



**El Dorado Hydroelectric Project
FERC Project No. 184**

2020 Water Temperature Monitoring Report

**EL DORADO IRRIGATION DISTRICT
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1.0 INTRODUCTION

The El Dorado Irrigation District (District) owns and operates the El Dorado Hydroelectric Project (Project No. 184), which is licensed by the Federal Energy Regulatory Commission (FERC). The Project No. 184 Monitoring Program¹ requires water temperature monitoring in stream reaches associated with Project No. 184 facilities. The specific monitoring requirements for water temperature monitoring are defined in the approved Project 184 Water Temperature Monitoring Plan (Plan; EID 2012).

Temperature monitoring is required during spring months to help evaluate breeding conditions for amphibians. Monitoring is also required during summer to determine if coldwater beneficial uses are being met in designated Project reaches. Therefore, temperature data obtained for selected stream segments during this study will be used to meet the following objectives:

- Characterize the temperature in stream segments by continuously monitoring from April to October;
- Gather and analyze data to determine if water temperatures in the Project Area protect coldwater habitat beneficial uses; and,
- Identify any project-controllable temperature resource measures that may be necessary for the protection, mitigation, and enhancement of beneficial uses, if applicable.

The majority of the Project Area lies within the South Fork American River (SFAR) drainage, part of the larger Sacramento River Basin. According to the Central Valley Region Basin Plan (CVRWQCB 2011), the designated beneficial uses for this basin include municipal water supply, power supply, contact recreation, non-contact recreation, canoeing and rafting, warm water fish habitat, coldwater fish habitat, coldwater fish spawning, and wildlife habitat. The designated beneficial uses for Lake Aloha, Silver Lake, and Caples Lake include municipal water supply, irrigation, stock watering, industrial process supply, power production, contact recreation, non-contact recreation, warm water and coldwater fish habitat, coldwater fish spawning, and wildlife habitat. Echo Lake and Echo Creek lie within the Lahontan Basin. The designated beneficial uses for these facilities include municipal water supply, groundwater

¹ Section 7 of the El Dorado Relicensing Settlement Agreement, U.S. Forest Service 4(e) Condition No. 37, and California State Water Resources Control Board Section 401 Clean Water Act Water Quality Certification Condition No. 13

recharge, navigation, recreation, commercial and sport fishing, coldwater fisheries, wild trout, and fish spawning (LRWQCB 2005).

Stream flow characteristics in watersheds within the Project Area are highly variable due to annual variations in both precipitation and air temperature, which result in variations in surface water temperatures. This temperature monitoring program has been designed to provide information regarding water temperature in the vicinity of the Project and identify any project-controllable temperature concerns that can be addressed by project management to protect coldwater beneficial uses.

Monitoring conducted in 2020 represents the twelfth continuous year of water temperature monitoring performed in accordance with the Plan. Results of the 2020 water temperature monitoring effort are presented herein. 2020 monitoring spreadsheet data (i.e., hourly, daily minimum, daily maximum and average daily water temperatures) is available online at: <http://www.eid.org/our-services/hydroelectric/project-184/project-184-document-library>.

2.0 METHODS

2.1 Site Selection

This water temperature monitoring program was designed to monitor surface water temperatures above and below Project diversions throughout the Project Area. The current Plan requires continuous recording temperature probes at various locations from April 1 through October 31, provided safe access was possible. These sites include:

- T1 Pyramid Creek downstream of Lake Aloha Dam
- T2 Pyramid Creek upstream of South Fork American River
- T3 Echo Creek downstream of Echo Lake Dam
- T4 Echo Creek upstream of Upper Truckee River
- T5 Caples Creek downstream of Caples Lake Dam
- T6 Silver Fork American River downstream of Silver Lake Dam
- T7 Silver Fork American River upstream of South Fork American River
- T8 South Fork American River upstream of Silver Fork Confluence
- T9 South Fork American River downstream of Kyburz Diversion
- T10 South Fork American River upstream of Powerhouse

T25 South Fork American River at Bridal Veil Picnic Area

In 2020, the District continued monitoring at additional sites not specified in the Plan. These sites are located along the Silver Fork American River and Caples Creek and are intended to provide additional information regarding the water temperature characteristics along the length of the Silver Fork American River:

- T26 South Fork American River downstream of the confluence with the Silver Fork American River and upstream of the Kyburz Diversion Dam
- T29 Silver Fork American River near Silver Fork Campground (near Fitch Rantz Bridge)
- T30 Silver Fork American River upstream of the confluence of Caples Creek
- T31 Caples Creek upstream of the confluence with Silver Fork American River

2.2 Temperature Recorders

Two ONSET HOBO Water Temperature Pro V2 Data Loggers were installed at all monitoring locations required in the Plan that could be safely accessed on or before April 1, 2020. Loggers at site T1 Lake Aloha were installed on June 4, 2020. Locations along the Silver Fork of the American T7 Silver Fork American River upstream of South Fork American River and T29 Silver Fork American River near Silver Fork Campground near Fitch Rantz Bridge were installed in mid-July when the sites could be safely accessed following snowmelt. Sites T30 Silver Fork American River upstream of the confluence of Caples Creek and T31 Caples Creek upstream of the confluence with Silver Fork American River were not recovered in 2019 due to forest closure so were in place for the full 2020 monitoring season.

All temperature loggers were programmed to record water temperature at 1-hour intervals, 24-hours per day. At each location, one recorder was designated as logger A and the other as logger B, and the two were deployed immediately adjacent to each other for redundancy purposes in the event one logger wasn't reading accurately. Recorders were housed in protective copper sleeves and secured to the stream bank using stainless steel cable. Data were downloaded from recorders using a HOBO waterproof data shuttle and/or transferred to a

laptop computer. All temperature recorders were removed in late October or early November with the exception of T1 as described in Section 3.1.

2.3 Data Analysis

Hourly data were downloaded using HOBOWare Pro software from which daily maximum, minimum, and average temperatures were calculated. Data were exported and compiled using Microsoft Excel. Daily average, minimum, and maximum temperatures for the each recorder deployed at a given location were compared graphically to search for anomalies. If data anomalies were observed for one recorder, then data from the other recorder were used in the analysis. When no data anomalies were present, the data from logger A were used in the analysis.

The thermal preference literature for salmonids (trout and salmon) is vast and widely variable depending upon genetic race of fish, acclimation temperatures, oxygen levels, food supply, and myriad other factors (McCullough 1999, Myrick and Cech 2004, Mathews and Berg 1997, Kupferberg et al. 2009). Based on this information, the generalized criteria for evaluating water temperatures for trout and other coldwater species including amphibians in this report is provided in Table 1.

Table 1. Criteria for evaluating water temperatures for trout and other coldwater species including amphibians in this report

Mean Daily Water Temperatures	Coldwater Species Response
< 20 °C	Optimal growth and survival
20 - 23 °C	Suitable; increased susceptibility to stressors
>23 - 26 °C	Physiological stress and behavioral shifts to compensate
> 26 °C	Adverse effects and potential mortality

3.0 RESULTS AND DISCUSSION

Results of 2020 temperature monitoring are summarized below for each monitoring location along with a general description of characteristics associated with each location. Figures showing the daily mean, maximum, and minimum water temperatures are presented in Appendix A. Daily Mean, maximum and minimum water temperatures are provided in electronic format in Appendix B.

3.1 Pyramid Creek (T1 & T2)

Pyramid Creek is a south-facing watershed located along the Sierra crest. Pyramid Creek drains Lake Aloha and is the highest elevation watershed monitored in this study. T1 is located in Pyramid Creek in the outflow channel just below the dam at Lake Aloha. T2 is located in Pyramid Creek upstream of the Highway 50 crossing. Temperature probes from T1 were not able to be recovered due to snow accumulation in November 2020. Site T1 will be downloaded when conditions allow access in 2021. Logger A data was used for site T2.

Daily average water temperatures at T2 are shown in Figure 2. Figure 3 will be updated when data for T1 is available. Figure 4 shows the daily maximum and minimum water temperatures at T2.

Water temperatures recorded in Pyramid Creek at water temperature monitoring site T2 was within the optimal and suitable range for trout and other coldwater species, including amphibians throughout the monitoring period.

3.2 Echo Creek (T3 & T4)

Echo Creek flows out of Echo Lake and into the Upper Truckee River near the town of Myers, CA. This east-facing watershed is the only watershed in the Project Area that is not within the American River drainage. T3 is located near the Echo Creek gage station approximately 100 meters downstream of the Echo Lake Dam. T4 is located upstream of the confluence with the Upper Truckee River near the town of Myers. Logger A data was used for both sites.

Daily average water temperatures at T3 and T4 are shown in Figure 5. Figure 6 shows the daily maximum and minimum water temperatures at T3 and Figure 7 shows the daily maximum and minimum water temperatures at T4.

Water temperatures recorded in Echo Creek at monitoring sites T3 and T4 were within the optimal and suitable range for trout and other cold water species, including amphibians throughout the monitoring period.

3.3 Silver Fork American River Watershed (T5, T6, T30, T31, T29, & T7)

The Silver Fork of the American River watershed is the largest tributary in the Project area. This north-facing watershed near the Sierra crest drains the

Kirkwood area between the South Fork American and Mokelumne watersheds. T5 was located in Caples Creek near the gage station below Caples Lake Dam. T6 was located in the Silver Fork American River downstream of Silver Lake Dam. T31 was located in Caples Creek upstream of the footbridge near the confluence of the Silver Fork. T30 was located in Silver Fork American River upstream of the confluence with Caples Creek near Forgotten Flat. T29 was installed in the Silver Fork near Silver Fork Campground (near Fitch Rantz Bridge). T7 was located in Silver Fork just above the confluence with the SFAR. Logger A data was used for all sites except T7, where Logger B data was used from August 3 – October 31, 2020 because Logger A was exposed to ambient air.

Daily average water temperatures at T5, T6, T30, T31, T29, and T7 are shown in Figure 8. The daily maximum and minimum water temperatures at T5, T6, T30, T31, T29, and T7 are shown in Figures 8-14.

Water temperatures recorded throughout the Silver Fork American River watershed were within the optimal range and suitable range for trout and other coldwater species, including amphibians throughout the monitoring period.

3.4 South Fork American River (T8, T26, T9, T25, and T10)

The SFAR drains the west side of the Sierra Nevada, and is the mainstem river within the Project area. T8 is located approximately 0.5 miles upstream of the Kyburz Diversion, upstream of the SFAR confluence with the Silver Fork, and is the upstream-most study location in the mainstem. T26 is located immediately upstream of the Kyburz Diversion. T9 is located just downstream of the Kyburz Diversion. T25 is located in the SFAR at Bridal Veil Picnic Area. T10 is located at the downstream end of the Project area, upstream of the Akin Powerhouse. Logger A data was used for all sites. For site T8 and T26, data from April 1 - July 15 was not recoverable due to missing probes and/or battery failure. New probes installed at both sites on July 16.

Daily average water temperatures in the SFAR (sites T8, T26, T9, T25, and T10) are shown in Figure 15. Figure 16 shows the daily maximum and minimum water temperatures in the SFAR above the confluence with the Silver Fork (T8). Figure 17 shows the daily maximum and minimum water temperatures in the SFAR above the Kyburz Diversion (T26) and Figure 18 shows the daily maximum and minimum water temperatures in the SFAR below the Kyburz Diversion Dam (T9). Figure 19 shows the daily maximum and minimum water

temperatures in the SFAR near the Bridal Veil Picnic Area in the middle of the Project reach. Figure 20 shows the daily maximum and minimum water temperatures in the SFAR upstream of the Akin Powerhouse (T10) at the downstream end of the Project reach.

As expected, water temperatures in the SFAR increased with the drop in elevation from T8 to T10. Water temperatures at T8, T26, and T9 were within the optimal and suitable range for coldwater species. Water temperatures in the middle (T25) and lower (T10) reaches of the Project were appropriate for the warmer water transitional species assemblage present in this reach (Moyle 2002).

Using hourly data, the average temperature difference above and below the Kyburz Diversion (between T26 and T9) was 0.05°C warmer below the diversion from July 16 to October 31, 2020. The maximum difference in temperature during this timeframe was 0.8°C, which was measured on October 15, 2020 when 1) water temperatures measured upstream of the diversion was 12.2°C and water temperatures measured downstream of the diversion was 11.5°C and 2) the District was not diverting water in October 2020 due to the annual canal outage. The 0.8°C difference appears to be an outlier value when compared to the maximum difference during each month from July through October as provided in Table 2.

Table 2. Maximum difference above and below the Kyburz Diversion (between T26 and T9) from July 16 to October 31, 2020

Month	Maximum temperature difference (°C)
July	0.3
August	0.3
September	0.4
October	0.8

4.0 CONCLUSION

Overall, water temperatures measured in the Project area were within the optimal and suitable range for trout and other coldwater species, including amphibians throughout the study period.

Water temperatures in the middle (T25) and lower (T10) reaches of the Project area begin to warm naturally at lower elevations. The upper reaches of the Project area support cold water species assemblages (e.g., rainbow trout assemblage; Moyle 2002), while the middle and lower reaches are grading into warmer water, and have a transitional species assemblage (pikeminnow-hardhead-sucker assemblage) reflective of this natural change and incrementally warmer water caused by higher ambient air temperatures.

5.0 REFERENCES

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Appendix A:

Figures



Figure 1. Locations of Annual Temperature Monitoring Stations, 2020. FERC Project No. 184.
Note: monitoring discontinued at T-27 and T-28 on Silver Fork American River in 2019 - these sites were additional monitoring locations not required by the Plan.

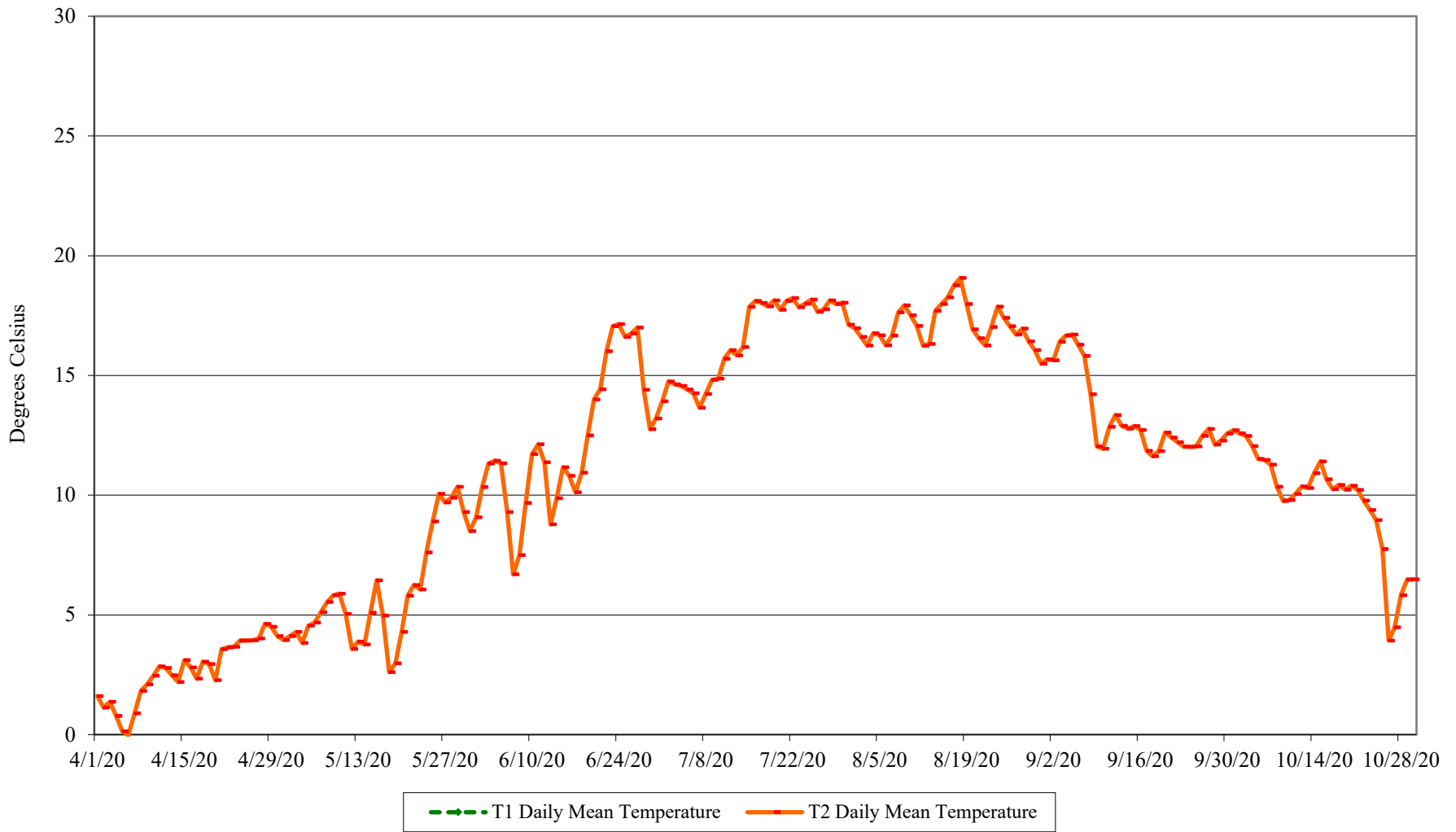


Figure 2. Daily Mean Temperature in Pyramid Creek at Pyramid Creek below Lake Aloha (T1) & Pyramid Creek upstream of the SFAR (T2)

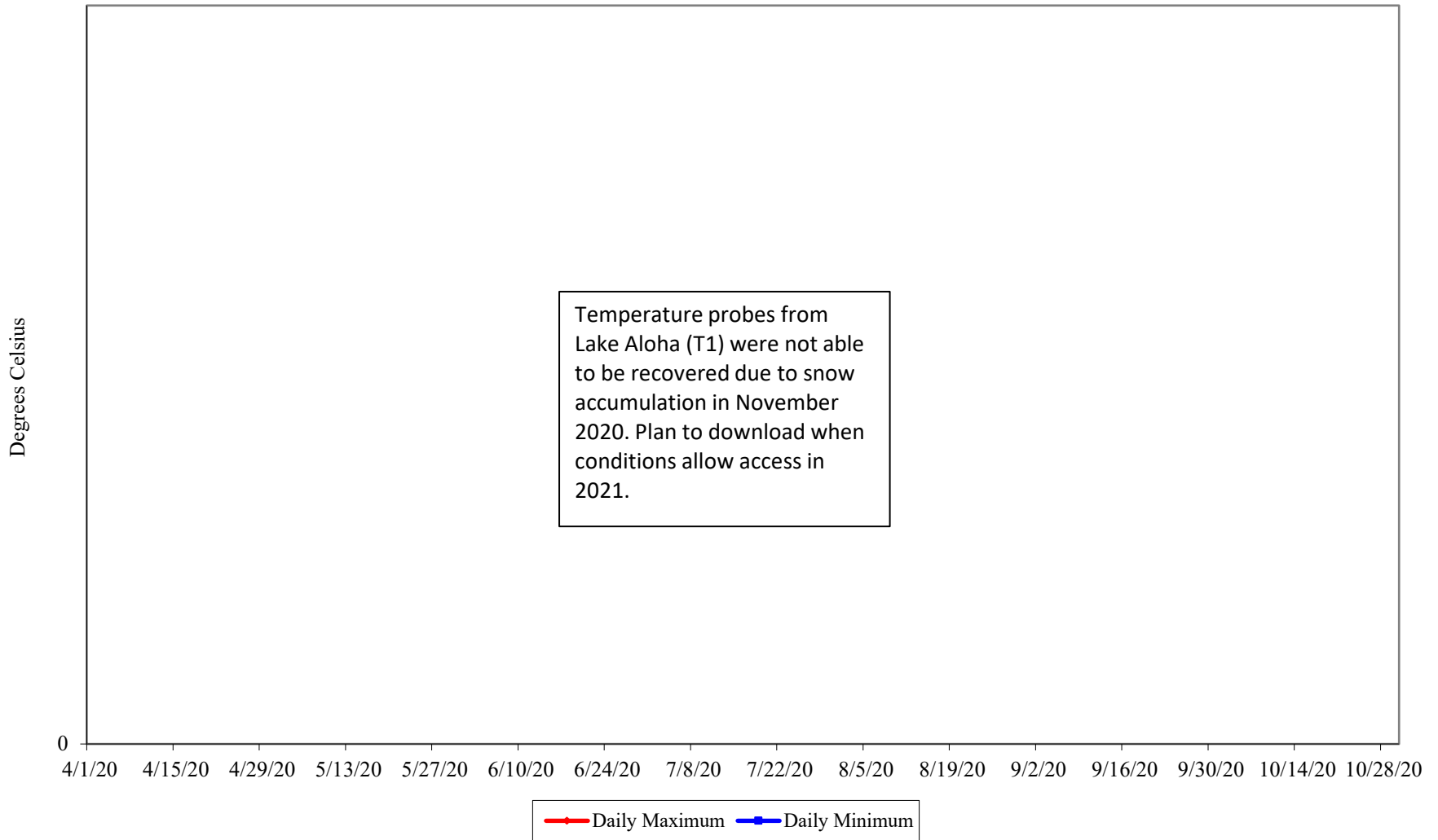


Figure 3. Daily Maximum and Minimum Water Temperatures in Pyramid Creek below Lake Aloha, T1

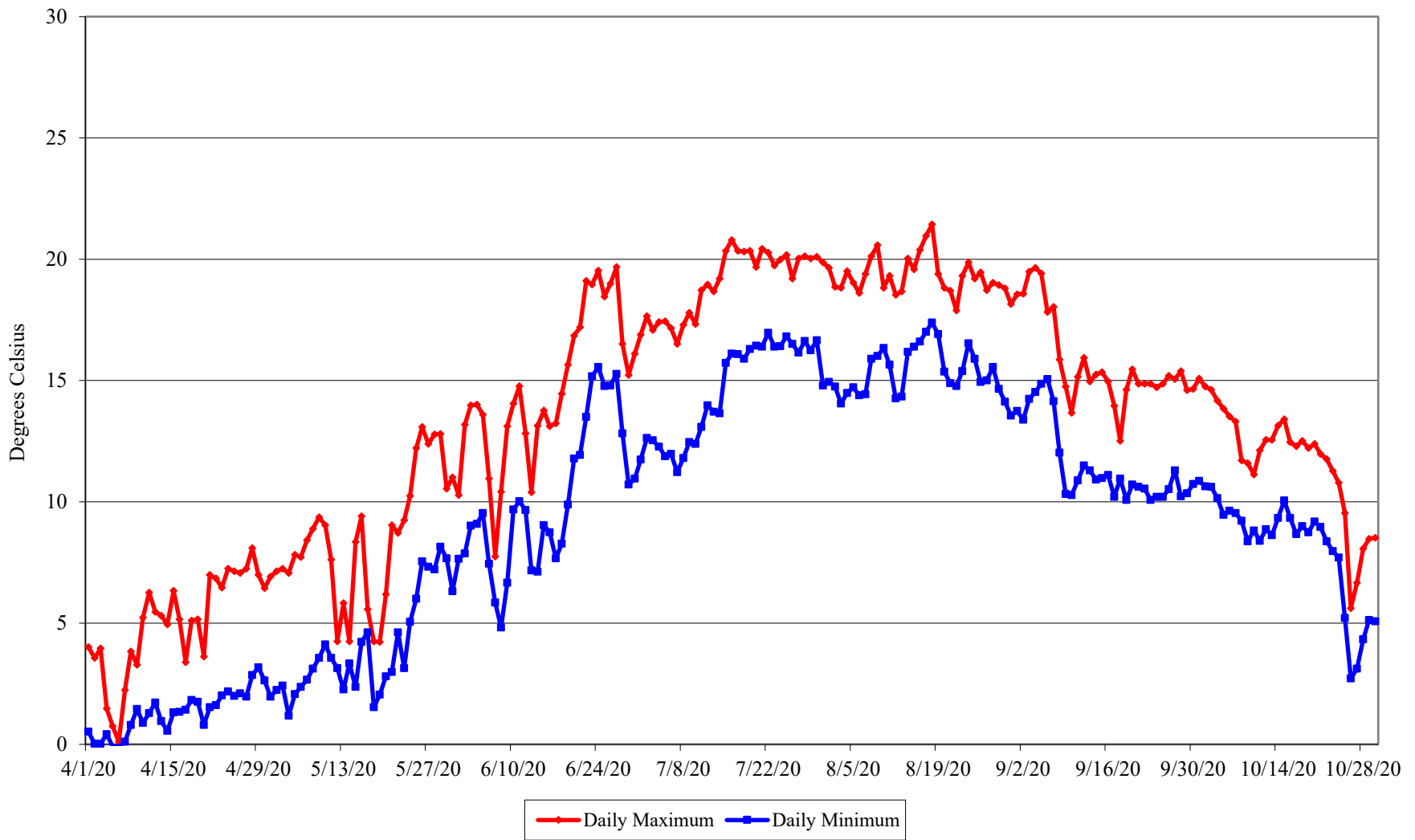


Figure 4. Daily Maximum and Minimum Water Temperatures in Pyramid Creek upstream of the SFAR, T2

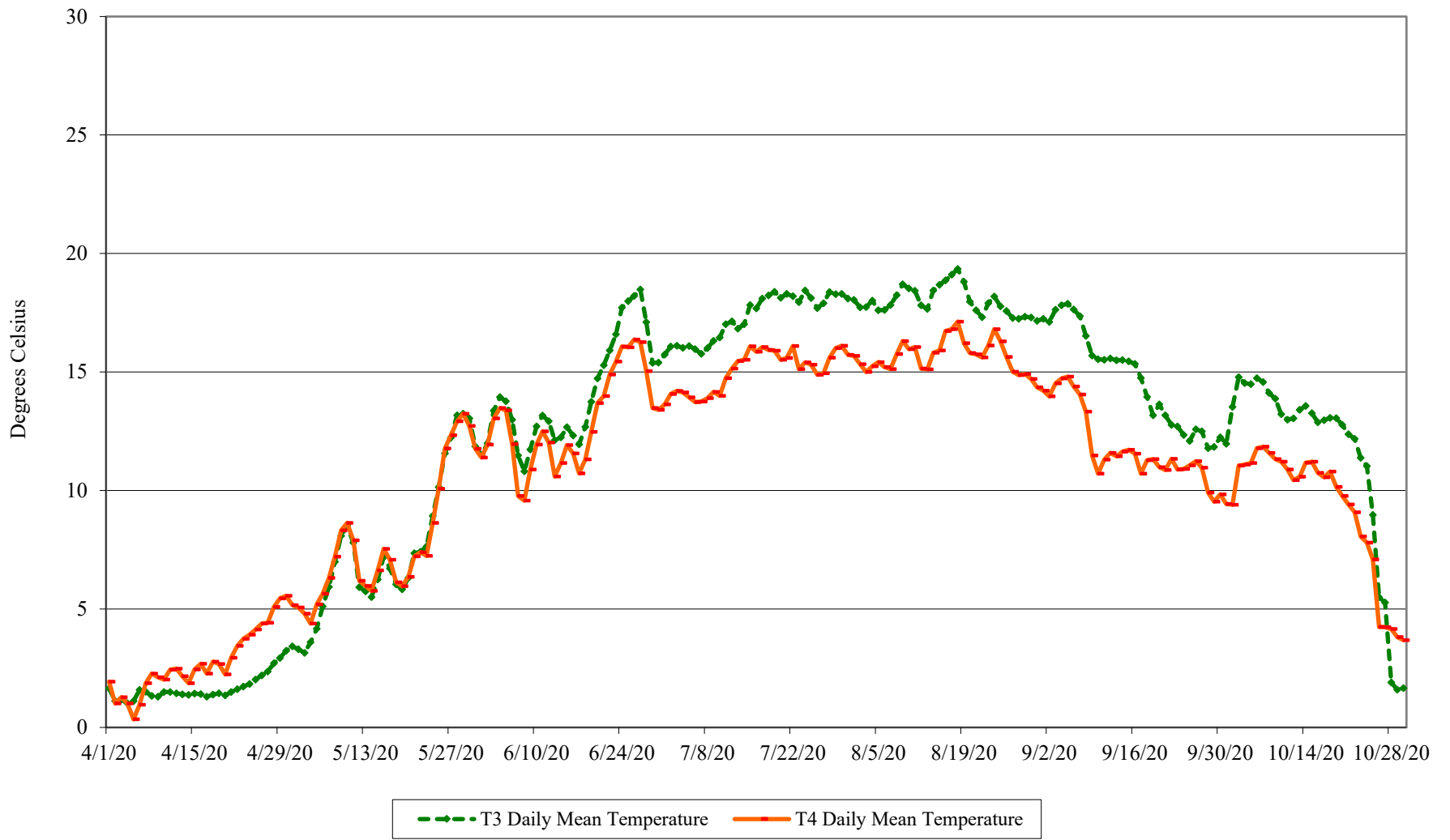


Figure 5. Daily Mean Temperature in Echo Creek at T3 & T4

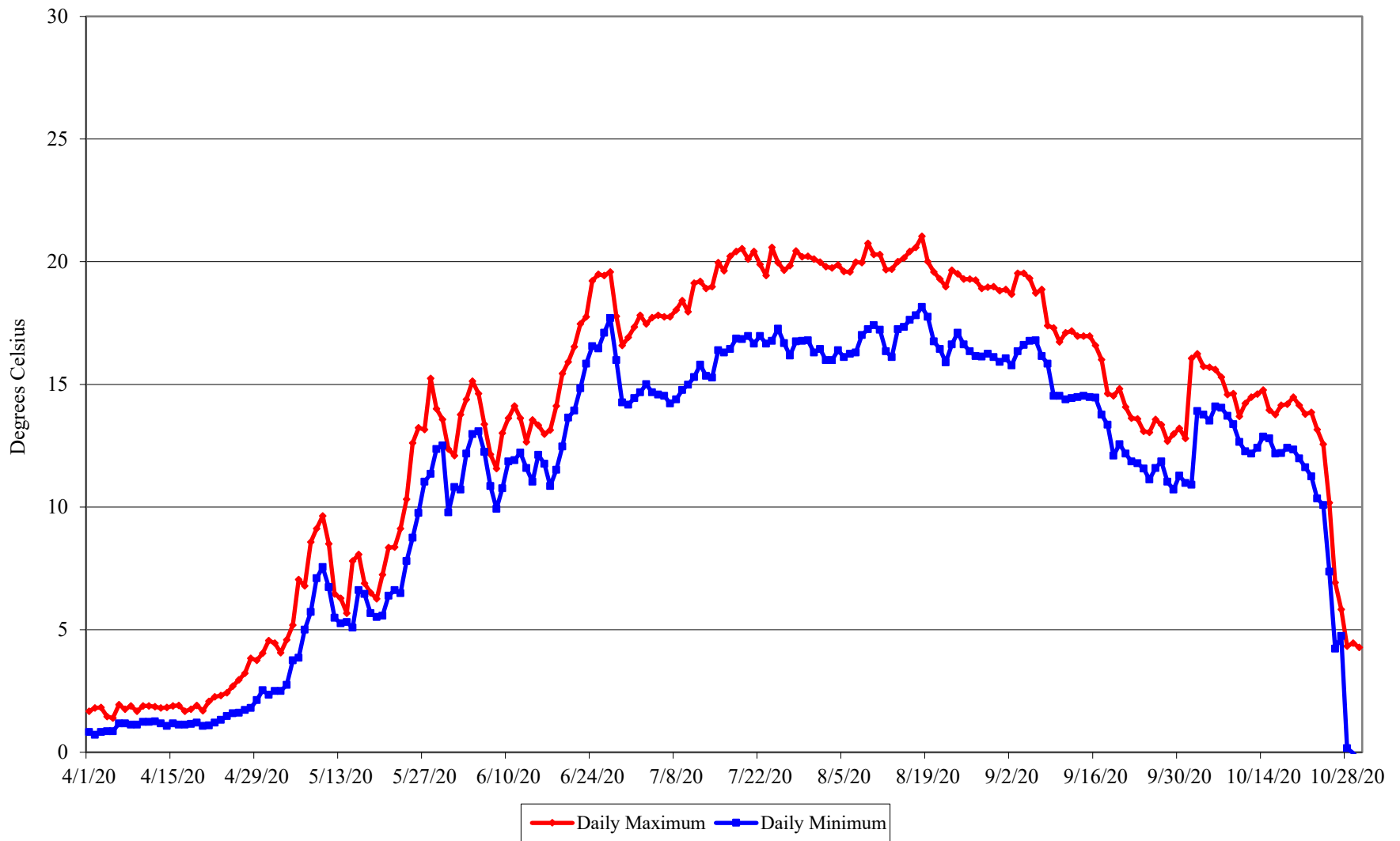


Figure 6. Daily Maximum and Minimum Water Temperatures Echo Creek downstream of dam , T3

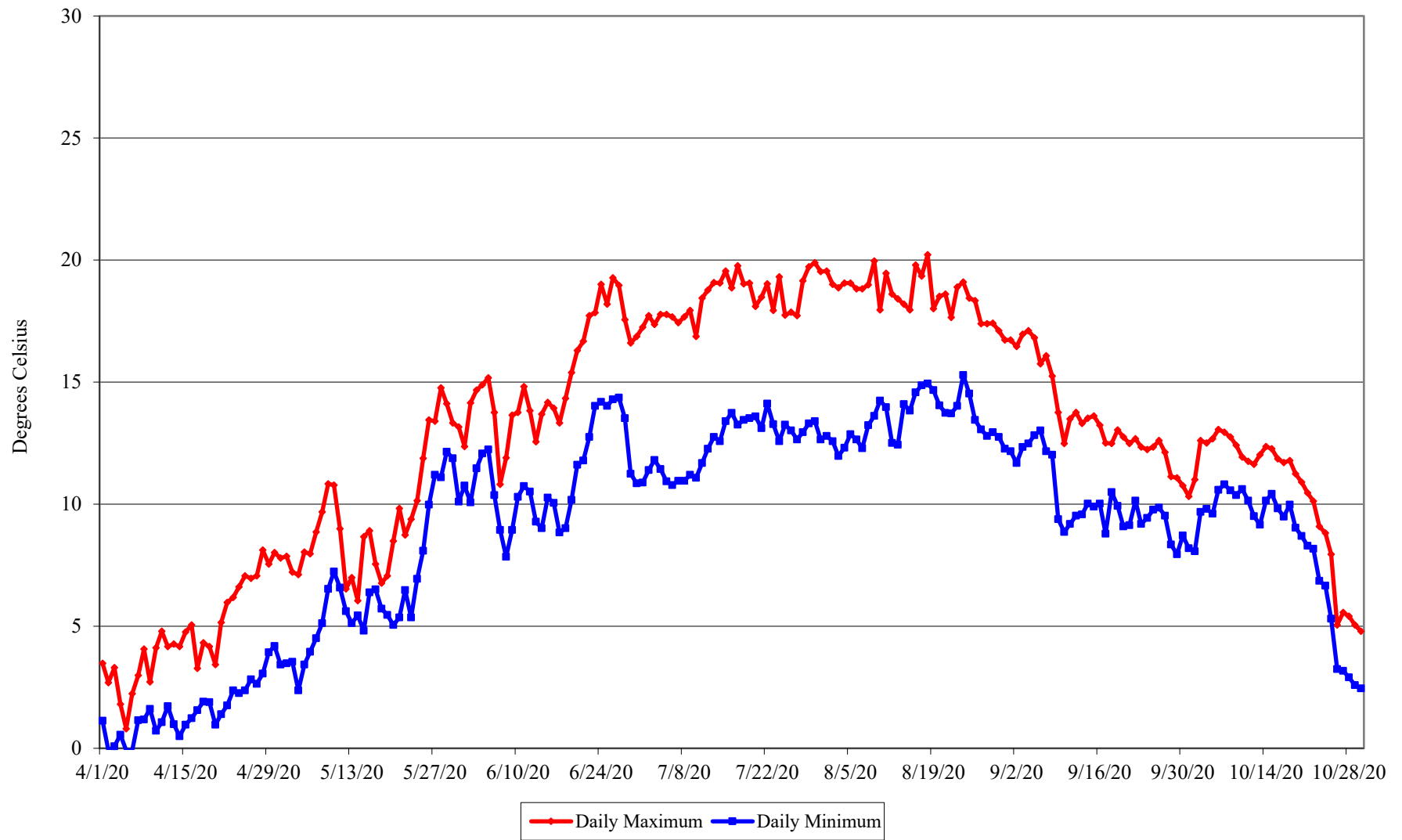


Figure 7. Daily Maximum and Minimum Water Temperatures in Echo Creek upstream of Upper Truckee R. T4

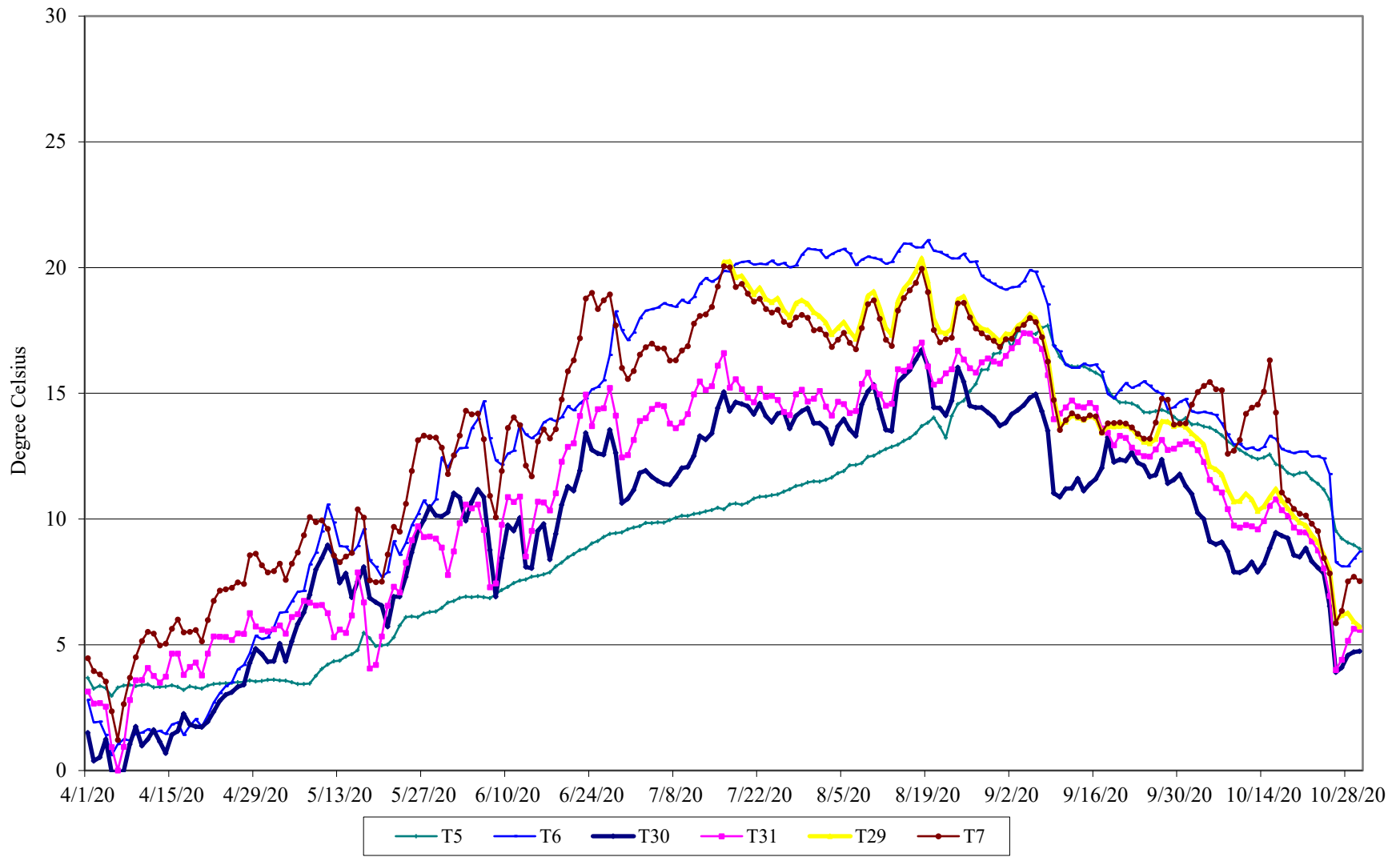


Figure 8. Daily Mean Temperature in Silver Fork of the American River and Caples Creek at T5, T6, T30, T29, T28, T27 and T7

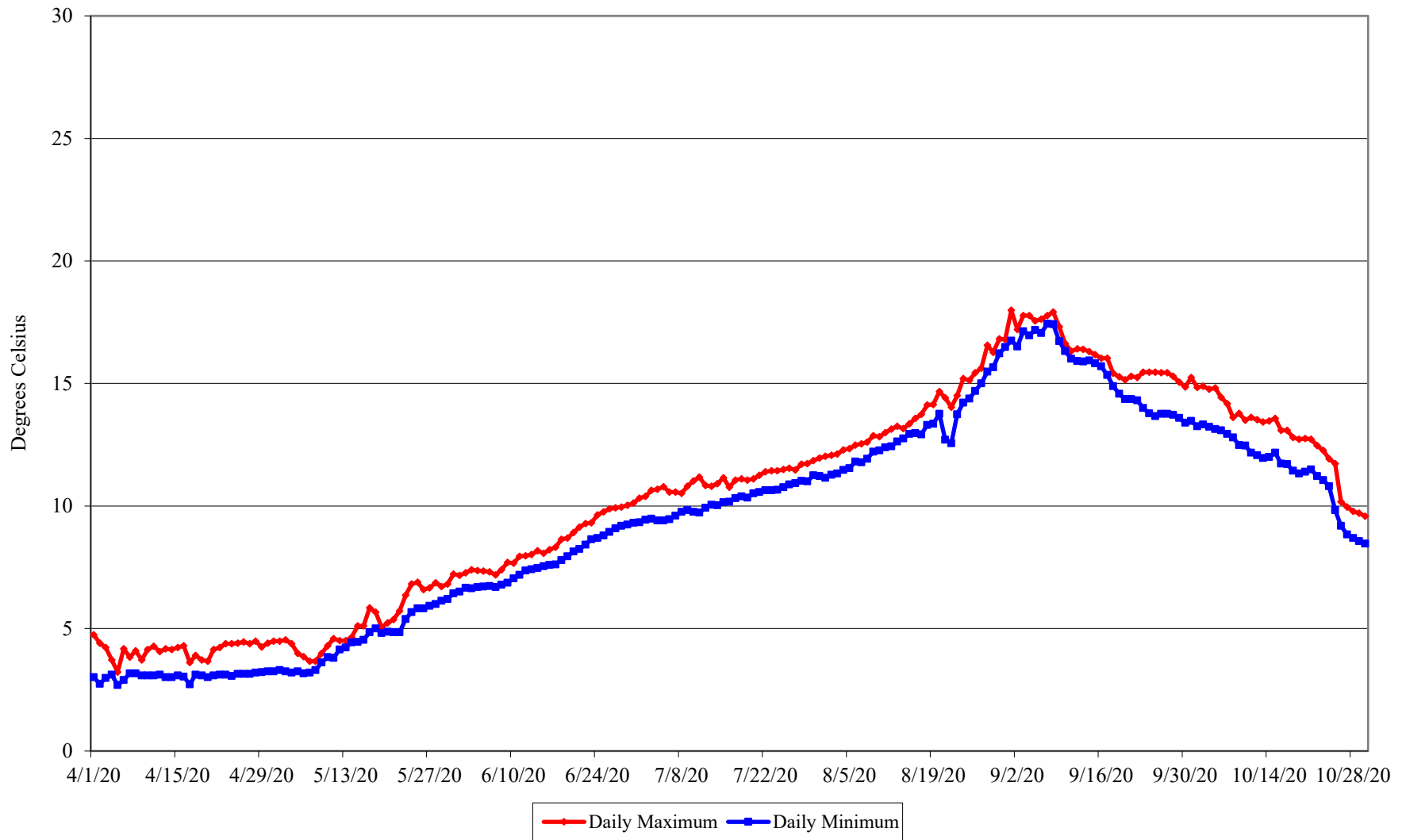


Figure 9. Daily Maximum and Minimum Water Temperatures in Caples Creek below Caples Lake T5

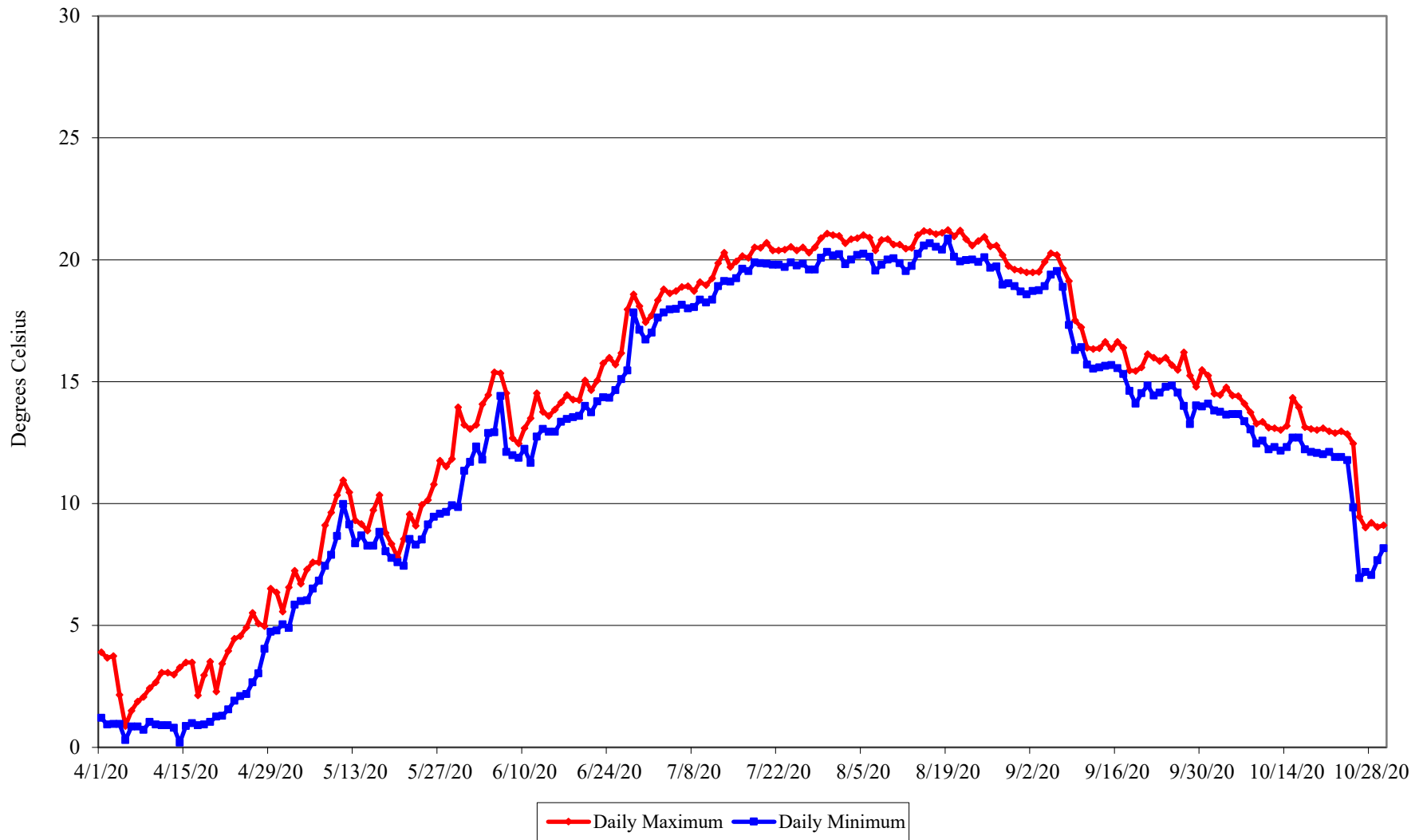


Figure 10. Daily Maximum and Minimum Water Temperatures in Silver Fork below Silver Lake T6

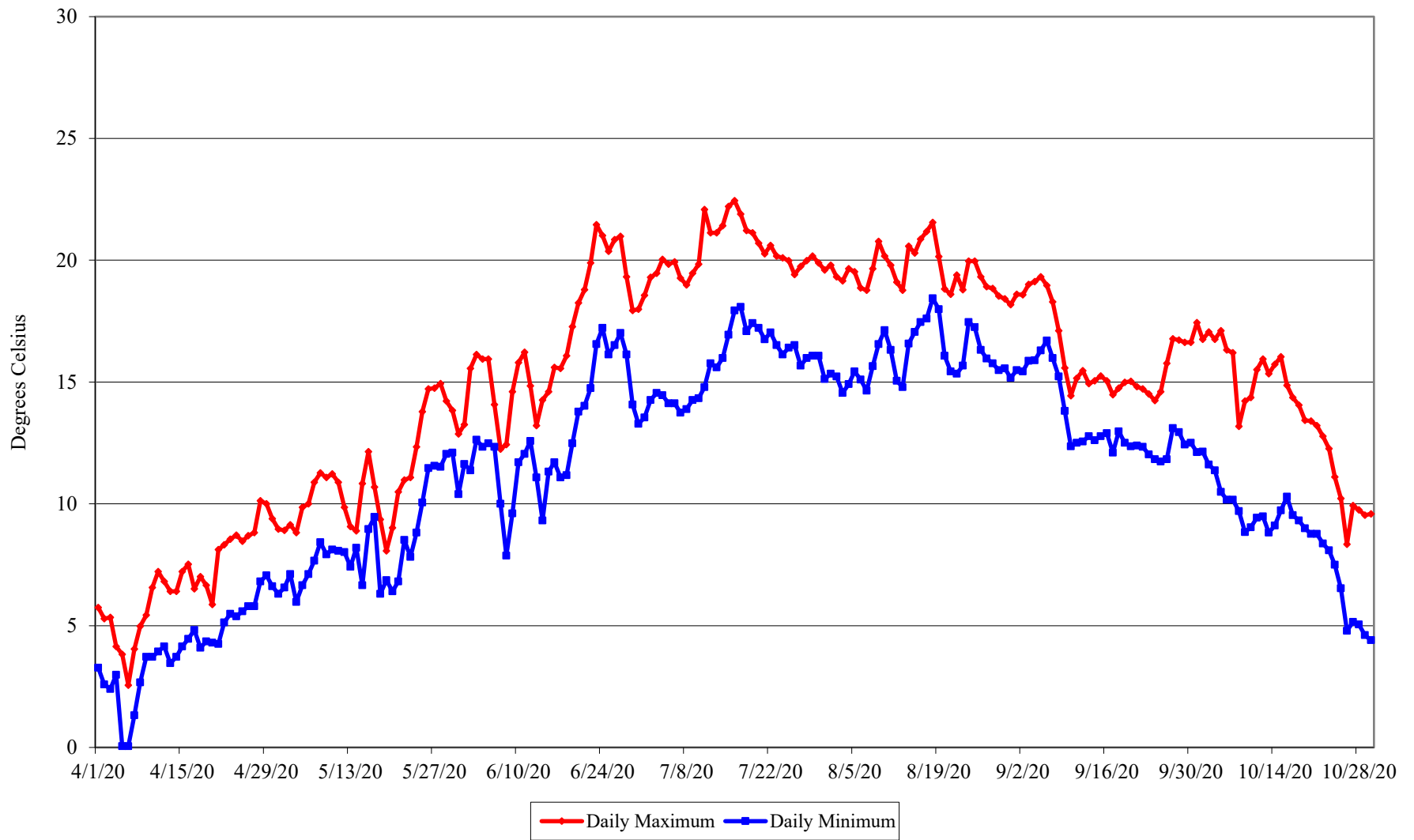


Figure 11. Daily Maximum and Minimum Water Temperatures in Silver Fork above SF American, T7

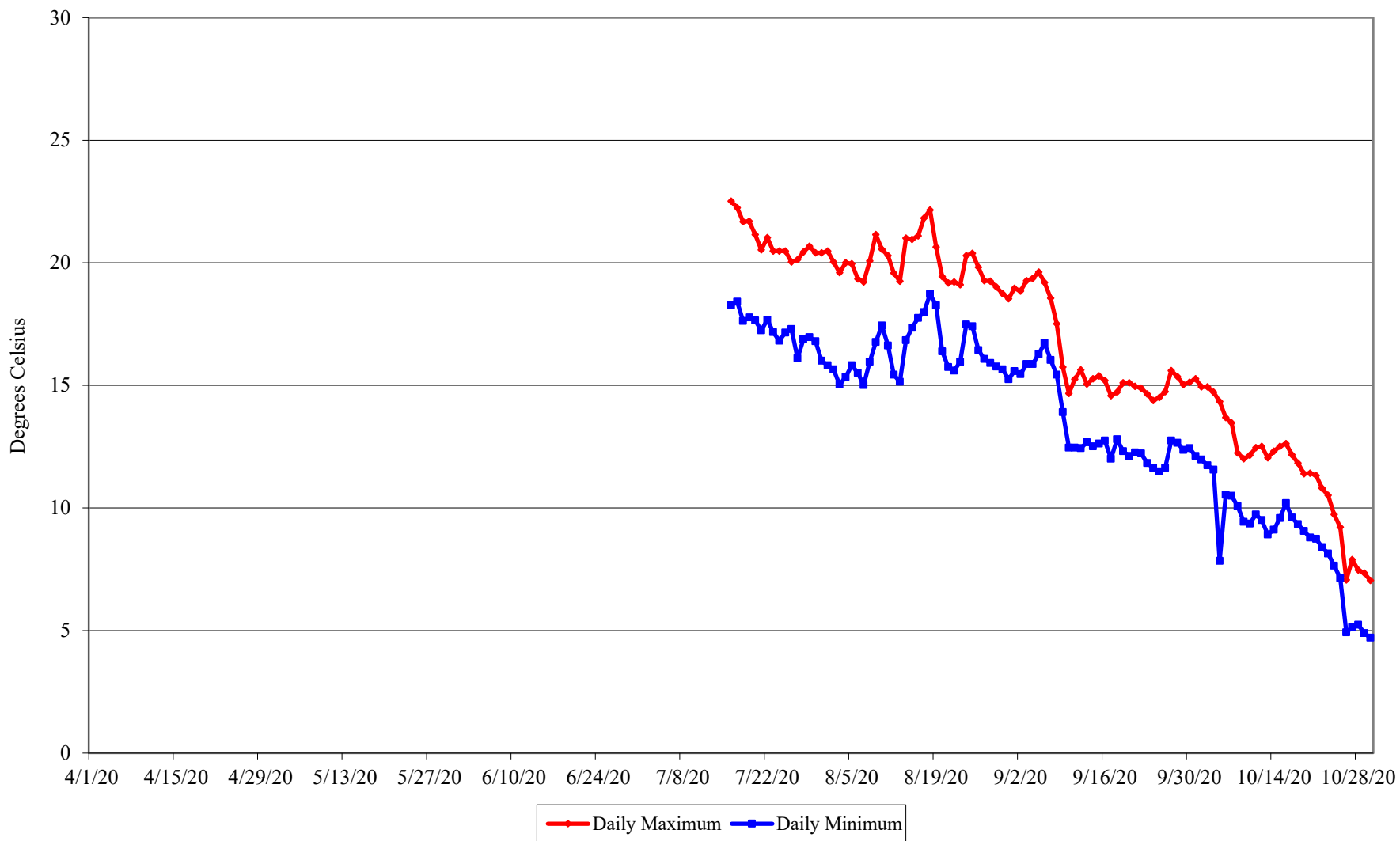


Figure 12. Daily Maximum and Minimum Water Temperatures in Silver Fork near Fitch Rantz Bridge, T29

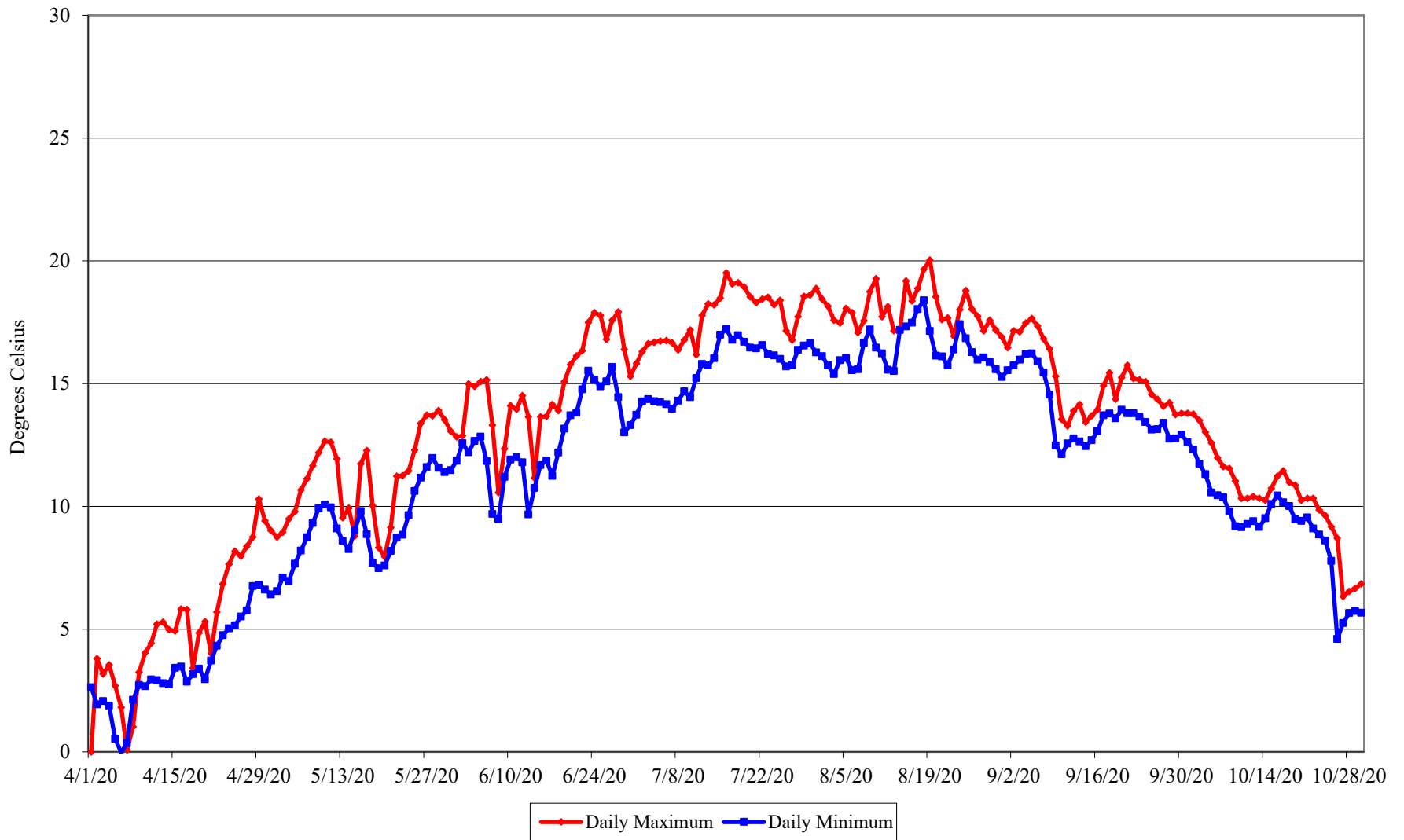


Figure 13. Daily Maximum and Minimum Water Temperatures in Silver Fork upstream of the confluence with Caples Creek, T30

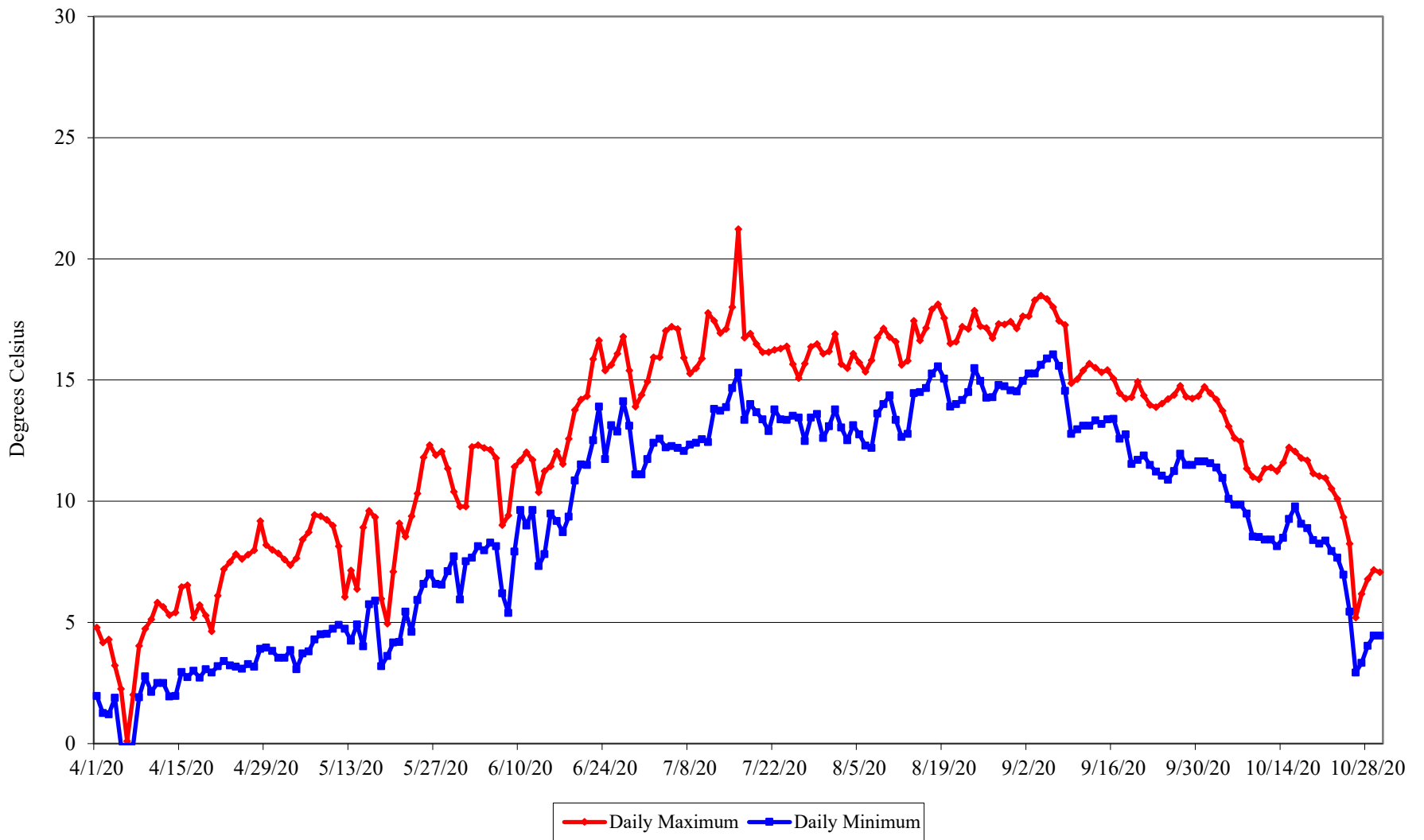


Figure 14. Daily Maximum and Minimum Water Temperatures Caples Creek upstream of the confluence with Silver Fork American River, T31

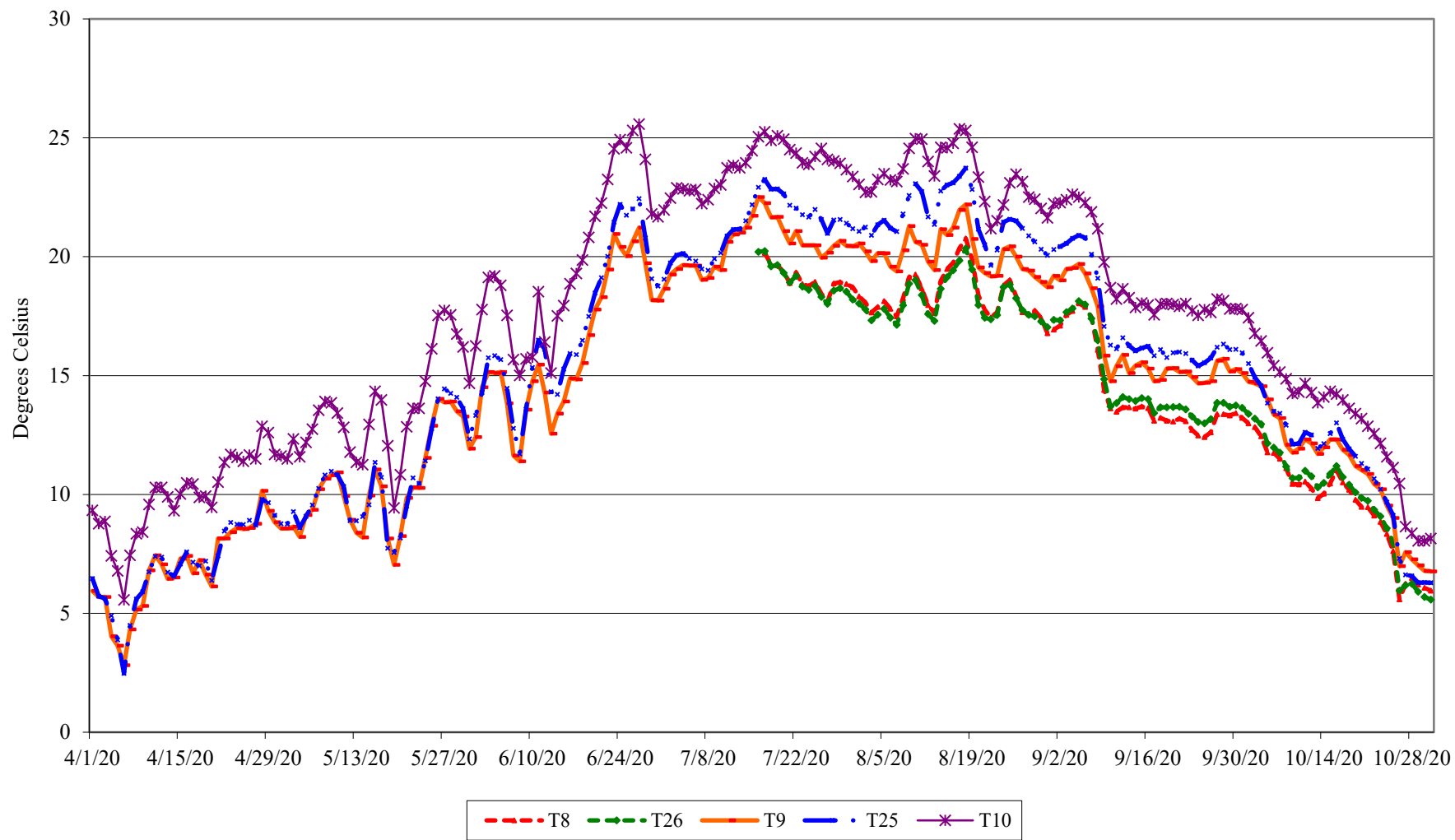


Figure 15. Daily Mean Temperature in the SF American River T8, T26, T9, T25, & T10

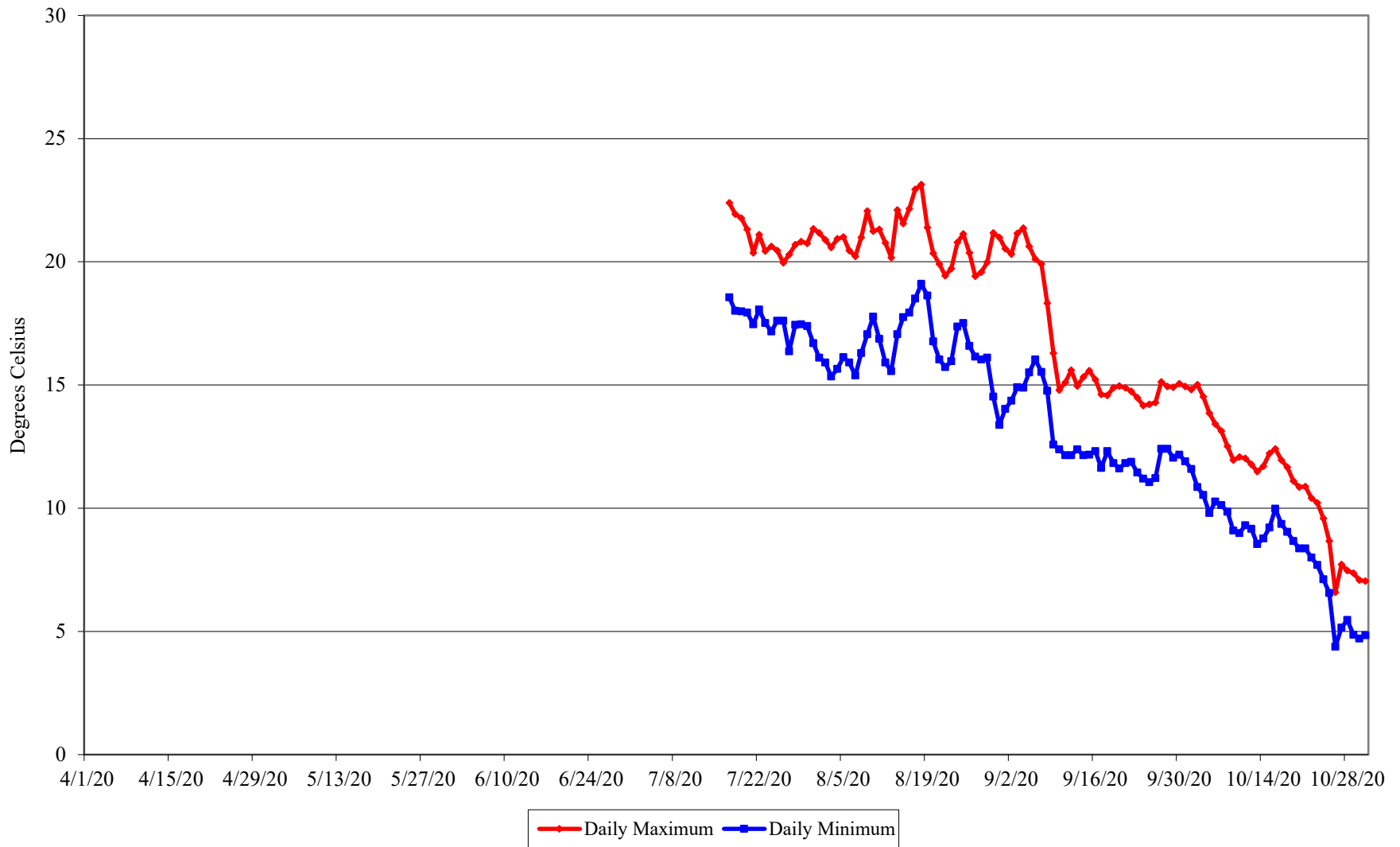


Figure 16. Daily Maximum and Minimum Water Temperatures in the SF American above Silver Fork, T8

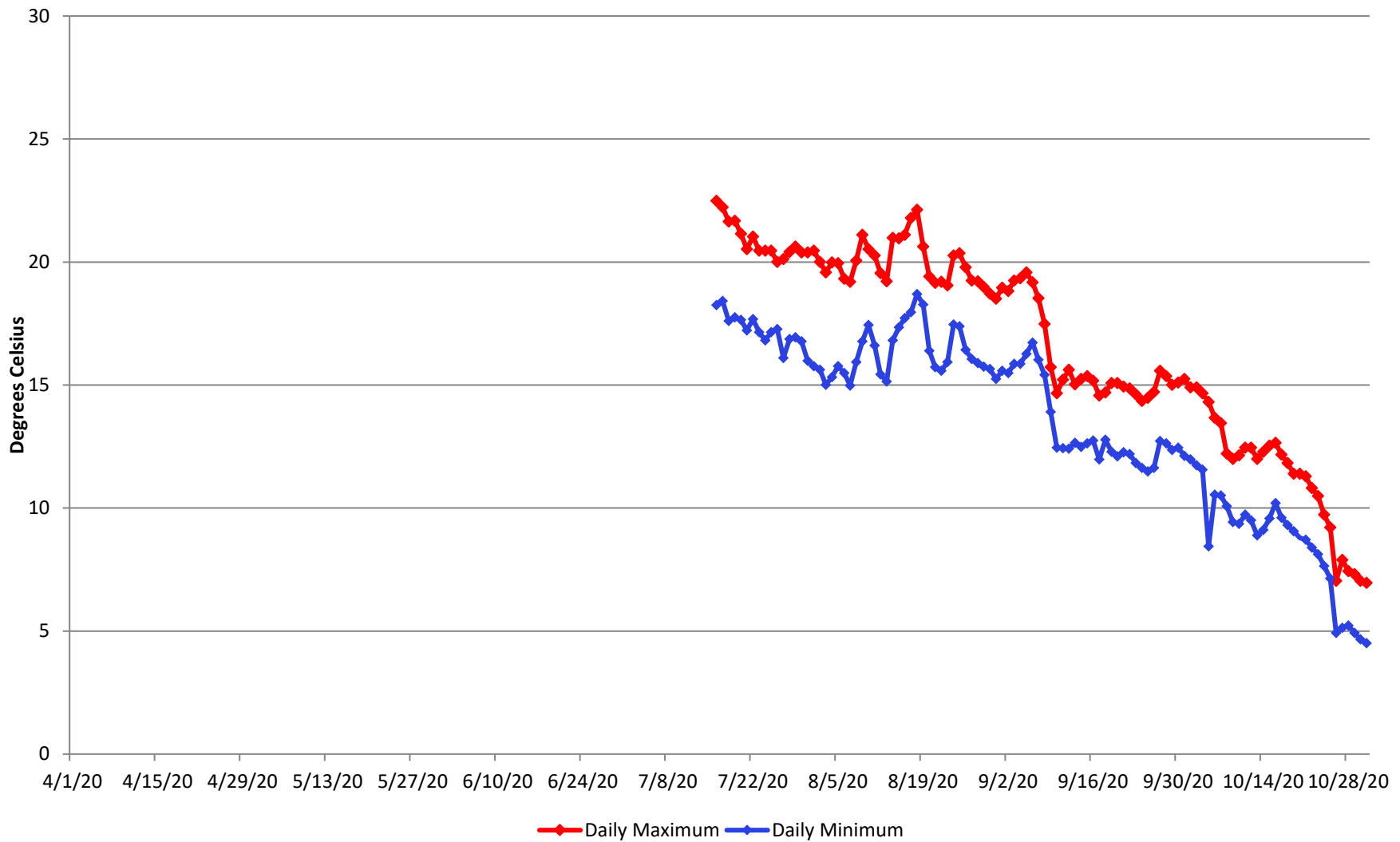


Figure 17. Daily Maximum and Minimum Water Temperatures in the SFAR above Kyburz Diversion, T26

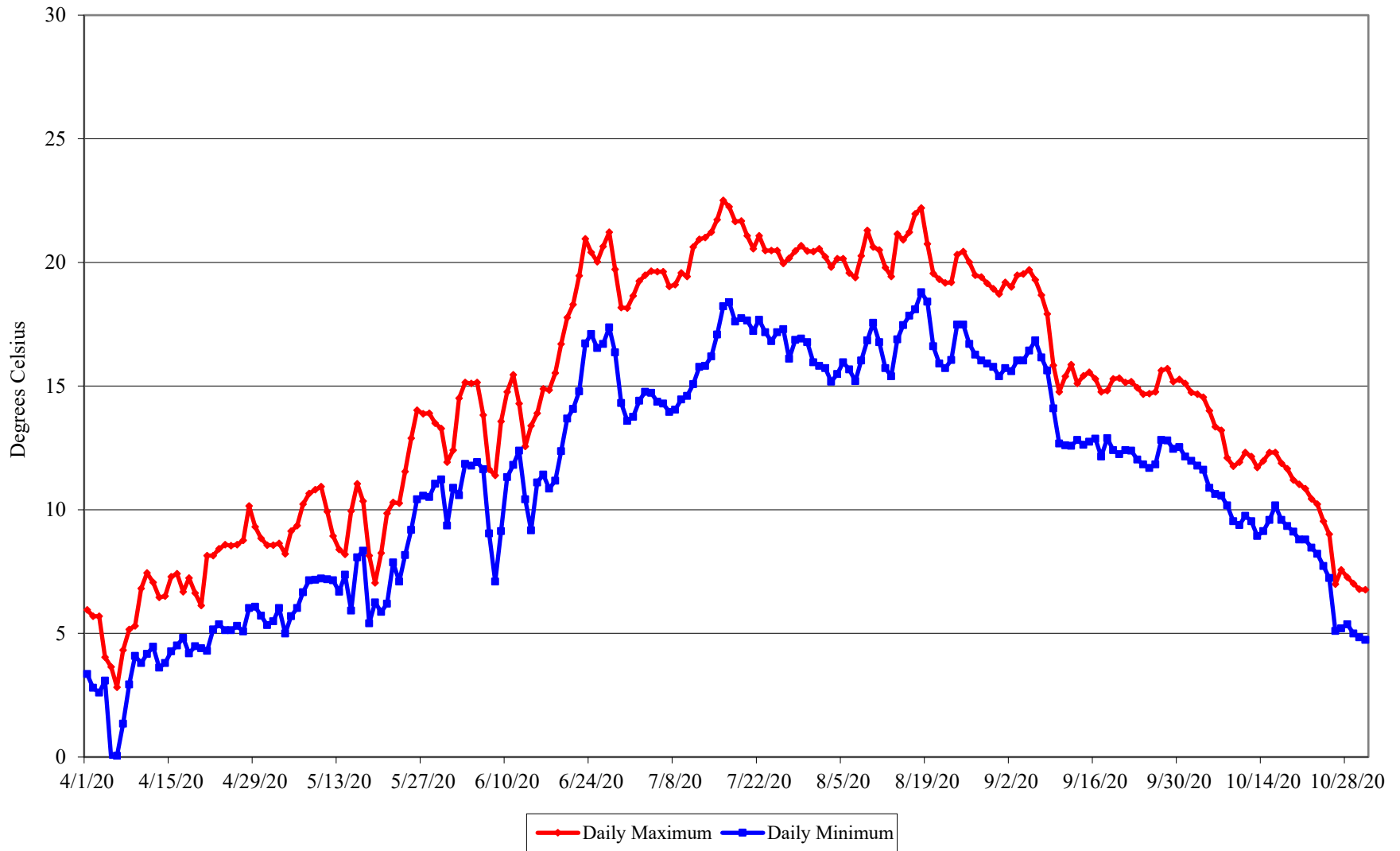


Figure 18. Daily Maximum and Minimum Water Temperatures in the SF American below Kyburz Diversion, T9

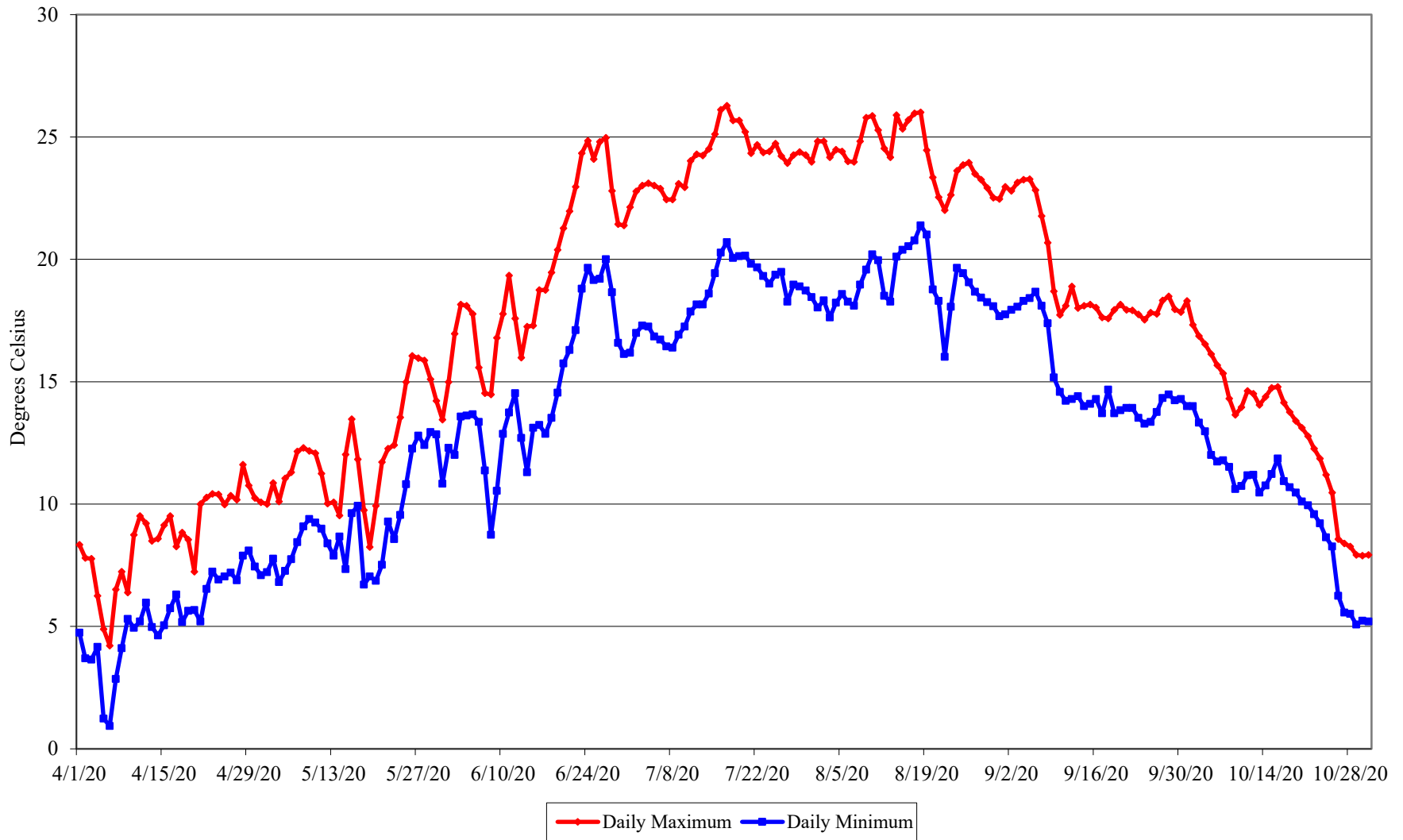


Figure 19. Daily Maximum and Minimum Water Temperatures in the SFAR at Bridalveil Picnic Area, T25

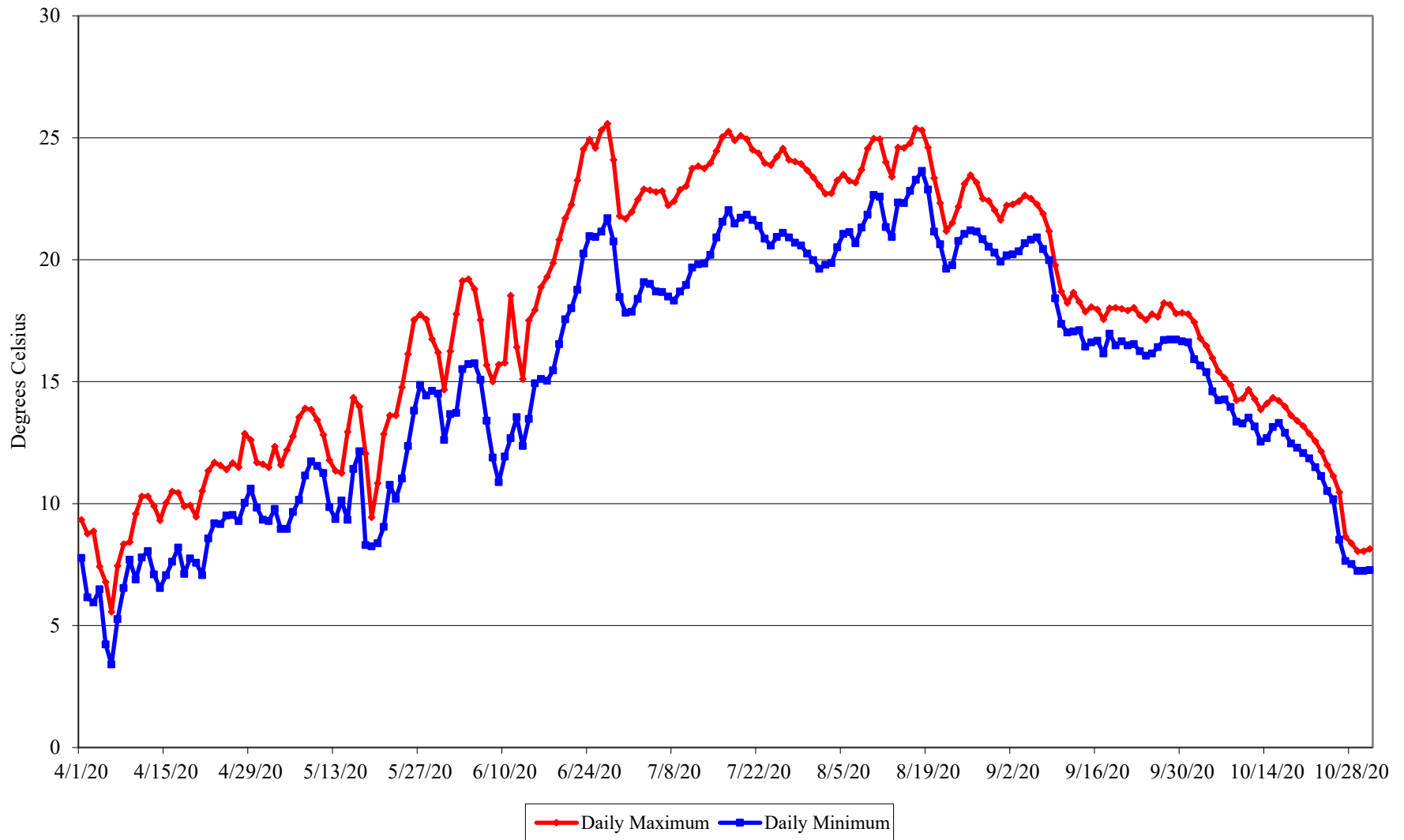


Figure 20. Daily Maximum and Minimum Water Temperatures in the SFAR at Akin Powerhouse, T10

Appendix B:

Spreadsheet data: 2020 Hourly, Daily Mean, Daily
Maximum, and Daily Minimum Water
Temperatures

[https://www.eid.org/our-services/hydroelectric/project-184/project-184-
document-library](https://www.eid.org/our-services/hydroelectric/project-184/project-184-document-library)