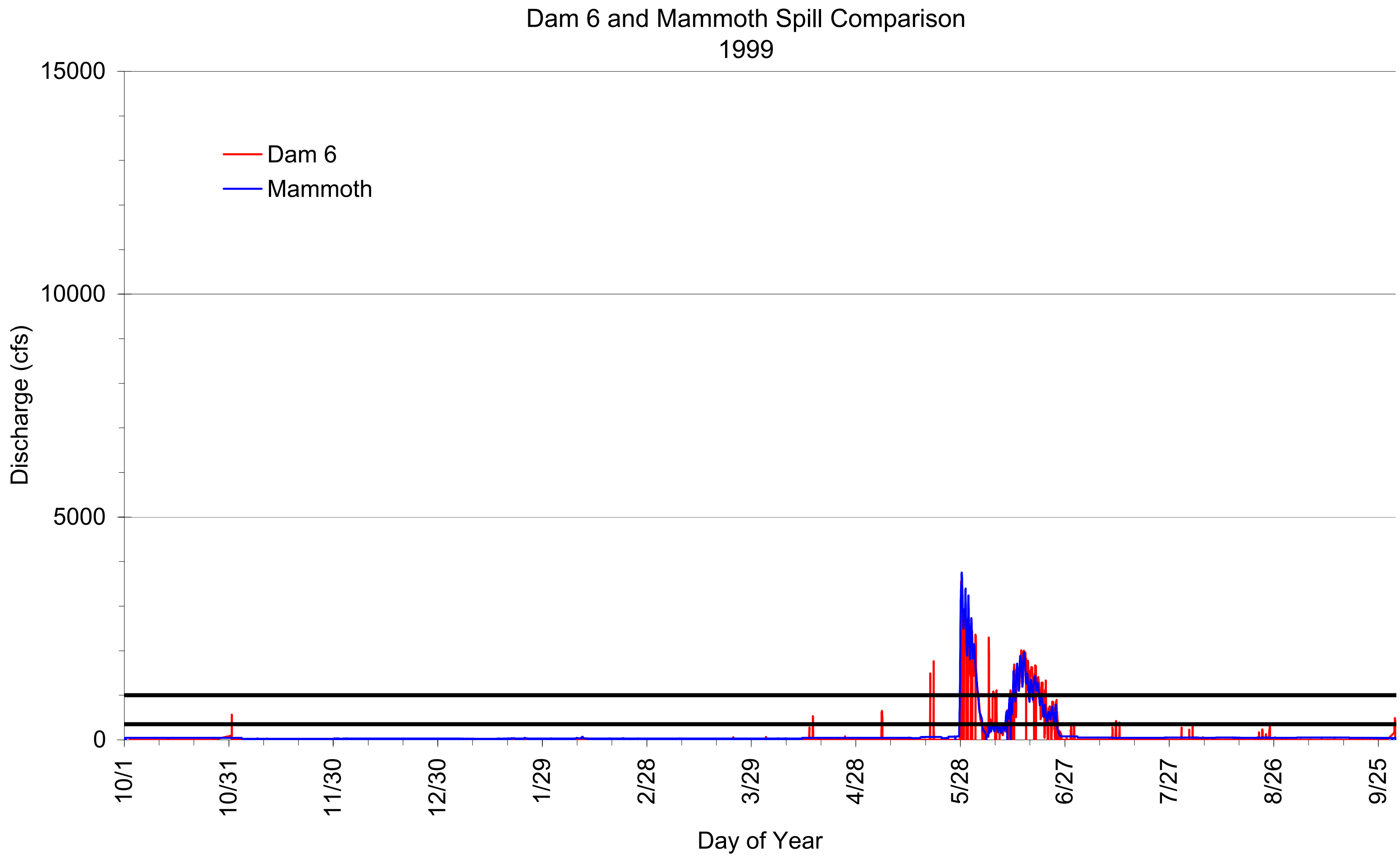


Figure REC 2-C-5: Comparison of Flows at Mammoth Pool Reservoir (Tied-for-First Run) and Dam 6 (Chawanakee Gorge Run) from 1997-2002. The boating range for Chawanakee Gorge Run (350 to 1,000 cfs) is indicated in the thick black lines (continued).

REC 2-C-1E

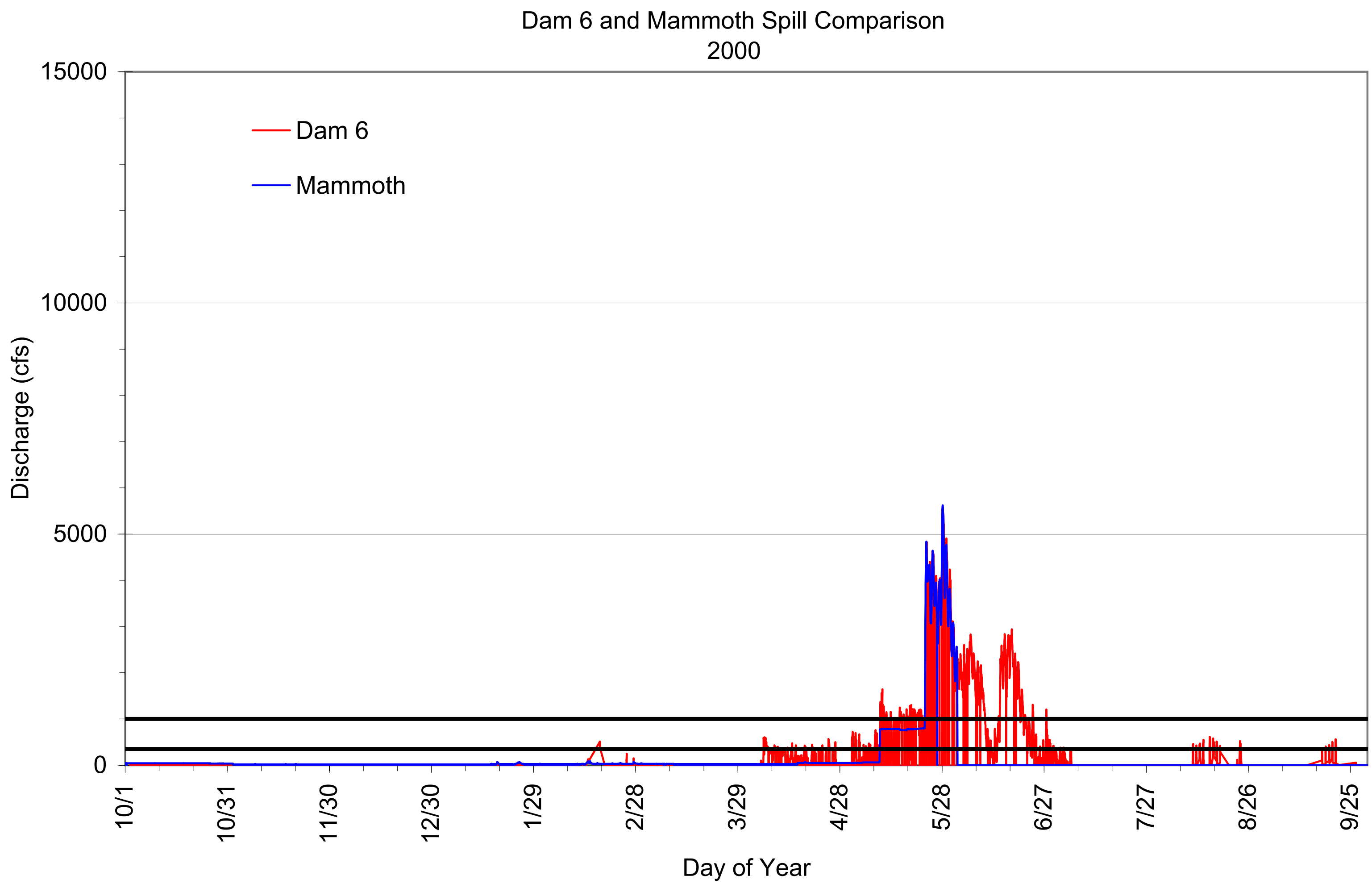


Figure REC 2-C-6: Comparison of Flows at Mammoth Pool Reservoir (Tied-for-First Run) and Dam 6 (Chawanakee Gorge Run) from 1997-2002. The boating range for Chawanakee Gorge Run (350 to 1,000 cfs) is indicated in the thick black lines (continued).

REC 2-C-1F

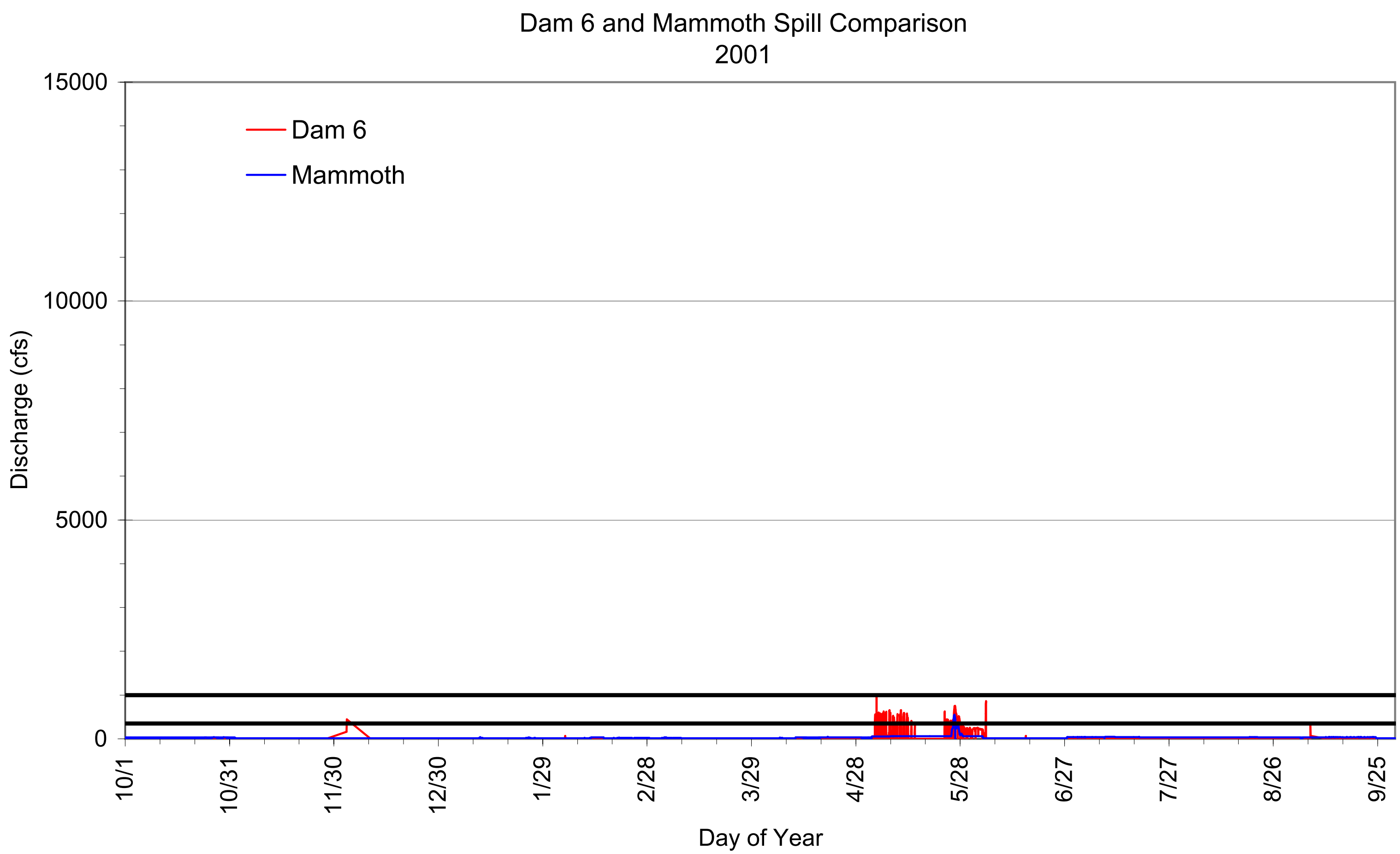


Figure REC 2-C-7: Comparison of Flows at Mammoth Pool Reservoir (Tied-for-First Run) and Dam 6 (Chawanakee Gorge Run) from 1997-2002. The boating range for Chawanakee Gorge Run (350 to 1,000 cfs) is indicated in the thick black lines (continued).

REC 2-C-1G

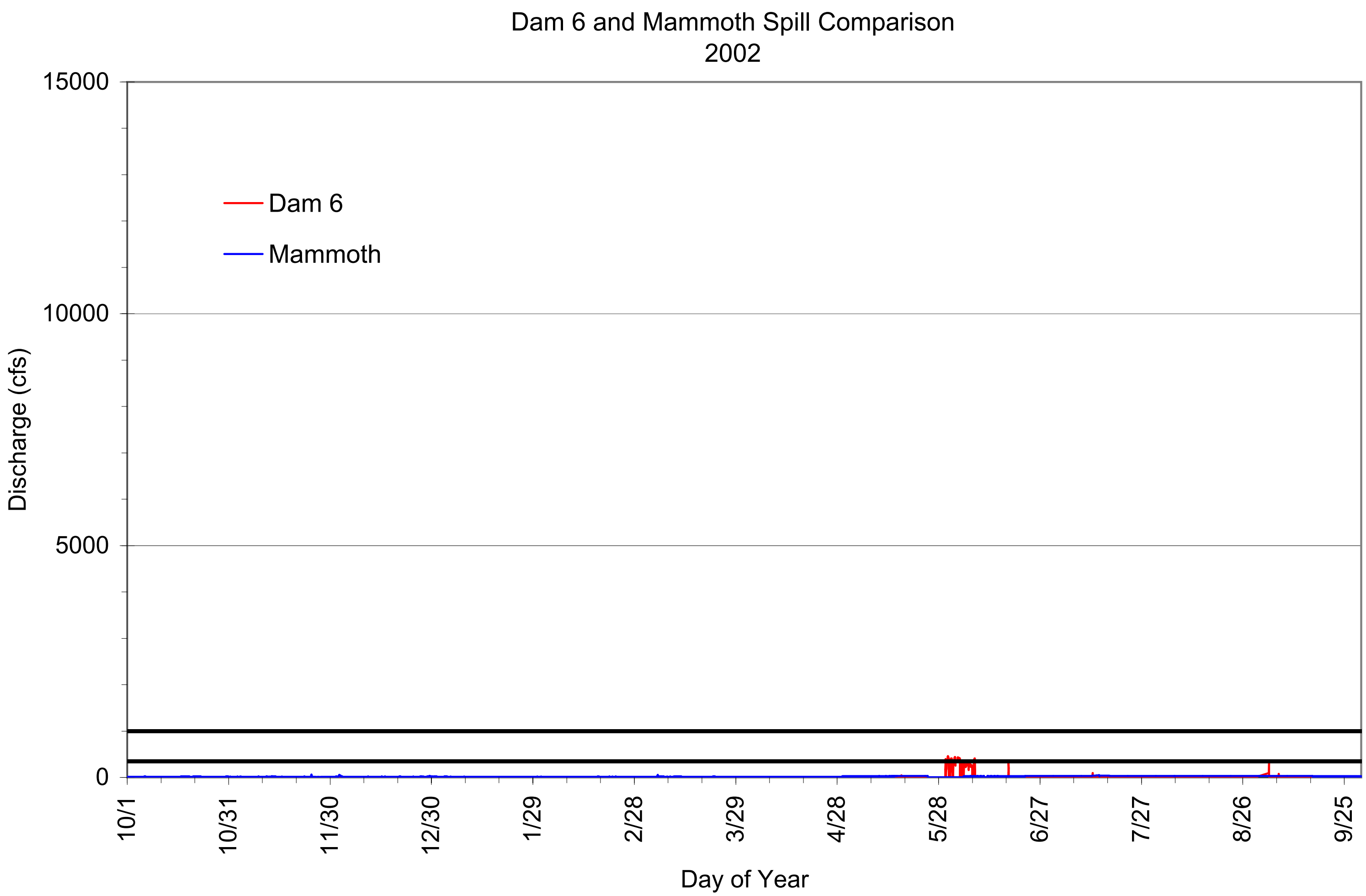


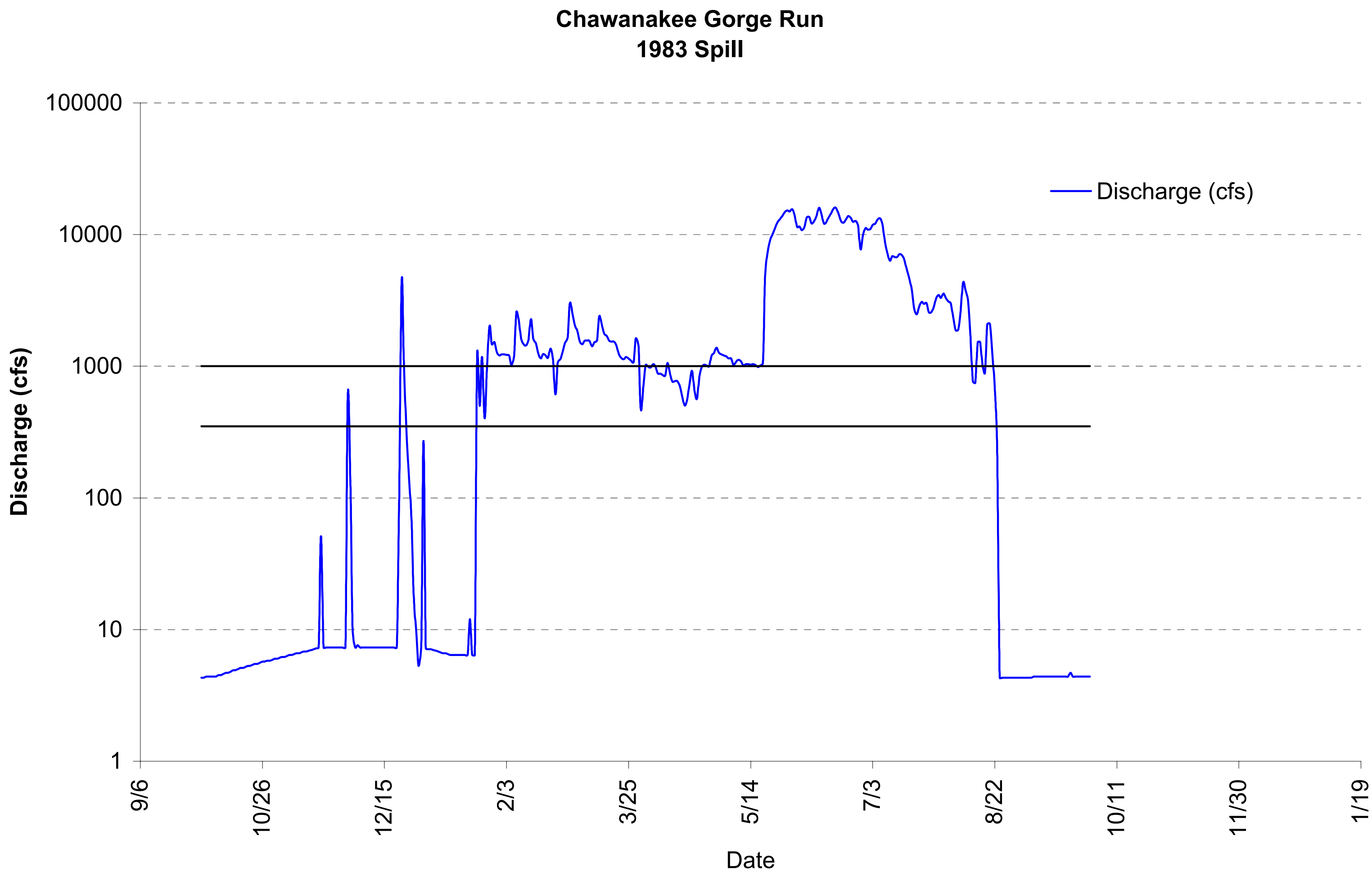
Table REC 2-C-1: Summary of Chawanakee Gorge Run Spill Events (1983-2002)[1,3]

Mean Daily Discharges

Date	Water-year Type	Duration (days)	Mean Daily Peak Spill Discharge (cfs)
11/30/82, 12/01/82, 12/22/82-12/31/82	Wet	7	4,400
1/22/83-8/23/83	Wet	214	16,000
11/24/83, 12/25/83-12/27/83,1/9/84-1/17/84,	Above Normal	9	2,010
5/29/84-6/6/84	Above Normal	13	1,330
2/12/86-7/18/86, 7/25/86	Wet	158	12,000
3/15/93-7/16/93	Wet	120 [2]	6,700
2/4/96-2/5/96, 2/18/96-7/14/96	Wet	149	20,500
12/10/96-12/12/96, 12/27/96-6/29/97	Wet	164 [2]	32,000
2/21/98, 3/24/98-4/4/98, 4/20/98-4/25/98, 4/28/98-8/18/98	Wet	115 [2]	10,600
5/6/99, 5/21/99, 5/29/99-6/26/99	Above Normal	31	2,670
4/5/00-7/4/00, 7/28/00, 8/12/00, 8/14/00-8/16/00, 8/23/00	Above Normal	87 [2]	4,770
5/4/01-5/13/01, 5/24/01-6/5/01	Dry	23 [2]	616
5/31/02-6/8/02	Dry	9	389

[1] Defined as when daily mean discharges are 100 cfs or greater than minimum instream flow requirements (spill criteria threshold).
[2] Flows did not meet spill criteria threshold for all days within range.
[3] Data is not available for 1988, 1989, 1990, 1991, 1992, and 1995.

Figure REC 2-C-8: Mean daily (1983 to 2002) (blue) and 15-minute Stevenson Creek and San Joaquin River combined flows (1996 to 2002) (light blue) within Chawanakee Gorge Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 1,000 cfs)[1].



[1]Data is not available for 1988, 1989, 1990, 1991, 1992, and 1995.

Figure REC 2-C-9: Mean daily (1983 to 2002) (blue) and 15-minute Stevenson Creek and San Joaquin River combined flows (1996 to 2002) (light blue) within Chawanakee Gorge Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 1,000 cfs) (continued).

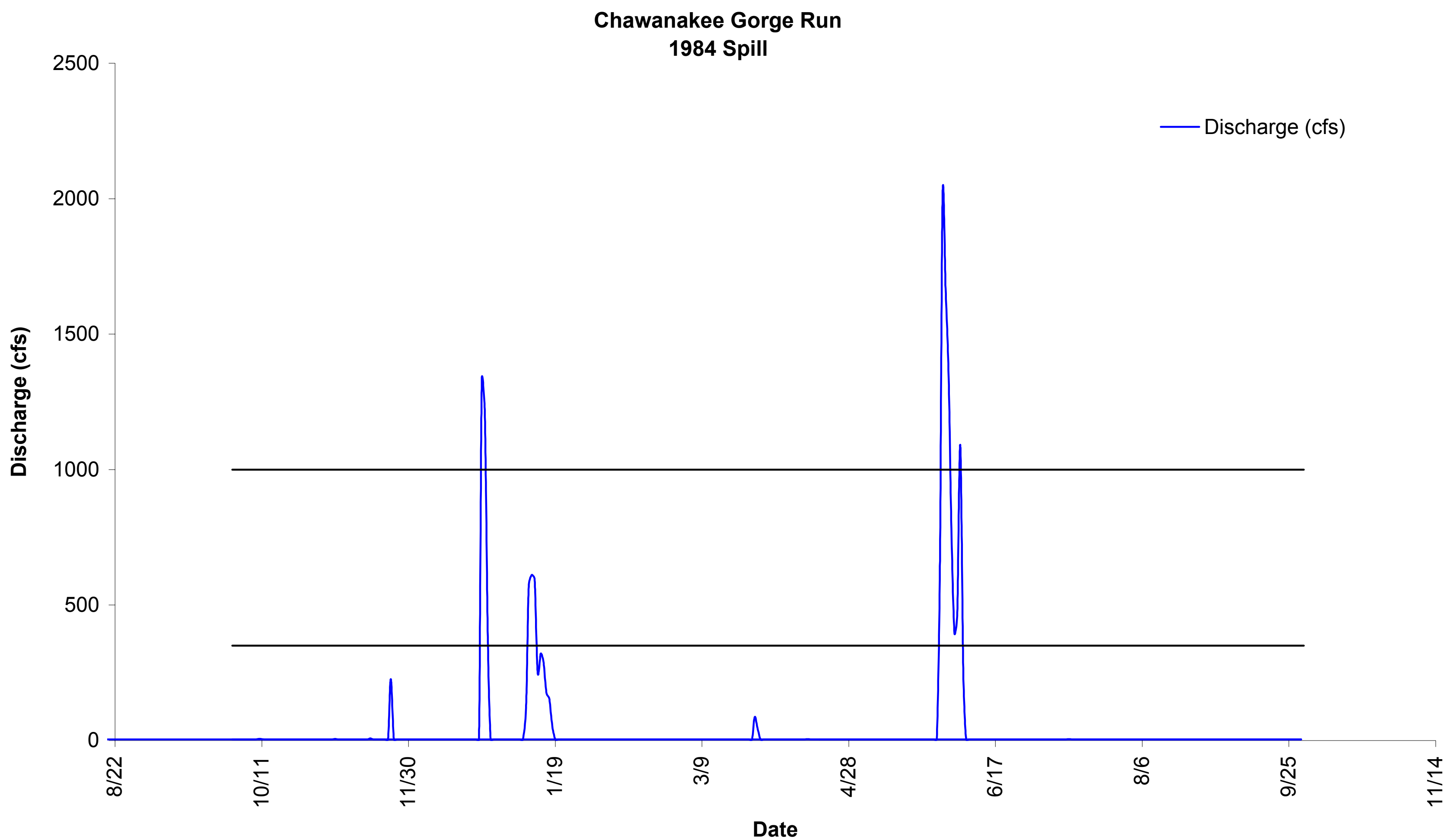


Figure REC 2-C-10: Mean daily (1983 to 2002) (blue) and 15-minute Stevenson Creek and San Joaquin River combined flows (1996 to 2002) (light blue) within Chawanakee Gorge Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 1,000 cfs) (continued).

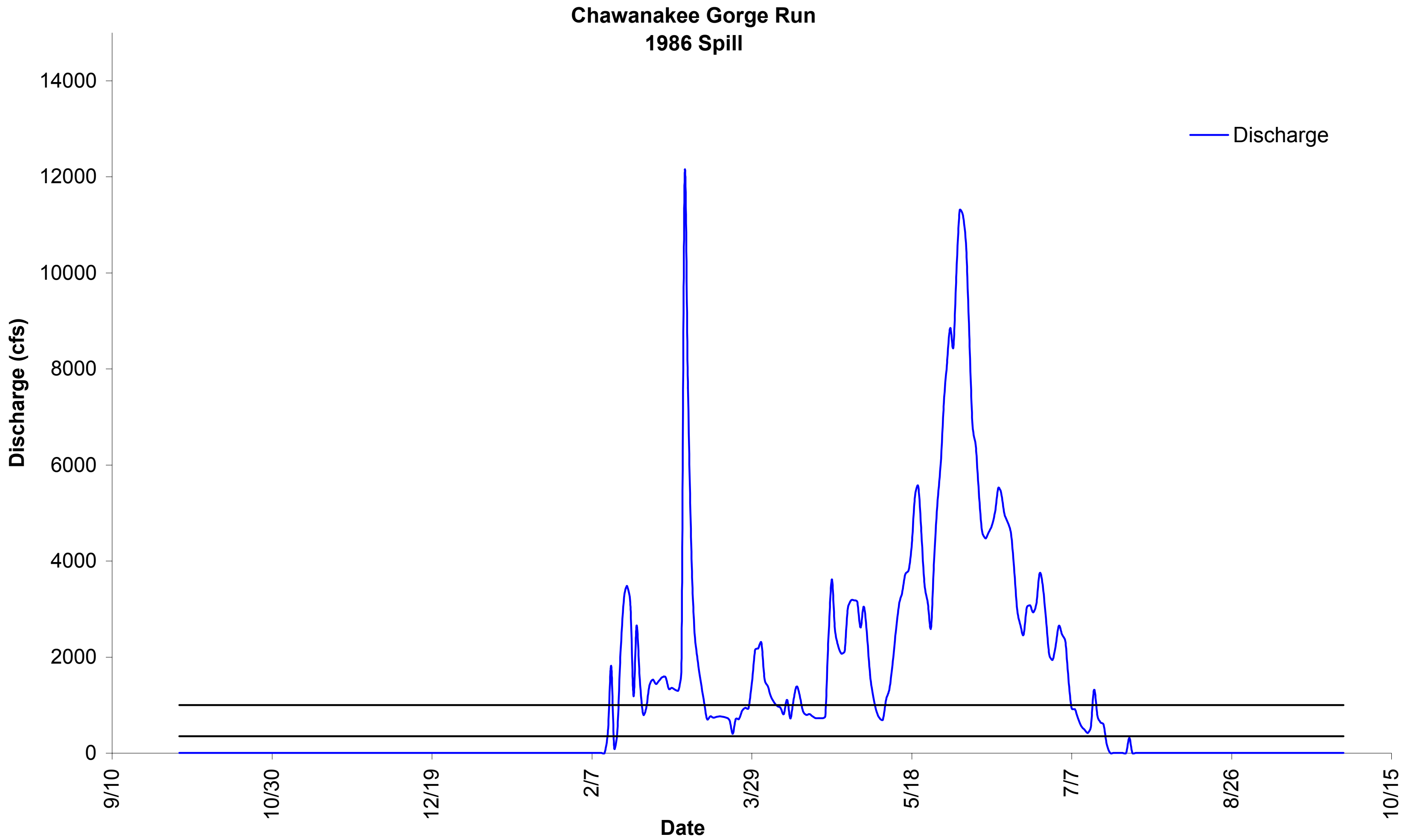


Figure REC 2-C-11: Mean daily (1983 to 2002) (blue) and 15-minuteStevenson Creek and San Joaquin River flows (1996 to 2002) (light blue) within Chawanakee Gorge Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 1,000 cfs) (continued).

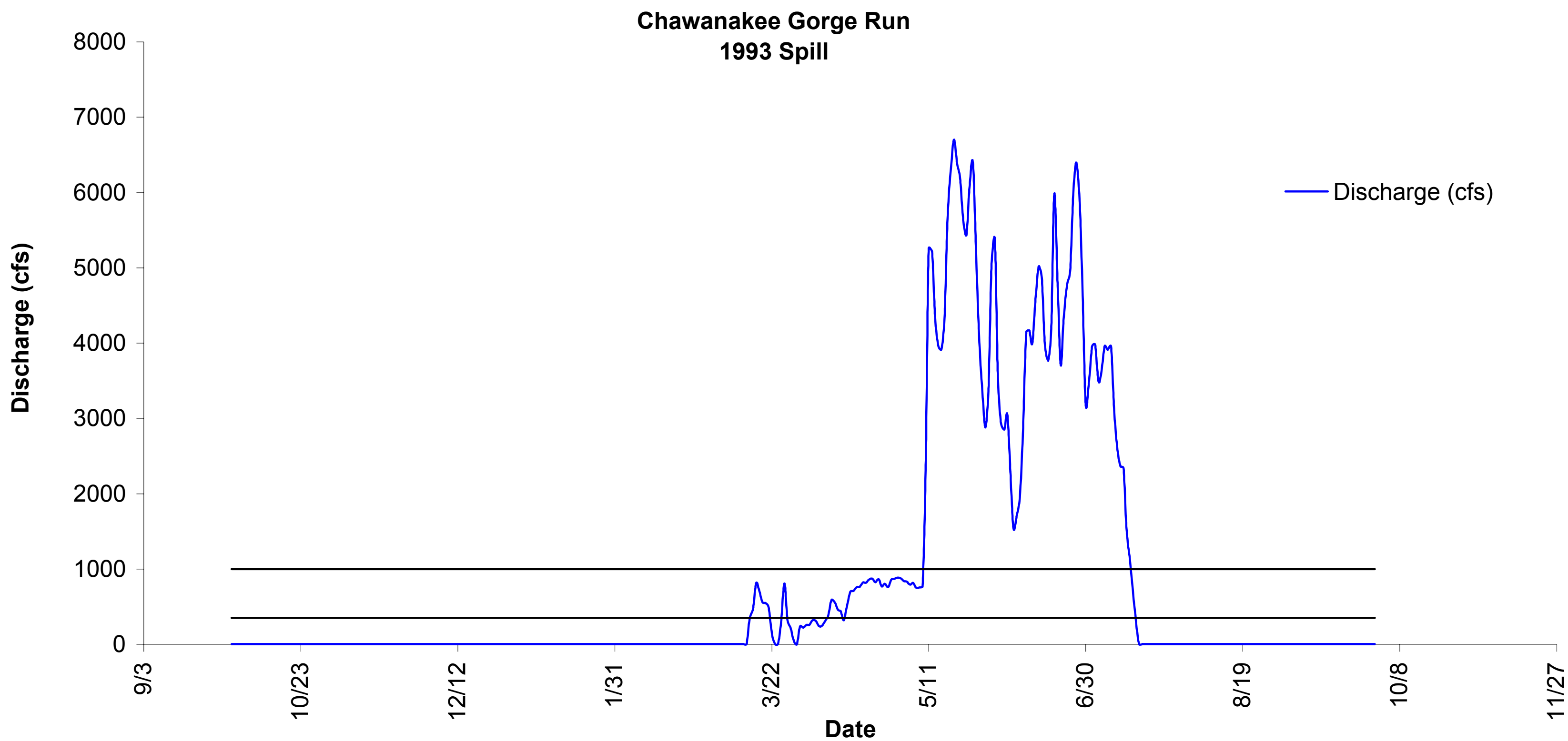
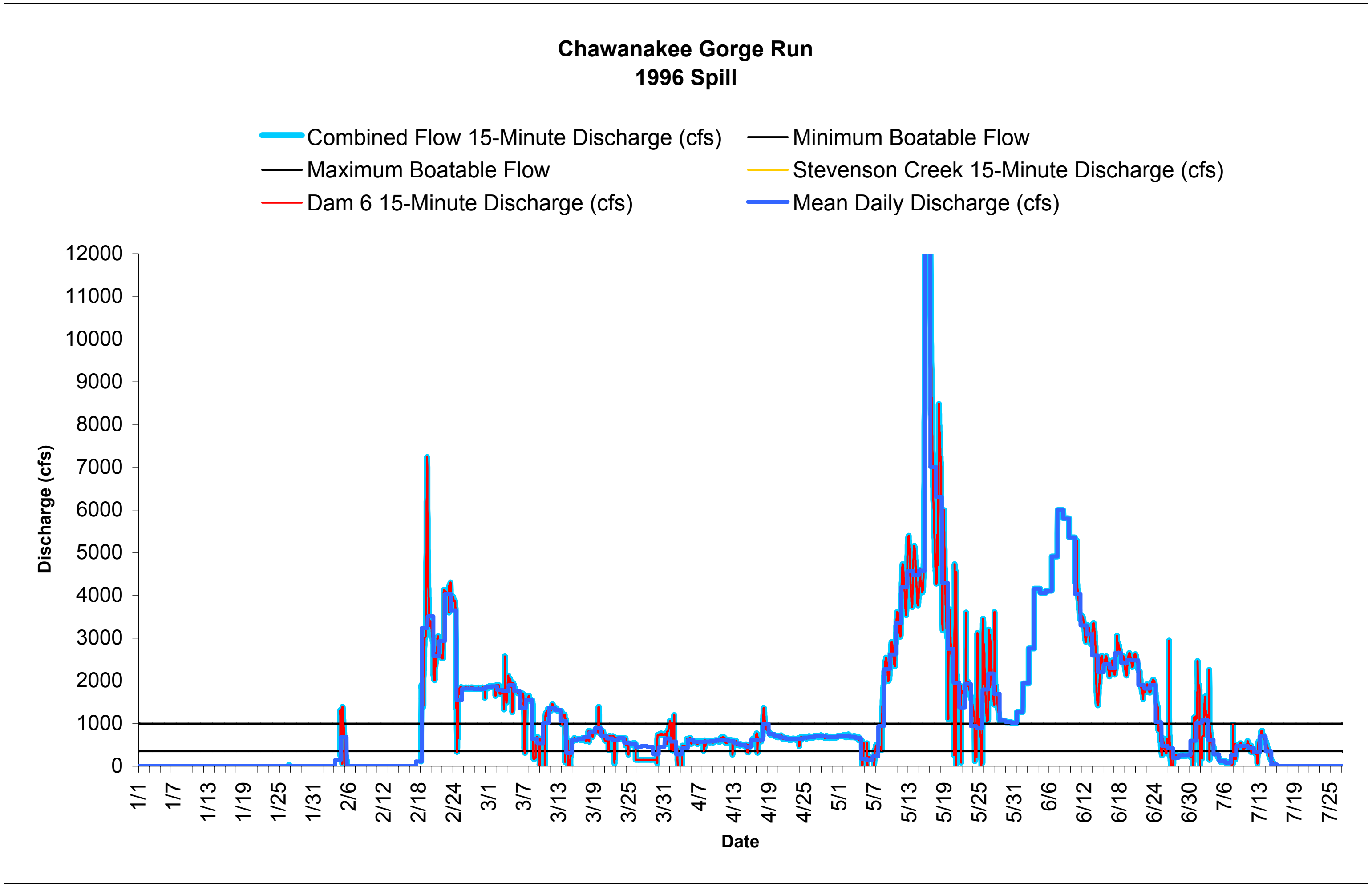


Figure REC 2-C-12: Mean daily (1983 to 2002) (blue) and 15-minute Stevenson Creek and San Joaquin River combined flows (1996 to 2002) (light blue) within Chawanakee Gorge Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 1,000 cfs) (continued).



NOTE: 15-minute flows the greatly exceed the Maximum Boatable Flow are not shown on the graphs and are noted as 'Flows exceed boatable range'.

Figure REC 2-C-13: Mean daily (1983 to 2002) (blue) and 15-minute Stevenson Creek and San Joaquin River combined flows (1993 to 2002) (light blue) within Chawanakee Gorge Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 1,000 cfs) (continued).

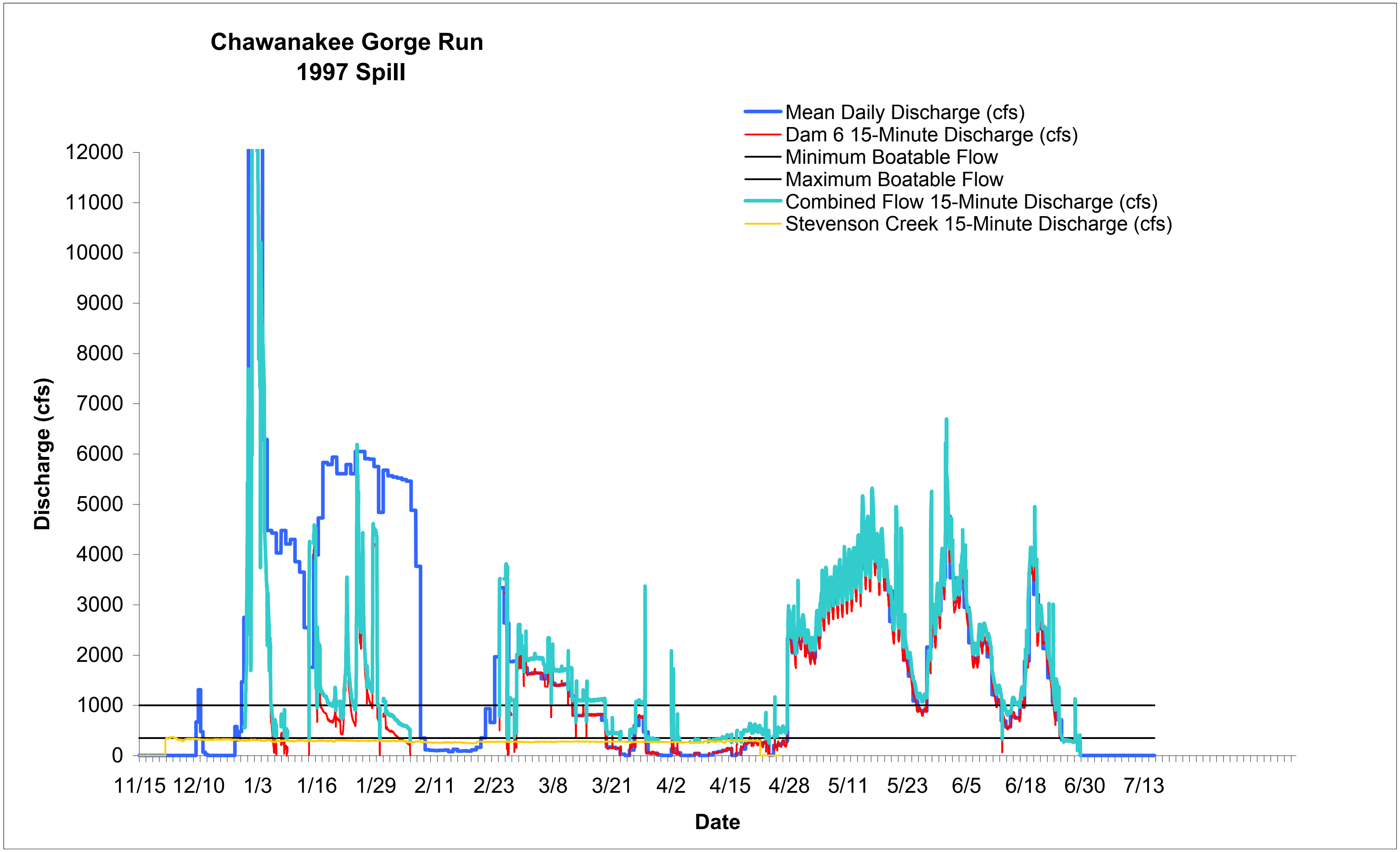


Figure REC 2-C-14: Mean daily (1983 to 2002) (blue) and 15-minute Stevenson Creek and San Joaquin River combined flows (1996 to 2002) (light blue) within Chawanakee Gorge Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 1,000 cfs) (continued).

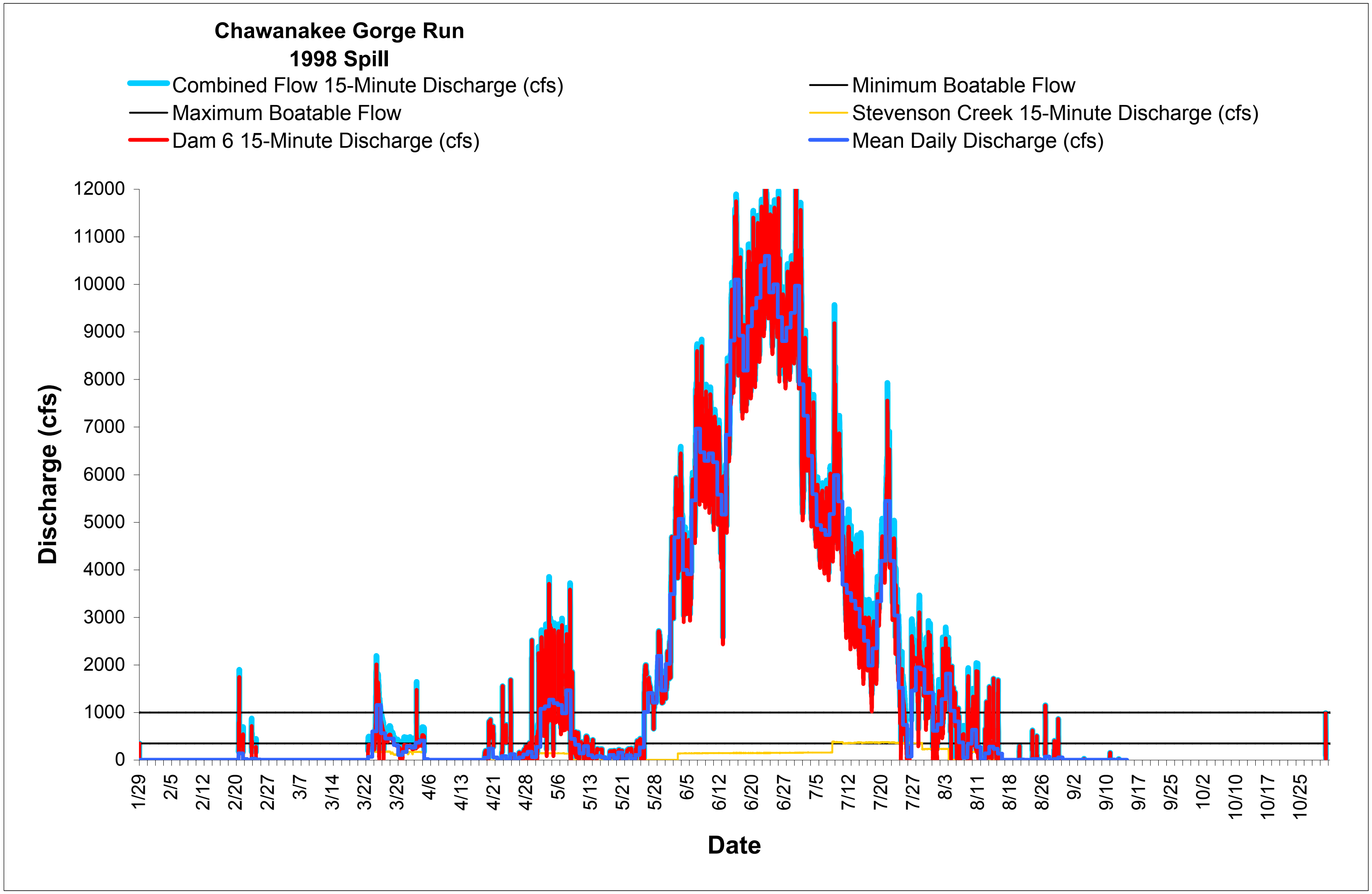


Figure REC 2-C-15: Mean daily (1983 to 2002) (blue) and 15-minute Stevenson Creek and San Joaquin River combined flows (1996 to 2002) (light blue) within Chawanakee Gorge Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 1,000 cfs) (continued).

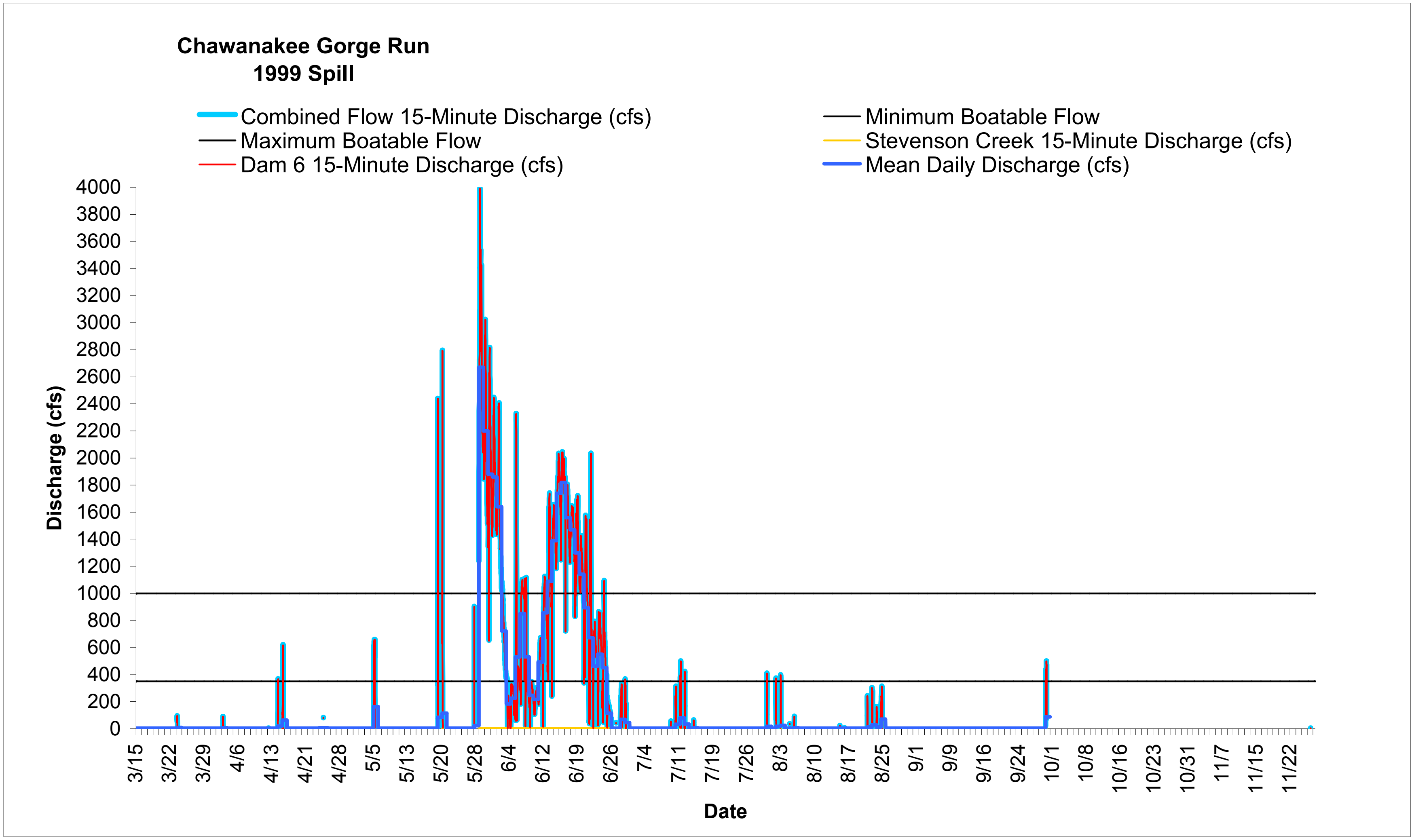


Figure REC 2-C-16: Mean daily (1983 to 2002) (blue) and 15-minute Stevenson Creek and San Joaquin River combined flows (1996 to 2002) (light blue) within Chawanakee Gorge Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 1,000 cfs) (continued).

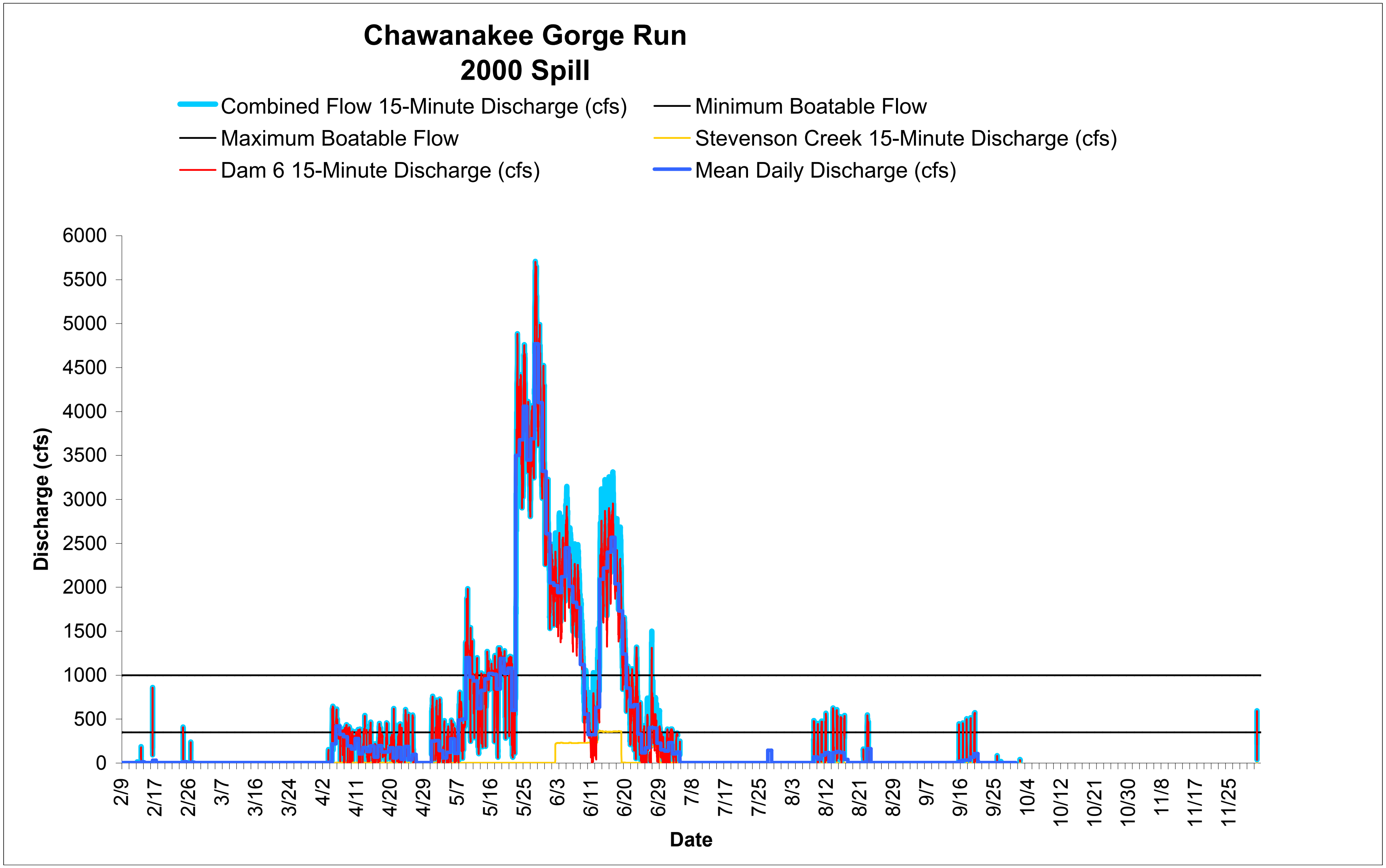


Figure REC 2-C-17: Mean daily (1983 to 2002) (blue) and 15-minute Stevenson Creek and San Joaquin River combined flows (1996 to 2002) (light blue) within Chawanakee Gorge Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 1,000 cfs) (continued).

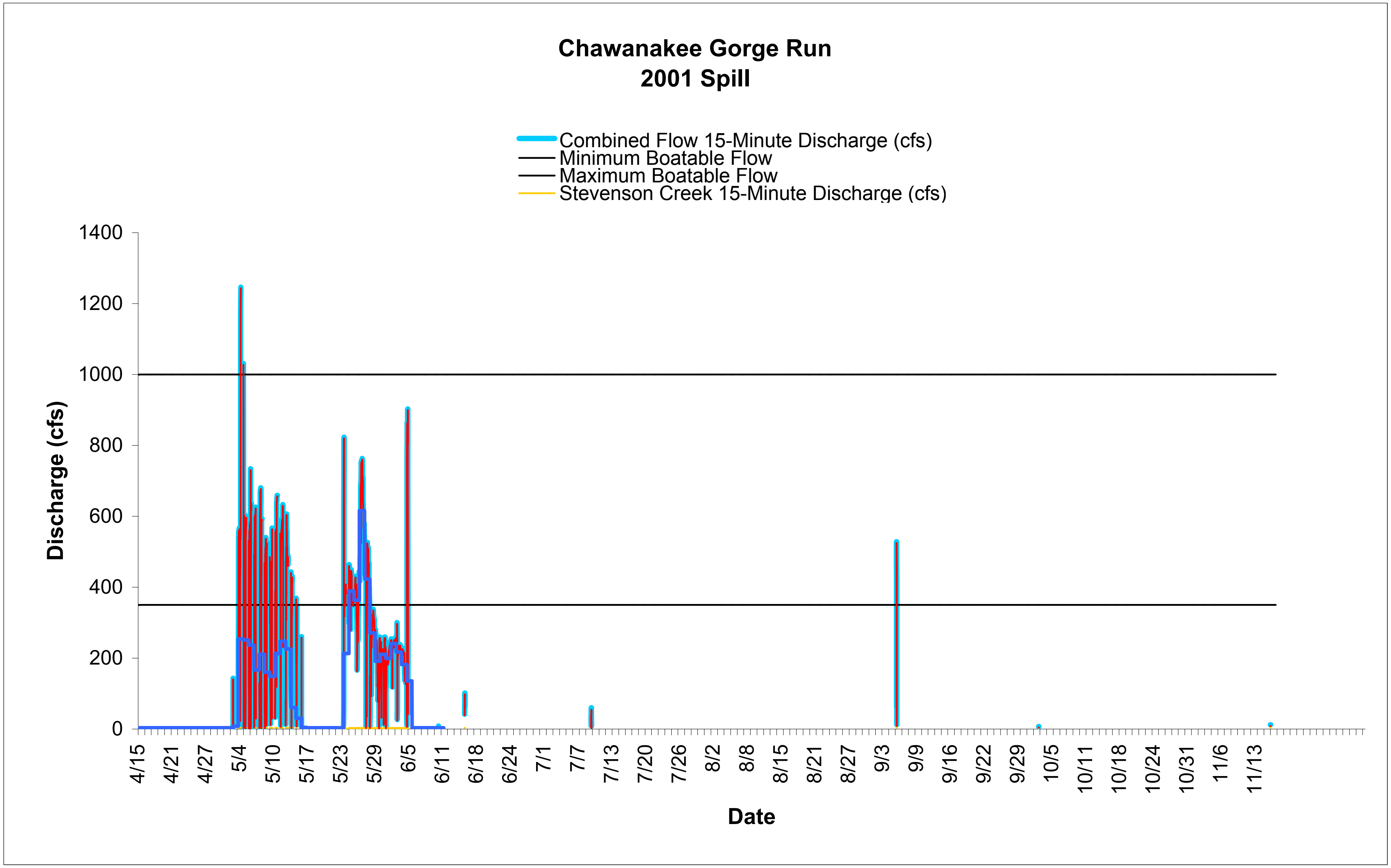


Figure REC 2-C-18: Mean daily (1983 to 2002) (blue) and 15-minute Stevenson Creek and San Joaquin River combined flows (1996 to 2002) (light blue) within Chawanakee Gorge Run when discharges are more than 100 cfs greater than minimum instream flow requirements. The boating range is identified by the black lines (350 to 1,000 cfs) (continued).