2011 EAGLE CREEK TEMPERATURE STUDY

ANNUAL REPORT

Prepared for:

Lower Minnesota River Watershed District

By: Scott Soil and Water Conservation District

February 2012

Lower Minnesota River Watershed District

SCOTT Soil & Water Conservation District

Background: This study was initiated by the Lower Minnesota River Watershed District (LMRWD) to evaluate the impact storm water runoff from Highway 101 has on temperatures of Eagle Creek, a DNR designated trout stream. Temperature loggers were placed upstream and downstream of Highway 101 by Bonestroo in June of 2006 (see Figure 1), and have been recording stream temperature since that time. Scott Soil and Water Conservation District (SWCD) contracts with the LMRWD to collect and report the temperature data. The loggers record temperature in 15-minute intervals. Since trout are sensitive to temperature, it is a critical variable to monitor. The optimal temperature range for adult brown trout is approximately 12.4 – 17.6° Celsius (Bell, 2006). Rainfall data is provided for this study at the Watershed Outlet Monitoring Program (WOMP) Station from June 21 through November 1st (see Figure 1).

Figure 1. Location of temperature loggers and WOMP station

Results: Under most conditions, temperature results track atmospheric temperatures. During winter months, the downstream water is cooler because it is exposed to cold air longer than upstream. During summer months, the downstream water is warmer because it is exposed to warm air longer.

During warm summer days, water temperatures occasionally exceed the optimal range for trout, but for only a few hours at a time (see Figure 2). This is likely due to hot air temperatures. Noticeable warming of water temperatures downstream of highway 101 also occur following some rain events, while the upstream logger does not respond as drastically (see Figure 3). This trend may in part be attributed to runoff caused by rain heating up after landing on and flowing across hot pavement.

A second possible variable to consider is overflow from the pond located between Highway 101 and the railroad tracks, which discharges into Eagle Creek from the west (see Figure 4). The downstream temperature logger is located approximately 30 feet downstream of this input. This pond holds water which is likely warmed by a combination of solar energy and storm water inflow from the area south of Hwy 101. Large amounts of warm water may be released during rain events as the pond fills and overflows. An investigation conducted on August 19, 2009, during a 2-inch rain event (see Figure 4) shows numerous temperature monitoring locations on Eagle Creek upstream and downstream of the pond tributary, including the tributary itself. The temperature of Eagle Creek rises almost 2°C directly after the tributary discharges into Eagle Creek. The tributary water is almost 5°C higher than Eagle Creek. Temperature spikes appear to be due less from direct Highway 101 runoff, but rather more significantly, a combination of the warm ponded water, runoff from Highway 101, and an increase of water volume leaving the pond. The temperature of the pond may not actually increase during storm events, but rather the volume of water discharging into Eagle Creek is perhaps the stronger influence on temperature rise. This greatly exceeds the small increase in temperature that typically occurs during dry periods that could be attributed to atmospheric warming of the stream. Even though the temperature exceeds the optimal range for trout by only a few degrees and for only a short period, these rapid temperature increases could be stressful to fish.

Water temperature is an important factor influencing the health of trout streams. Overall, water quality of Eagle Creek appears good. Brown Trout are making a comeback (Peterson, 2008), water temperatures rarely exceed optimal range, and most of the riparian area is in a natural state. However, the state water quality standard for Class 2A waters maintain there shall be "no material increase" in temperature. Future monitoring will help track whether the planned road construction will reduce the temperature spikes in Eagle Creek following rain events.

Notes: In 2011, Highway 101 was under construction and therefore, collections were not able to be made as often as normal. A stretch of data was lost between March and June, which is possibly due to the fact that collections were not able to be made during the summer (see Figure 5). The upstream logger was slightly buried in sediment when a site visit was made on July 1st (see red spike in figure 2) and December 21st. Both times, the sediment was removed and a new channel was diverted towards the logger in hopes that the velocity will prevent sediment from pooling in this area. The sediment could affect the readings by muting the temperatures fluctuations because it is reading the temperature of the sediment, rather than the stream water. Besides the loss of some data, the loggers worked well despite the fact they are about at the end of their lifespan.

Figure 5 shows mean daily temperatures. For unknown reasons, data was lost between March 23 and June 21. Monthly graphs displaying the raw 15-minute temperature values are provided following figure 5.

Recommendations: Since the loggers are nearing the end of their lifespan, new loggers could be installed in the same locations, plus one upstream of the pond tributary and possibly one in the tributary. The upstream logger should be placed in a location less likely to get buried in sediment.

Road construction was taking place on Highway 101 this year, including the stretch of road that crosses Eagle Creek. Some runoff was to be reduced to Eagle Creek and instead diverted to a storm water holding pond. By continuing monitoring efforts, the opportunity exists to determine how much influence the roadway has on stream temperature before, during, and after construction is complete and runoff is minimized.

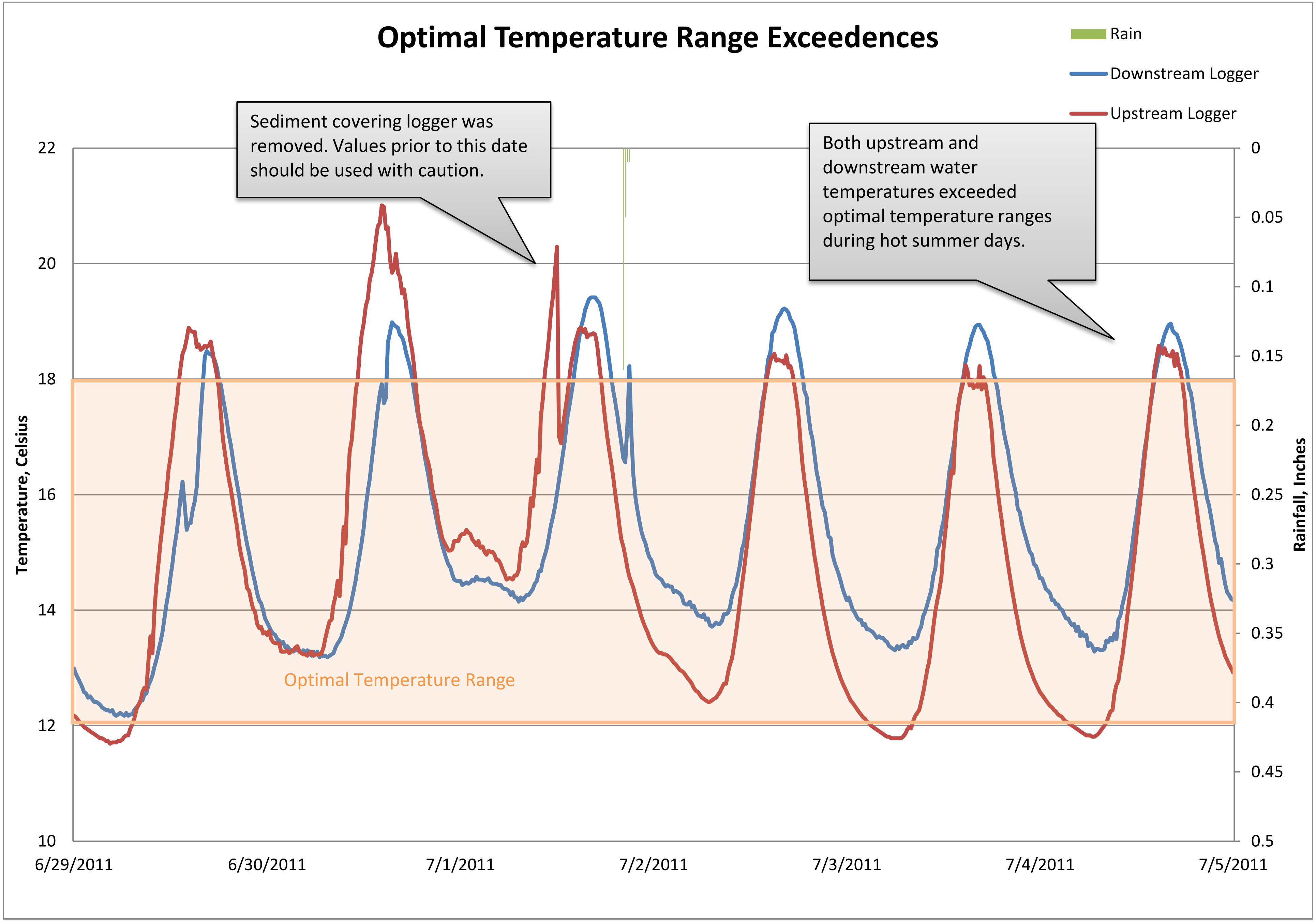


Figure 2. Daily Stream Temperatures in Eagle Creek. During warm summer days, the optimal range is exceeded for a few hours during mid-day.

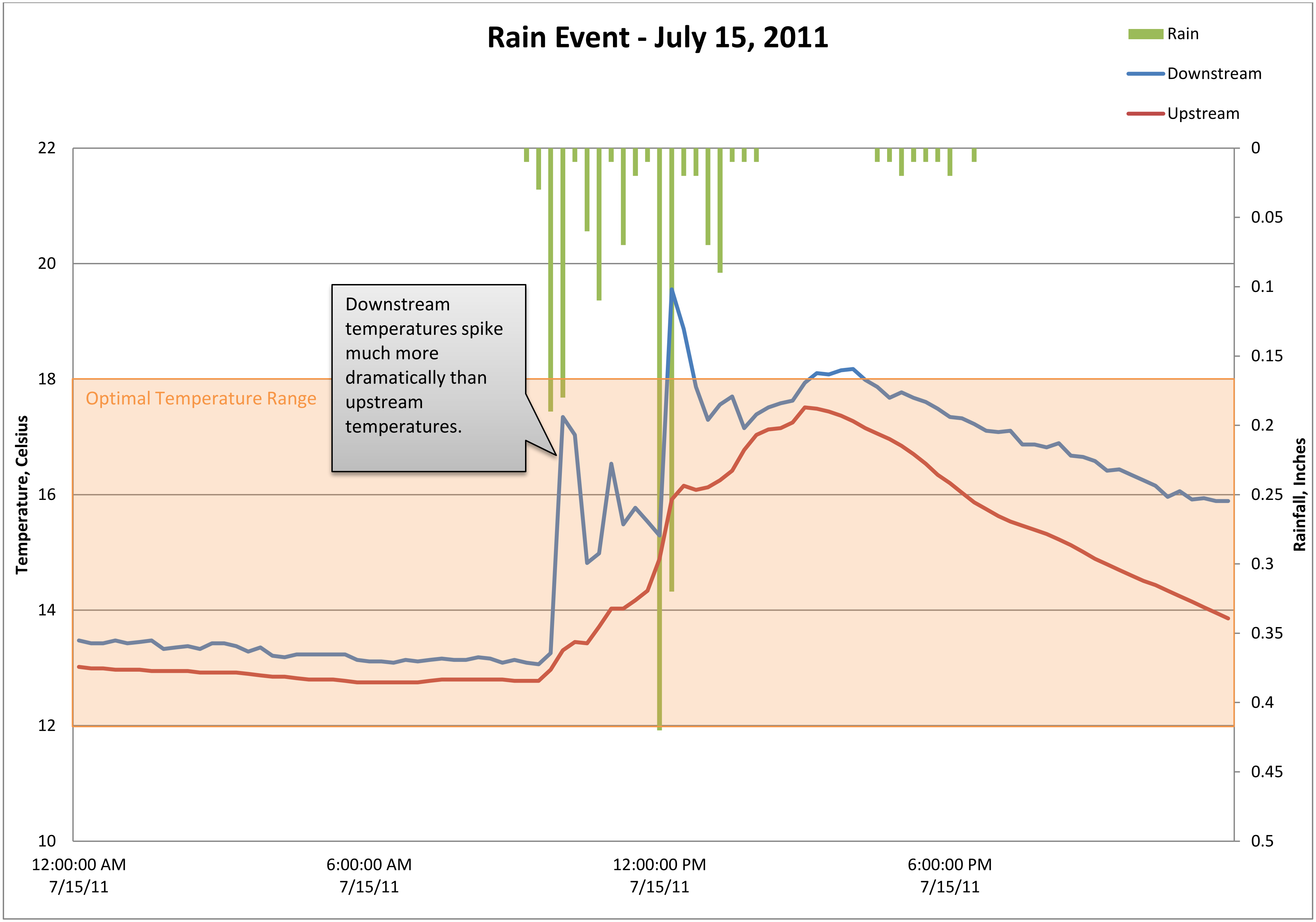


Figure 3. Rain Event Response. This graph represents the temperature deviations following a rain event.

Figure 4. Investigative Temperature Monitoring During Rain Event. White arrows indicate flow direction. Callouts indicate temperature values taken at approximately 4:00pm on August 19, 2009 during a 2" rain event. Notice temperature increase between (B) and (C). Tributary (E), which comes from the pond, is contributing warmer water than the direct contribution from Highway 101 (estimated that 5–10 cfs water coming from tributary during time of measurement).

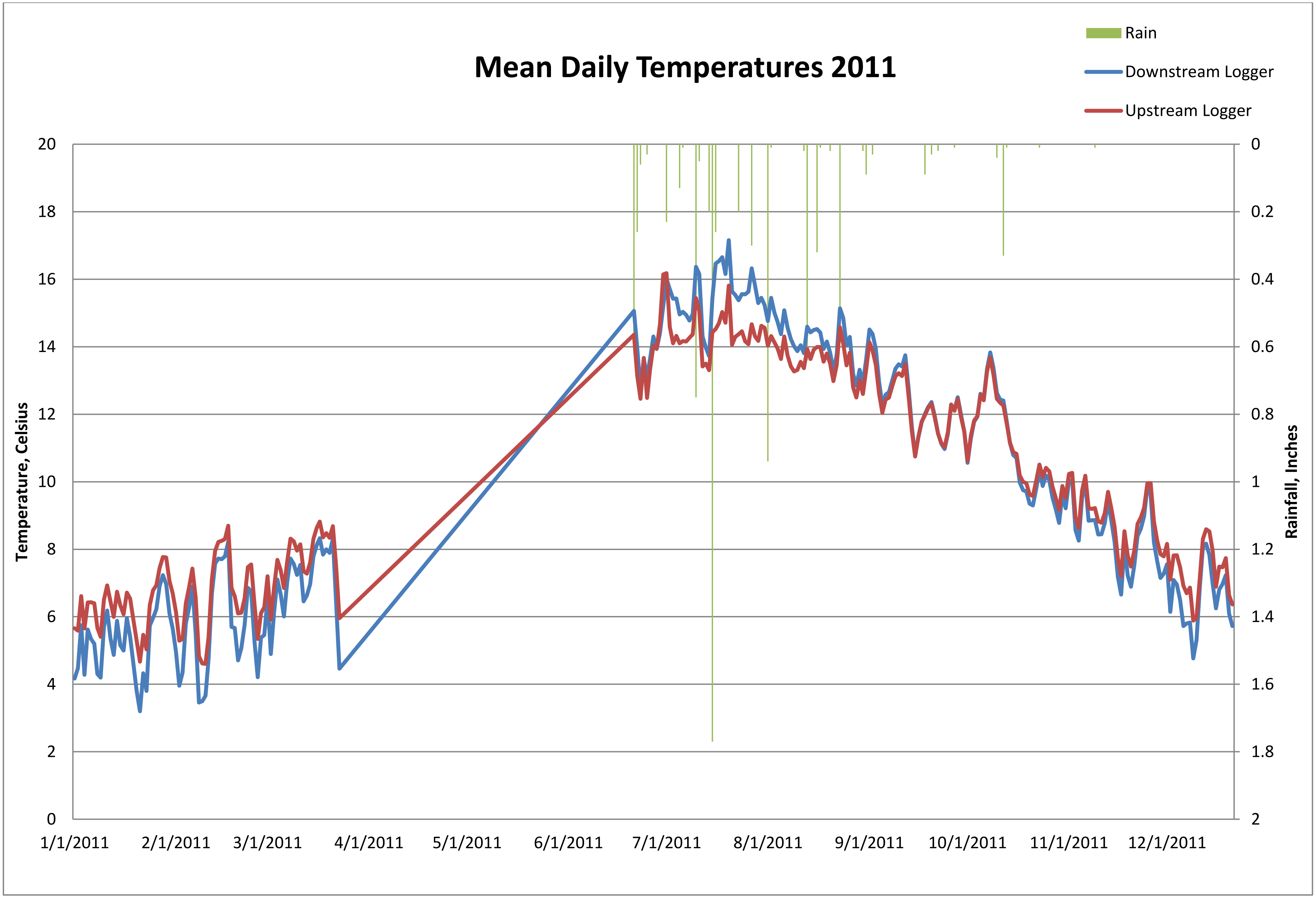
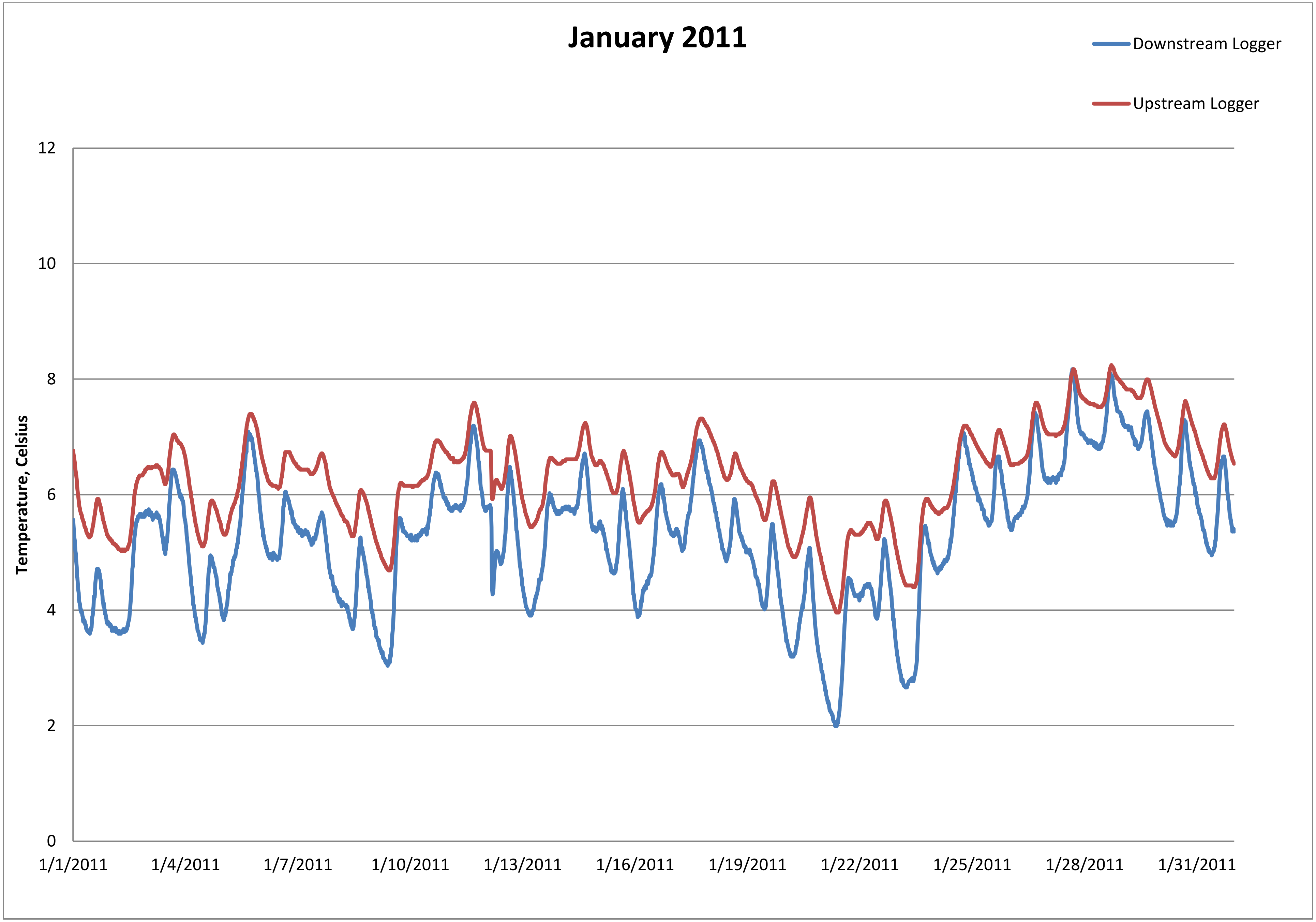
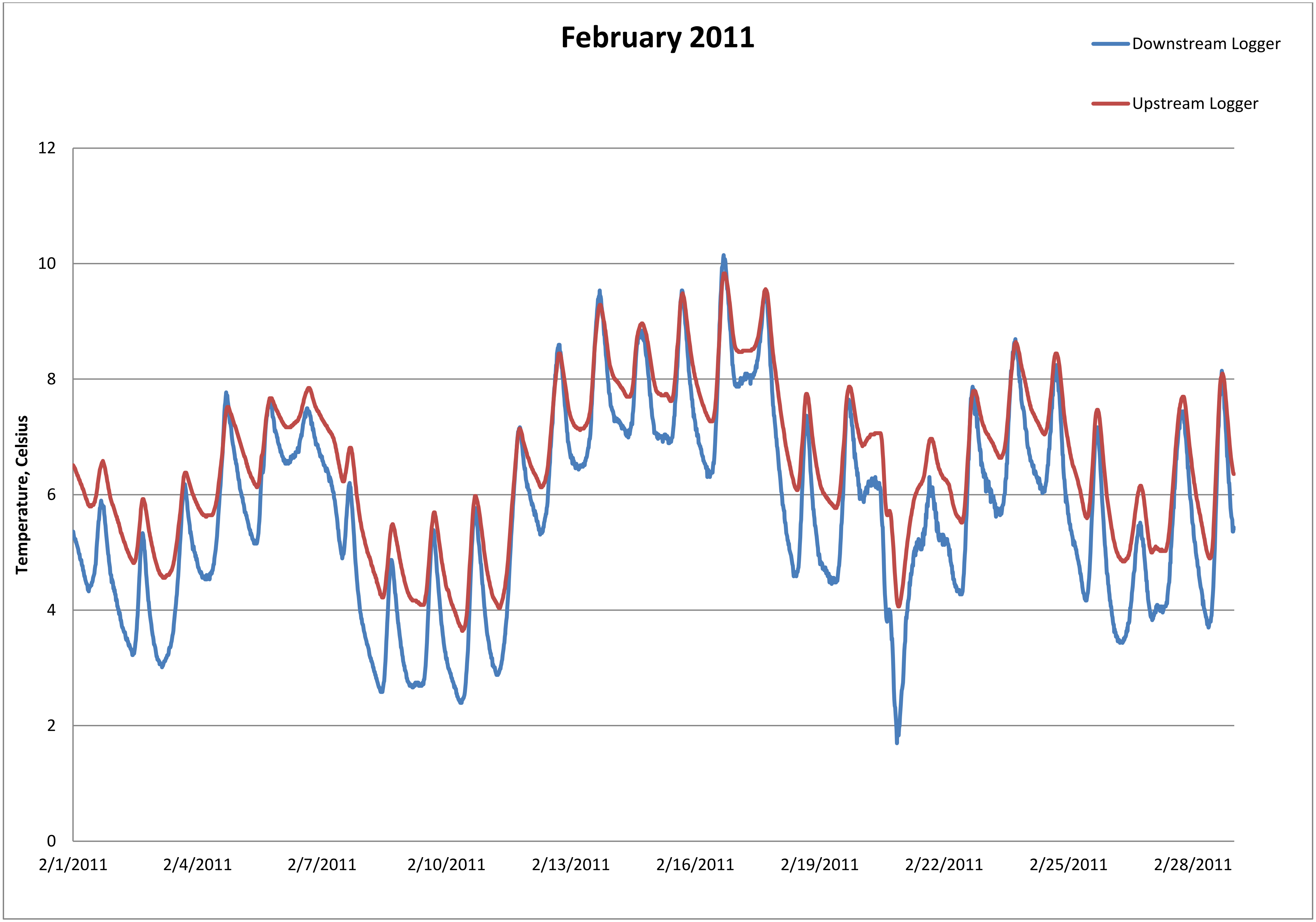
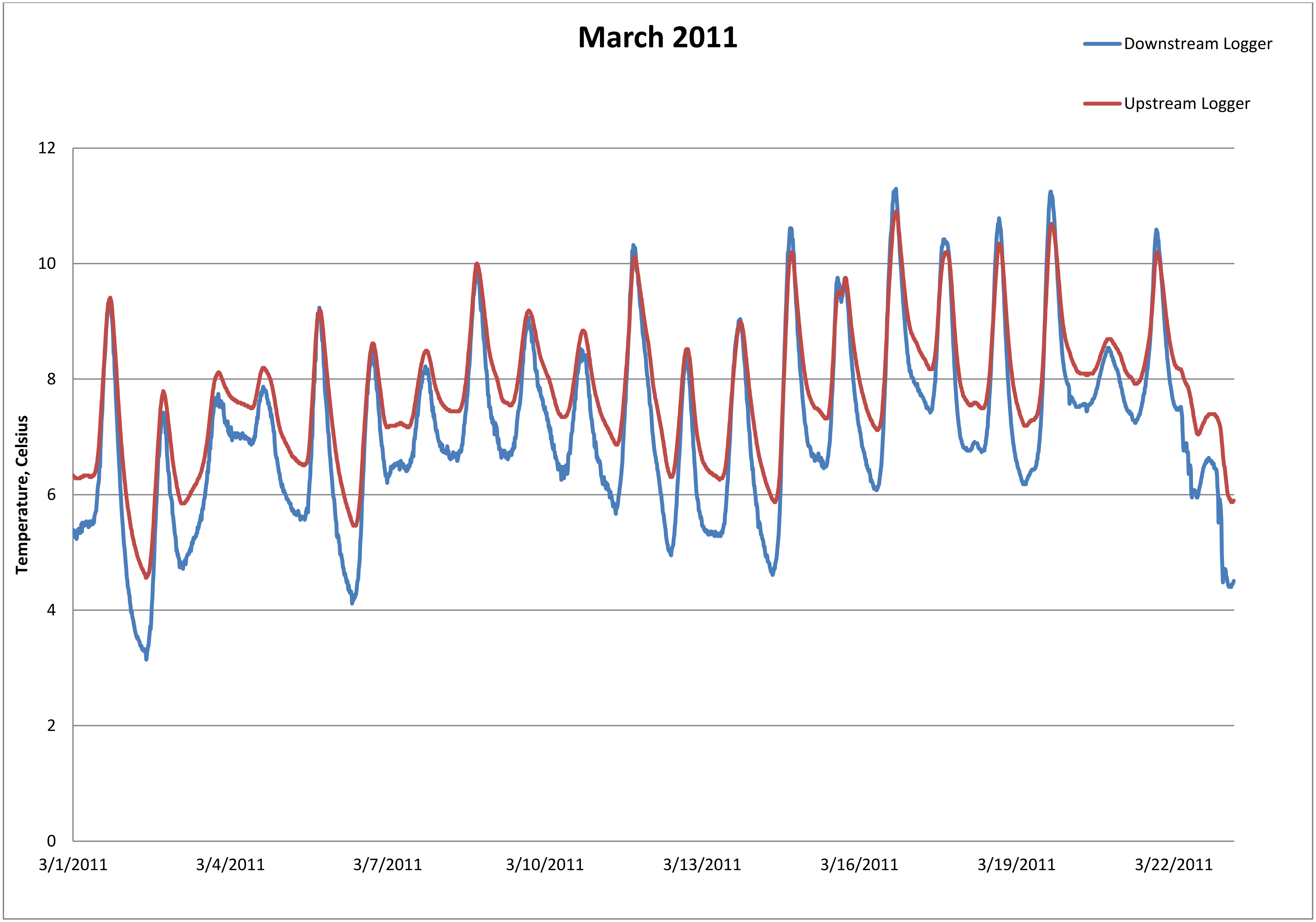
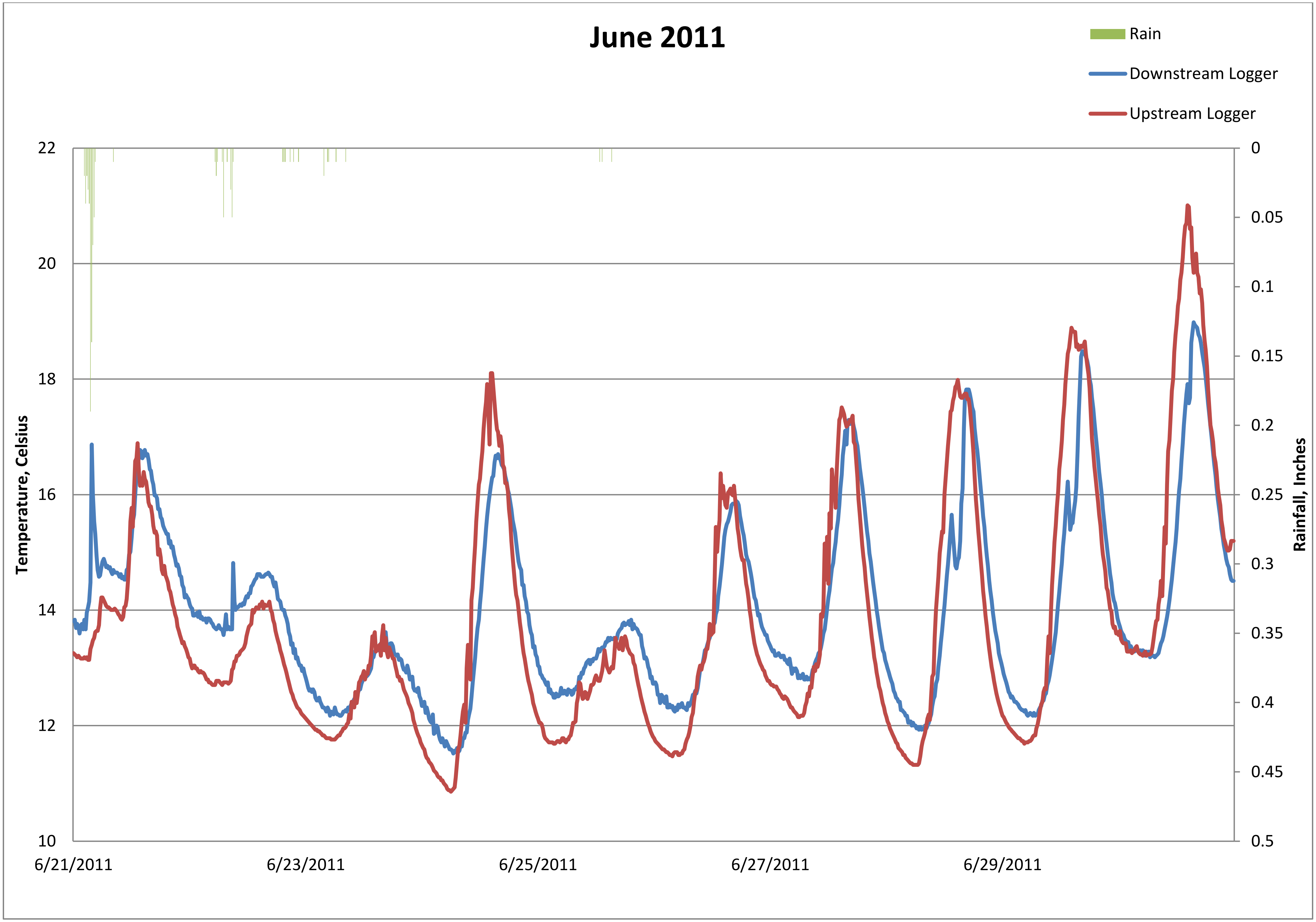


Figure 5 Mean Daily Temperature Values. Data missing from March 23 – June 22.

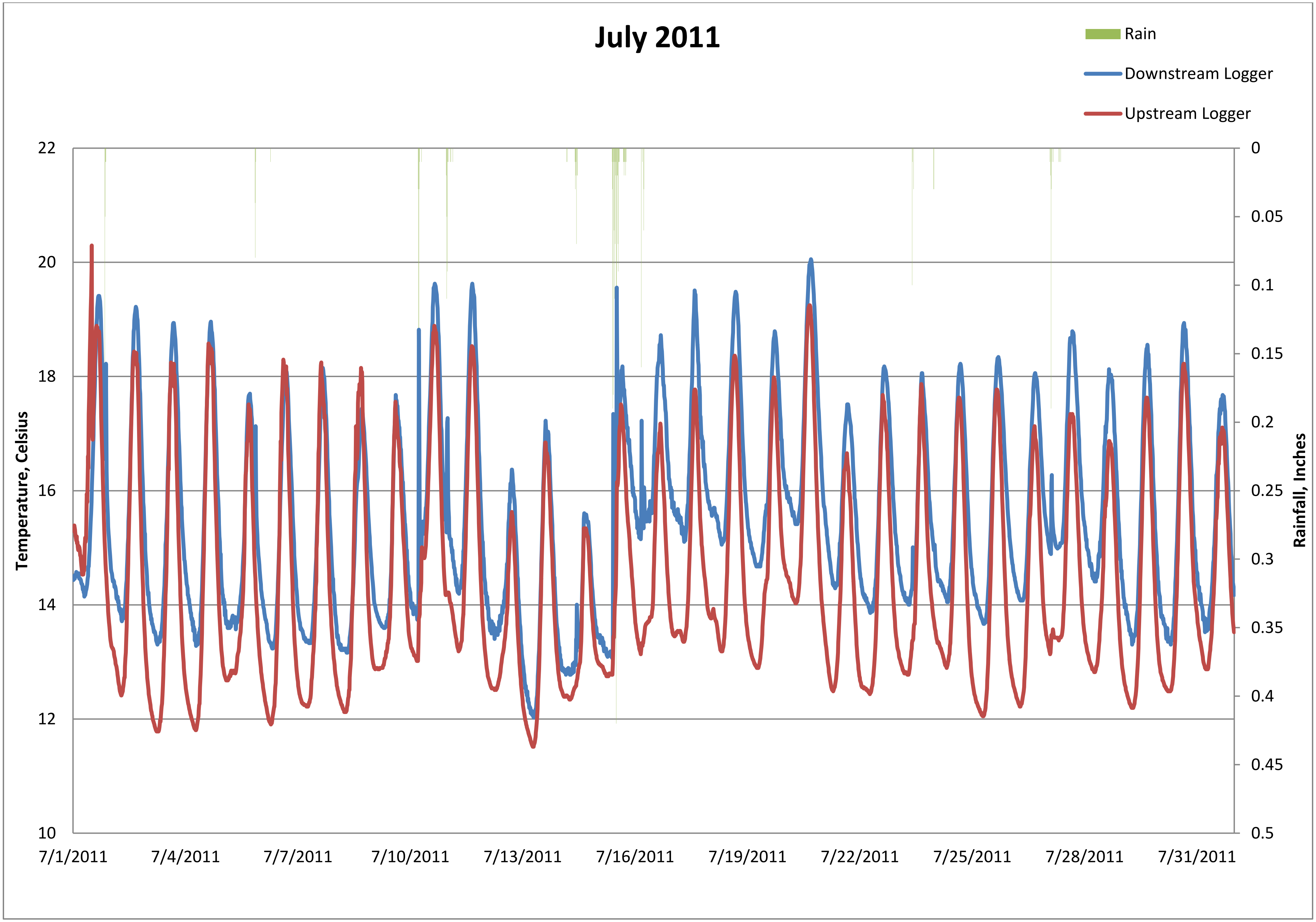

January 2011
Downstream Logger
Upstream Logger
Temperature, Celsius
0
2
4
6
8
10
12
1/1/2011
1/4/2011
1/7/2011
1/10/2011
1/13/2011
1/16/2011
1/19/2011
1/22/2011
1/25/2011
1/28/2011
1/31/2011


February 2011
Downstream Logger
Upstream Logger
Temperature, Celsius
12
10
8
6
4
2
0
2/1/2011
2/4/2011
2/7/2011
2/10/2011
2/13/2011
2/16/2011
2/19/2011
2/22/2011
2/25/2011
2/28/2011

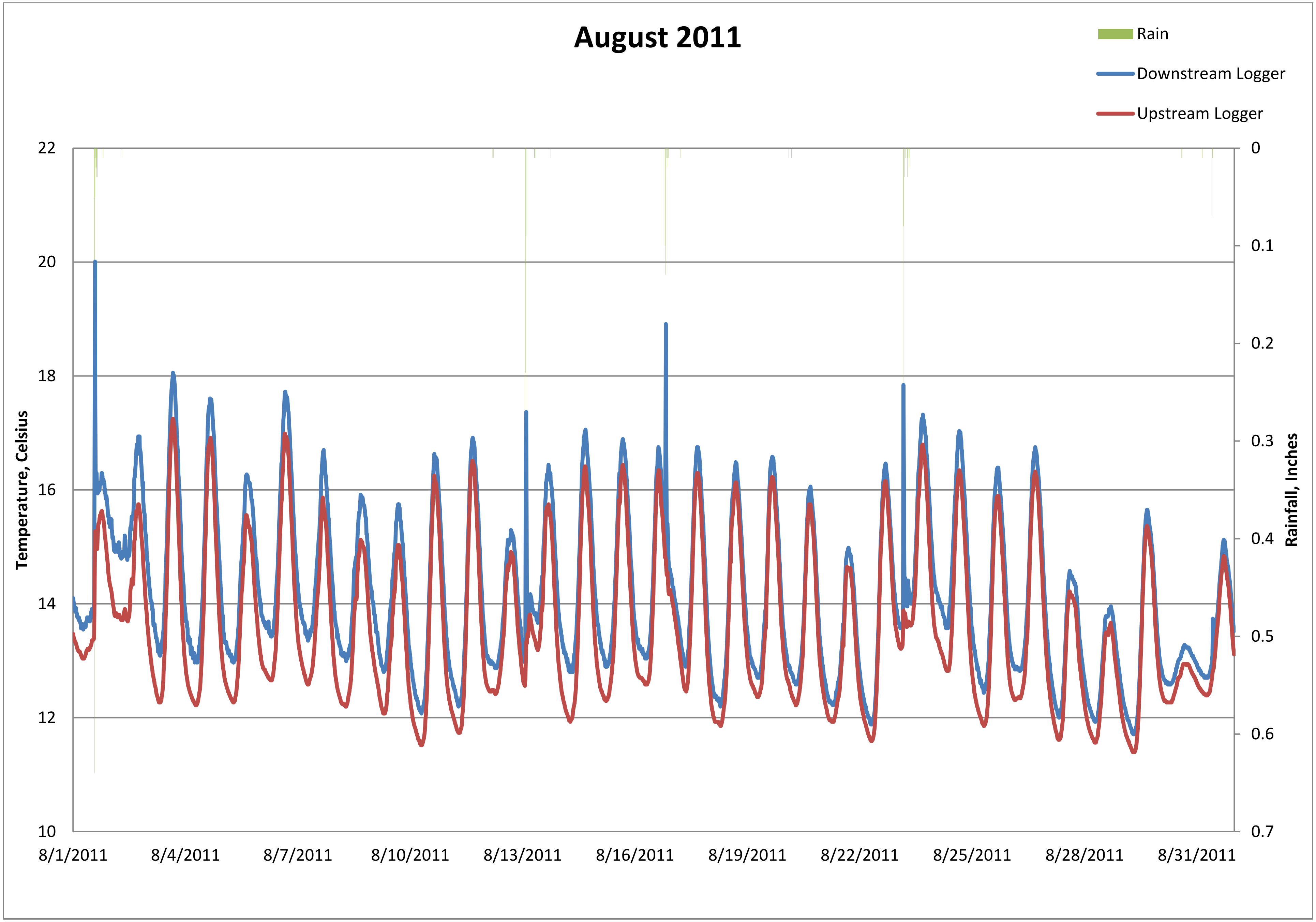

March 2011
Downstream Logger
Upstream Logger
Temperature, Celsius
0
2
4
6
8
10
12
3/1/2011
3/4/2011
3/7/2011
3/10/2011
3/13/2011
3/16/2011
3/19/2011
3/22/2011

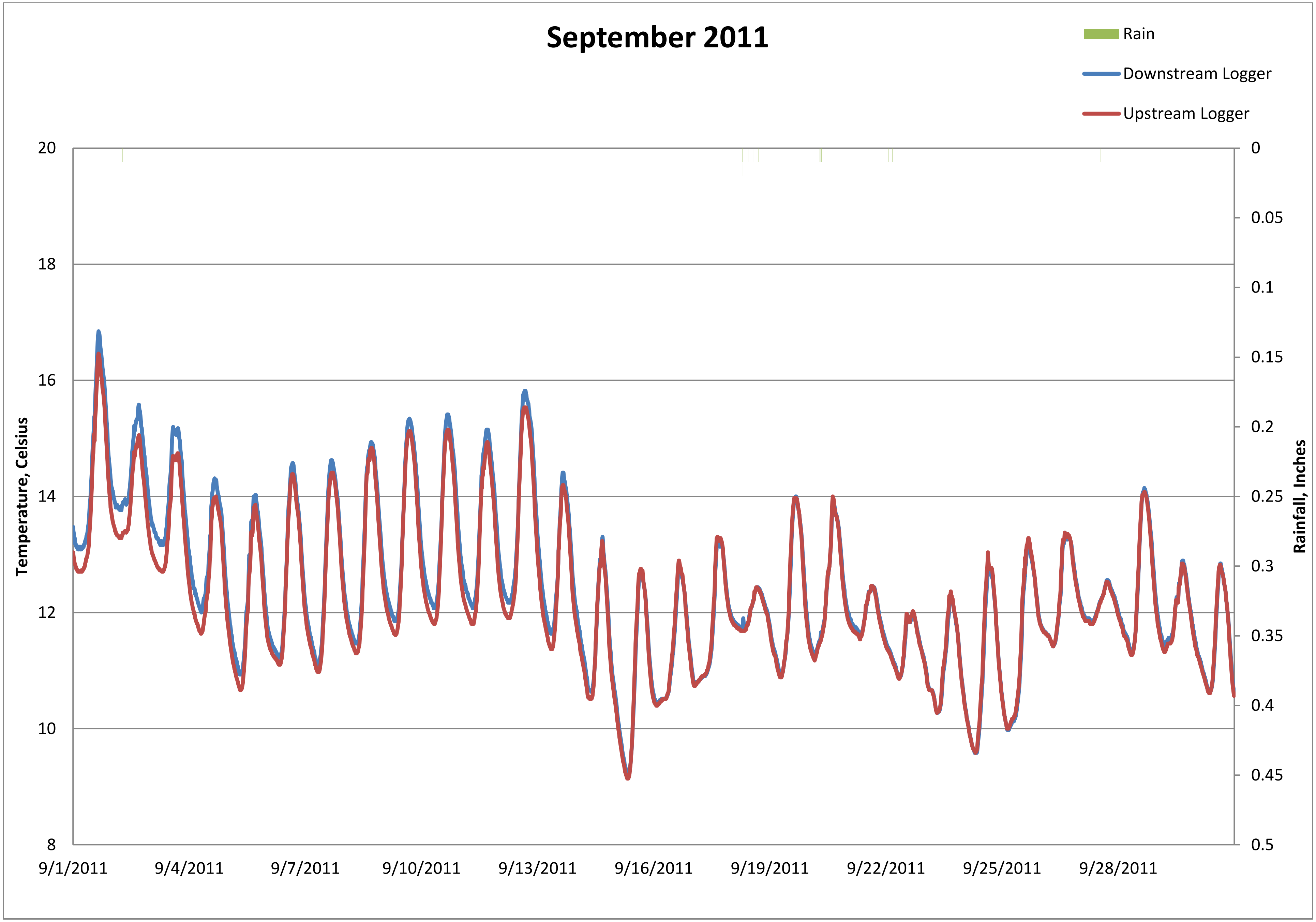


June 2011
Rain
Downstream Logger
Upstream Logger
Temperature, Celsius
Rainfall, Inches
22
20
18
16
14
12
10
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
6/21/2011
6/23/2011
6/25/2011
6/27/2011
6/29/2011

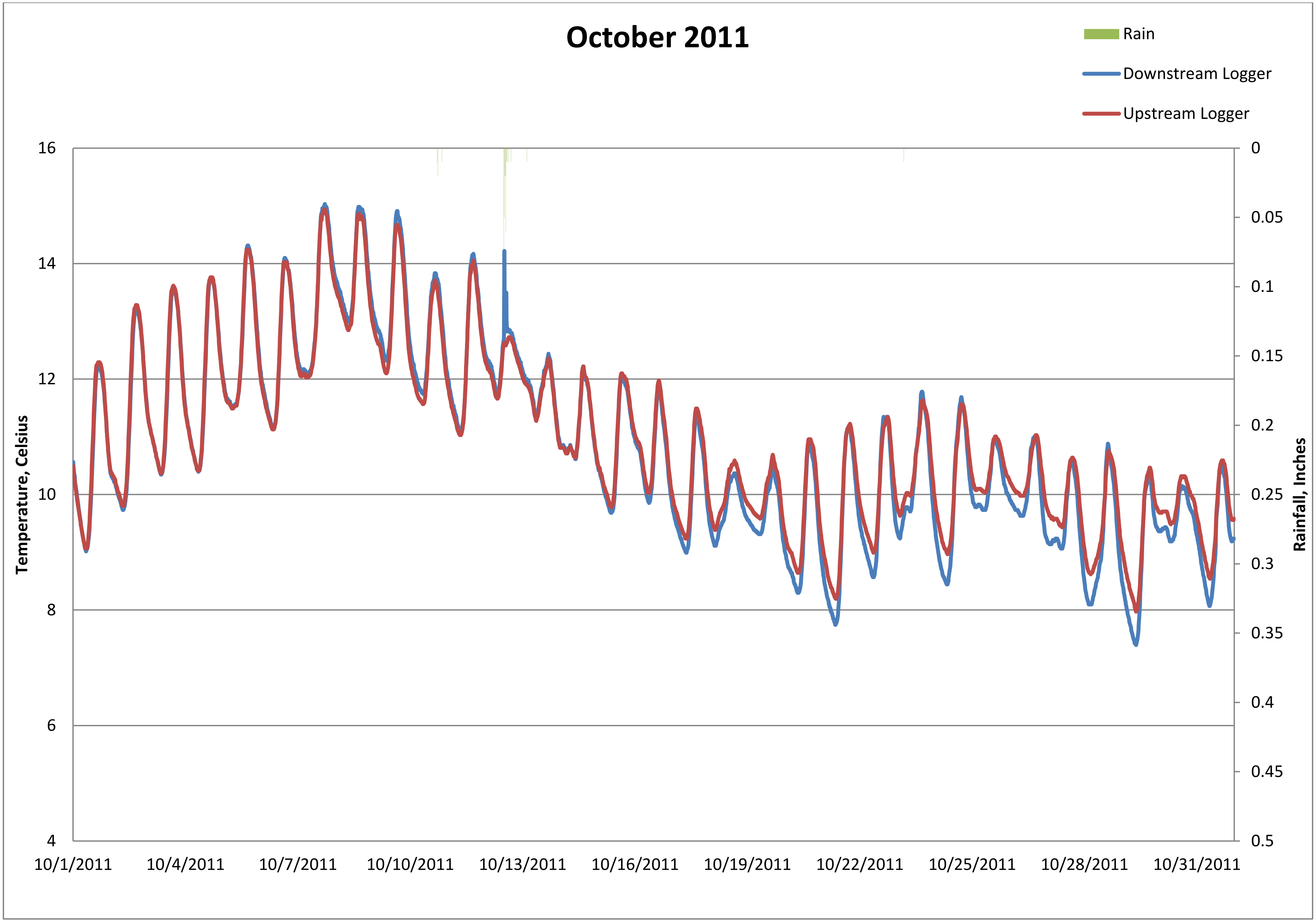


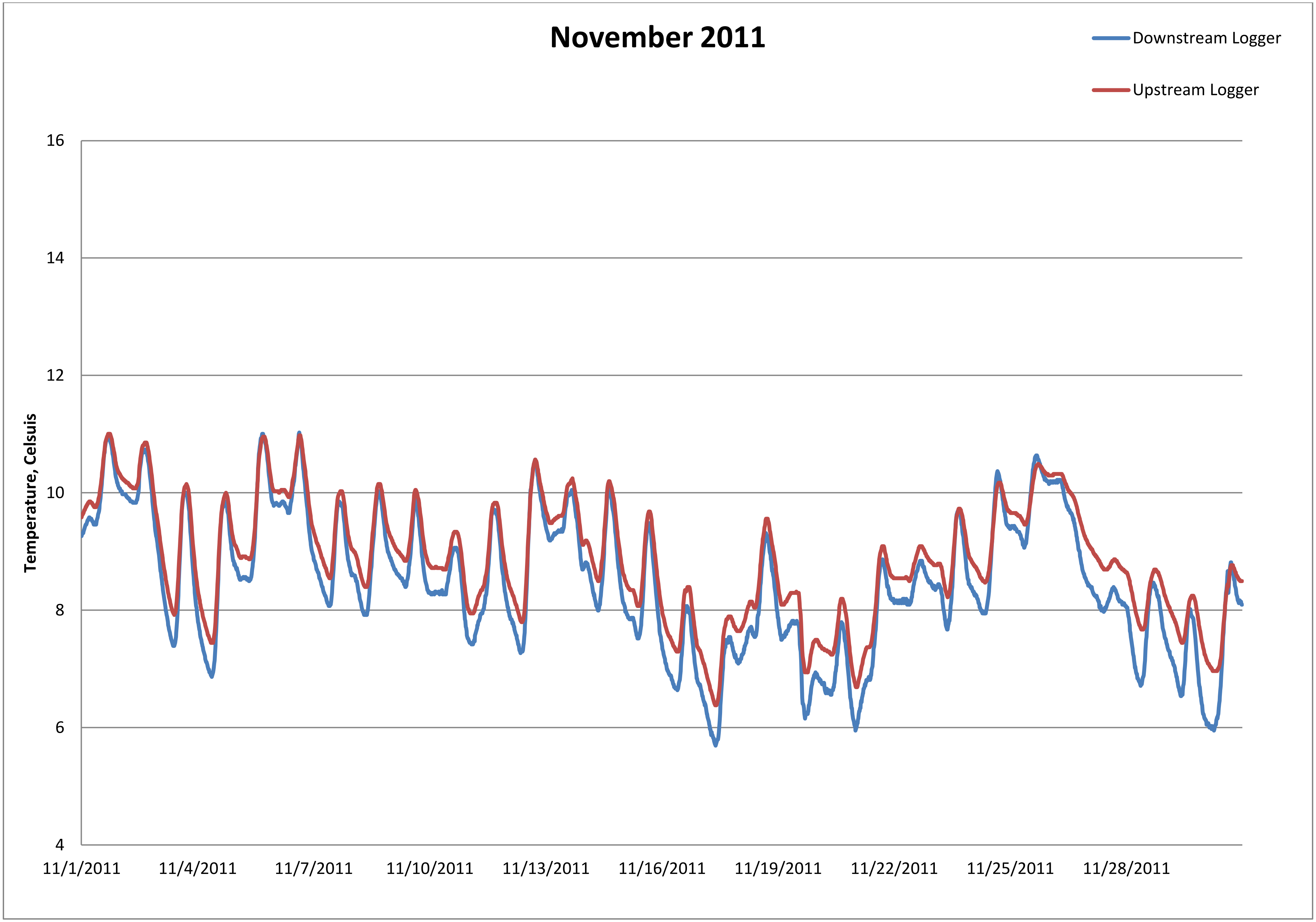
July 2011
Rain
Downstream Logger
Upstream Logger
Temperature, Celsius
Rainfall, Inches
22
20
18
16
14
12
10
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
7/1/2011
7/4/2011
7/7/2011
7/10/2011
7/13/2011
7/16/2011
7/19/2011
7/22/2011
7/25/2011
7/28/2011
7/31/2011

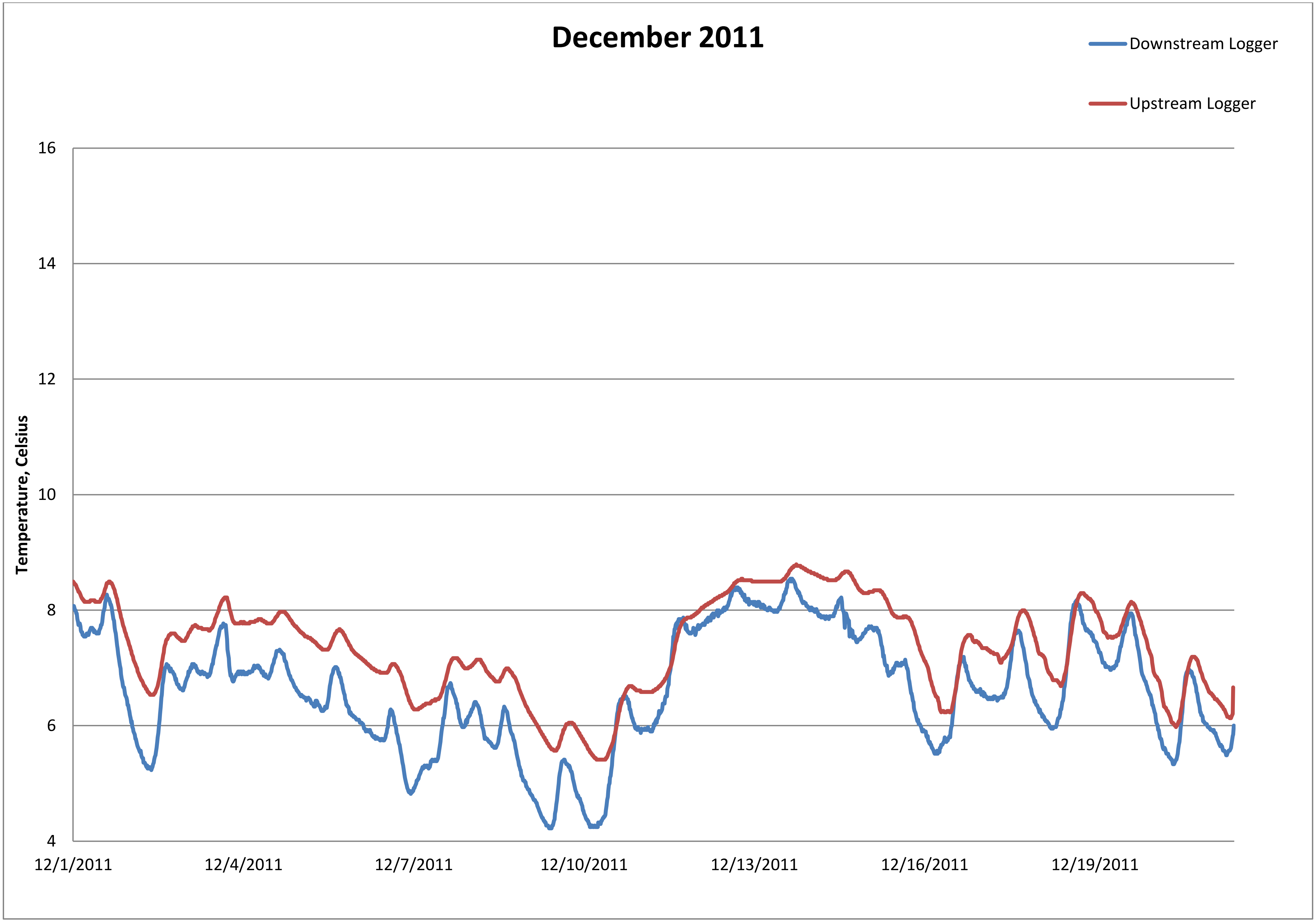

August 2011
Rain
Downstream Logger
Upstream Logger
Temperature, Celsius
Rainfall, Inches
22
20
18
16
14
12
10
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
8/1/2011
8/4/2011
8/7/2011
8/10/2011
8/13/2011
8/16/2011
8/19/2011
8/22/2011
8/25/2011
8/28/2011
8/31/2011



September 2011
Rain
Downstream Logger
Upstream Logger
Temperature, Celsius
Rainfall, Inches
20
18
16
14
12
10
8
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
9/1/2011
9/4/2011
9/7/2011
9/10/2011
9/13/2011
9/16/2011
9/19/2011
9/22/2011
9/25/2011
9/28/2011


October 2011
Rain
Downstream Logger
Upstream Logger
Temperature, Celsius
Rainfall, Inches
16
14
12
10
8
6
4
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
10/1/2011
10/4/2011
10/7/2011
10/10/2011
10/13/2011
10/16/2011
10/19/2011
10/22/2011
10/25/2011
10/28/2011
10/31/2011


November 2011
Downstream Logger
Upstream Logger
Temperature, Celsius
16
14
12
10
8
6
4
11/1/2011
11/4/2011
11/7/2011
11/10/2011
11/13/2011
11/16/2011
11/19/2011
11/22/2011
11/25/2011
11/28/2011



December 2011
Downstream Logger
Upstream Logger
Temperature, Celsius
16
14
12
10
8
6
4
12/1/2011
12/4/2011
12/7/2011
12/10/2011
12/13/2011
12/16/2011
12/19/2011

Works Cited:

Bell J.M., 2006. The Assessment of Thermal Impacts on Habitat Selection, Growth, Reproduction, and Mortality in Brown Trout (*Salm trutta* L): A Review of the Literature. Prepared for the Vermillion River EPA Grant #WS 97512701-0 and the Vermillion River Joint Powers Board. Applied Ecological Services, Inc.

Peterson, David. (2008, October 1). "Without a doubt: More trout in Eagle Creek." *Star Tribune*. 2008. Star Tribune. 21 May 2009 [http://www.startribune.com/local/south/29842934.html?elr=KArksi8cyaiUo8cyaiUiD3aPc:_Yyc:aUU].