

Ozarks Environmental and Water Resources Institute (OEWRI)
Missouri State University (MSU)

Water Temperature Monitoring in the Big Barren Creek Watershed, Mark Twain National Forest, Southeast Missouri Water Years 2017-2021

UPDATED SUMMARY REPORT

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SUMMARY

This report summarizes the 2017-2021 Water Year (WY) water temperature results for the three stations that were installed in the Big Barren Creek watershed in 2016. The “Water Year” runs each year from October 1st to September 30th. Big Barren Creek is a tributary of the Current River Basin (8-digit Hydrological Unit Code (HUC) #11010008) located in portions of Ripley, Oregon, and Carter Counties in southeast Missouri (Figure 1). Most of the streams within the Big Barren Creek watershed are ephemeral due to the underlying mature karst landscape where sinkholes, losing streams, and caves are common (Imes, 2007; Weary et al., 2014). However, the monitoring sites at ANA and NAT are within, and just upstream of, the Big Barren Creek Natural Area (BBCNA). This area is perennial and has a relatively robust population of rare mussel species (Finley et al., 2015 Figure 2). The BBCNA has a series of bluff pools in an approximately 2 km stretch of Big Barren Creek that is hydrologically cutoff from the Current River located about 20 km downstream during base flow conditions. The LBB site is also perennial as is about 400 m downstream of Twin Springs and approximately 600 m upstream of the confluence with the Current River. Drainage areas range from 102.4-190.4 km² (Table 1).

Temperature data was recorded every 15-minutes using Onset Hobo UTBI-001 TidbiT v2 Water Temperature Loggers (Photos 4-11). The temperature loggers were installed inside a PVC pipe assembly and secured inside protective concrete housings at each site. The concrete housings were placed in the deepest part of the channel at each location and secured to a tree using coated steel wire. Raw data is downloaded approximately every 6 months using the Hobo Waterproof Shuttle. There was a total of 1,826 days of records collected at these three gages that were installed prior to WY2017 in September 2016 (Table 1).

Water temperatures in the Natural Area were more variable than the site in the lower watershed over the last five years suggesting discharge from Twin Springs is moderating water temperature throughout the year. At ANA, water temperature ranged from 2.69-26.18 °C with a median of 13.95 °C (Table 2). Temperature readings at NAT were slightly lower with a similar range between 1.83-24.03 °C, but the median was similar at 14.00 °C. Water temperatures at these sites tend to follow seasonal air temperature trends. However, at LBB temperature ranged from 4.04-20.06 °C with a median of 14.19 °C. This suggests the upstream sites are more connected to the shallow groundwater while the lower site is likely receiving more water from a deeper source that surfaces at Twin Springs during base flow that is more similar to water temperature trends at Big Spring (Imes, 2007). However, unlike at Big Spring, water at LBB mixes with water from the main channel during, and immediately, after storms that can increase the seasonal variability at this site.

References

Finely, J.M., A.D. Roberts, J. Hundley, J. Smith, and B.R. Simmons (2015) A Freshwater Mussel Survey of Big Barren Creek Natural Area Carter County, Missouri. U.S. Fish and Wildlife Service.

Imes, J.L., L.N. Plummer, M.J. Kleeschulte, and J.G. Schumacher (2007) Recharge Area, Base-Flow and Quick-Flow Discharge Rates and Ages, and General Water Quality of Big Spring in Carter County, Missouri, 2000-04. U.S. Geological Survey Scientific Investigations Report 2007-5049.

Weary, D.J., R.W. Harrison, R.C. Orndorff, R.E. Weems, J.S. Schindler, J.E. Repetski, and H.A. Pierce (2014) Bedrock Geologic Map of the Spring Valley, West Plains, and Parts of the Piedmont and Poplar Bluff 30'x60' Quadrangles, Missouri, Including the Upper Current River and Eleven Point River Drainage Basins. U.S. Geological Survey Scientific Investigations Map 3280.

TABLES

Table 1. Temperature monitoring station locations in the Big Barren Creek watershed.

Site Name	ID	Northing (m) NAD83,UTM15N	Easting (m) NAD83,UTM15N	Ad (km ²)	Elevation (m)	River-km	Start Record	End Record
Above Natural Area	ANA	4,080,909.826	672,147.052	102.4	167.6	22.3	10/1/2016	9/30/2021
Natural Area	NAT	4,080,190.904	672,499.745	103.5	163.3	20.9	10/1/2016	9/30/2021
Lower Big Barren	LBB	4,072,136.969	682,912.238	190.4	112.1	0.6	10/1/2016	9/30/2021

Table 2. WY2017-WY2021 Big Barren Creek watershed temperature monitoring station data summary.

Site Name	ID	% Exceedance Temperature (°C)										
		Min	10%	20%	30%	40%	50%	60%	70%	80%	90%	Max
Above Natural Area	ANA	2.69	8.57	9.78	10.98	12.32	13.95	15.89	17.80	19.48	20.98	26.18
Natural Area	NAT	1.83	8.12	9.39	10.71	12.32	14.00	16.08	18.25	19.67	20.65	24.03
Lower Big Barren	LBB	4.04	11.39	12.34	12.97	13.55	14.19	14.65	14.96	15.46	16.34	20.06

FIGURES

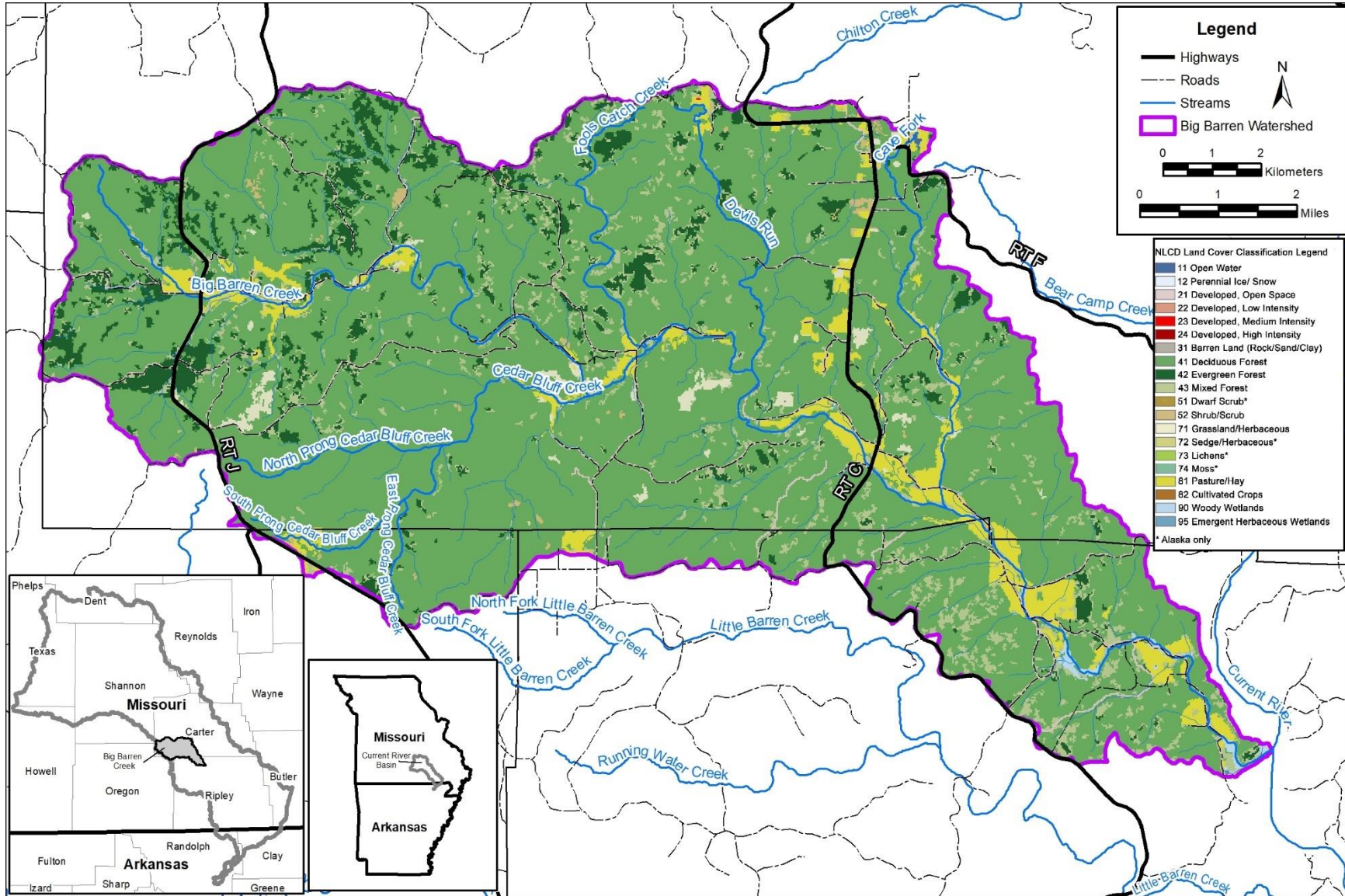
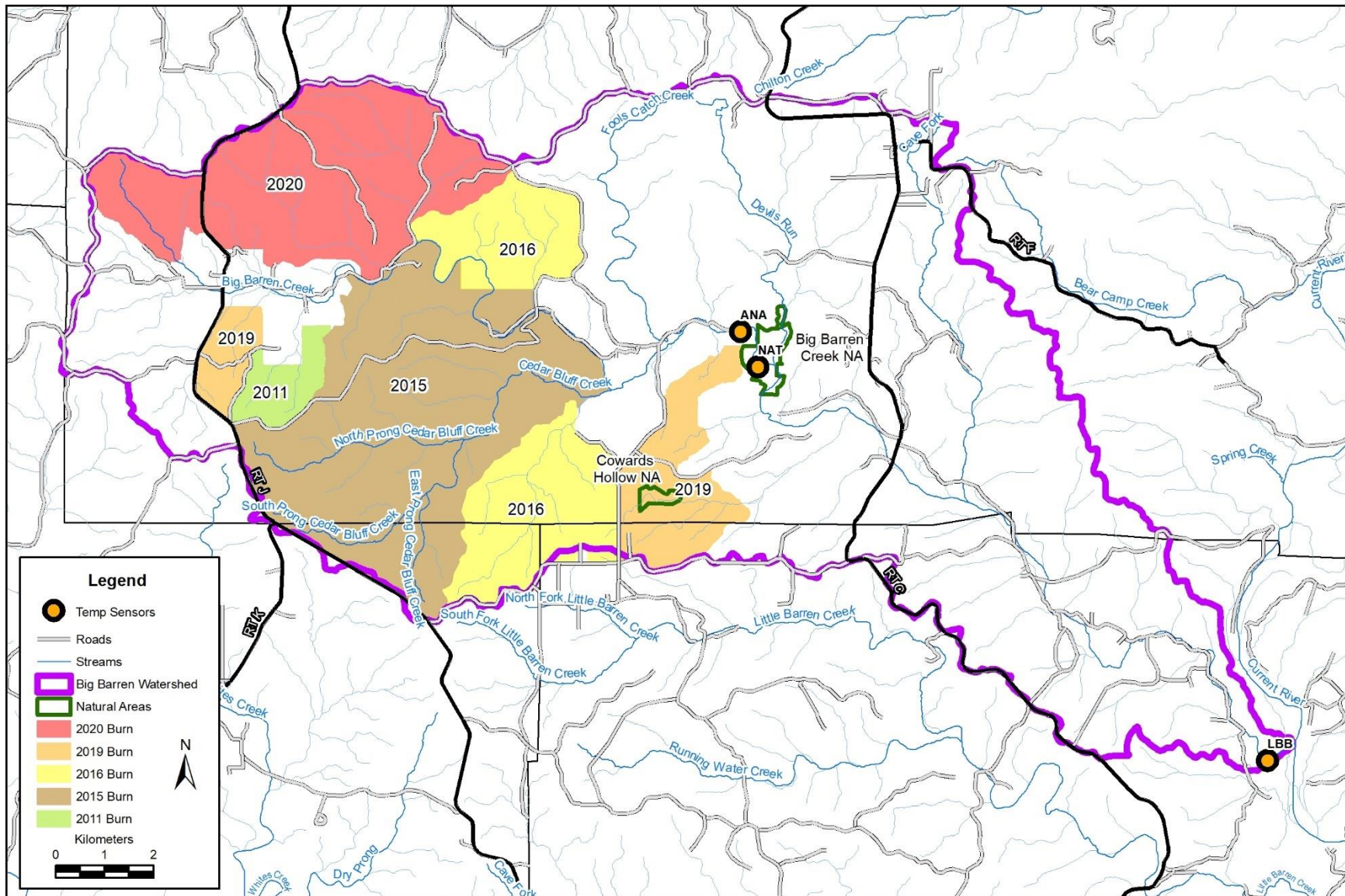


Figure 1. Location and land use of the Big Barren Creek watershed.



MONITORING STATION INFORMATION

Above Natural Area (102.4 km²)

Site Name:	Above Natural Area
Site ID:	ANA
Location Description:	Monitoring station is located approximately 100 m upstream of County Road C-167 crossing on the main stem of Big Barren Creek in Carter County



Photo 1. Looking upstream at monitoring site ANA (April 14, 2021).

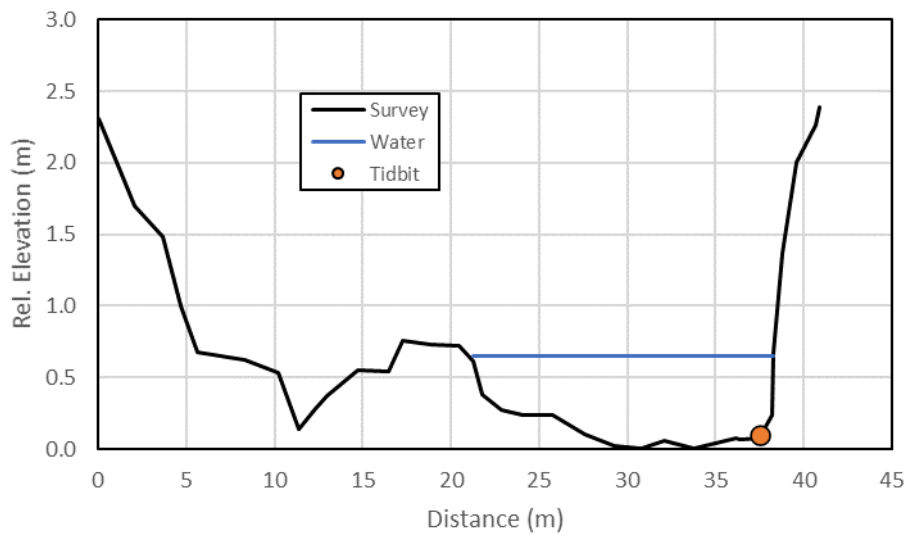


Figure 3. ANA cross-section and Tidbit location looking downstream.

Natural Area (103.5 km²)

Site Name:	Natural Area Temperature
Site ID:	NAT
Location Description:	Monitoring station is located approximately 1.3 km downstream of County Road C-167 crossing on the main stem of Big Barren Creek in Carter County



Photo 2. Looking upstream at monitoring station NAT (April 14, 2021).

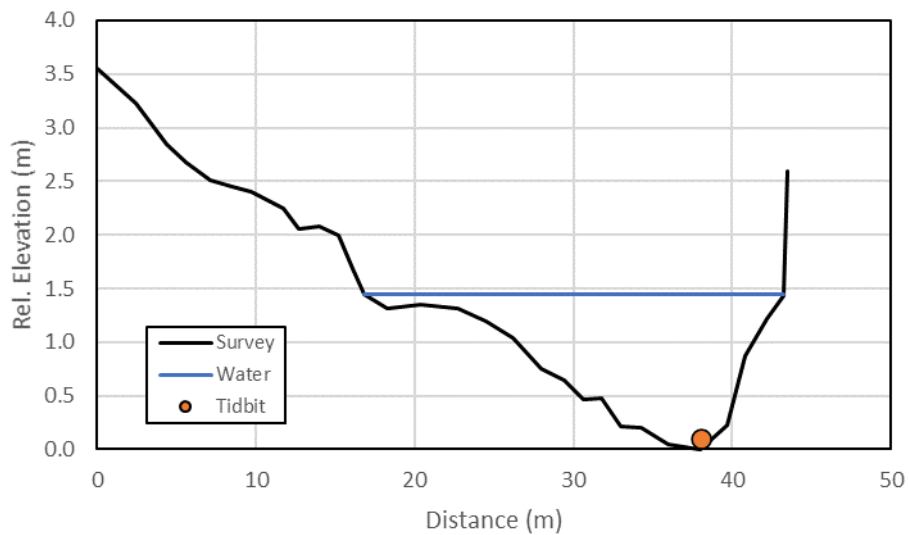


Figure 4. NAT cross-section and Tidbit location looking downstream.

Lower Big Barren Creek (190.4 km²)

Site Name:	Lower Big Barren
Site ID:	LBB
Location Description:	Monitoring station is located approximately 600 m upstream of the confluence on the main stem of Big Barren Creek and Current River in Ripley County

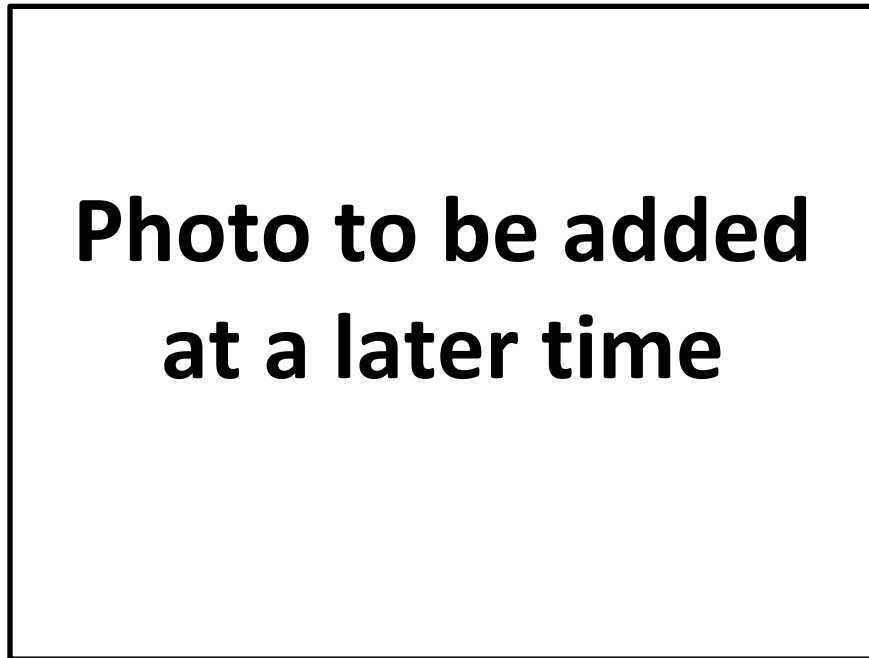


Photo 3. Looking upstream at monitoring station LBB.

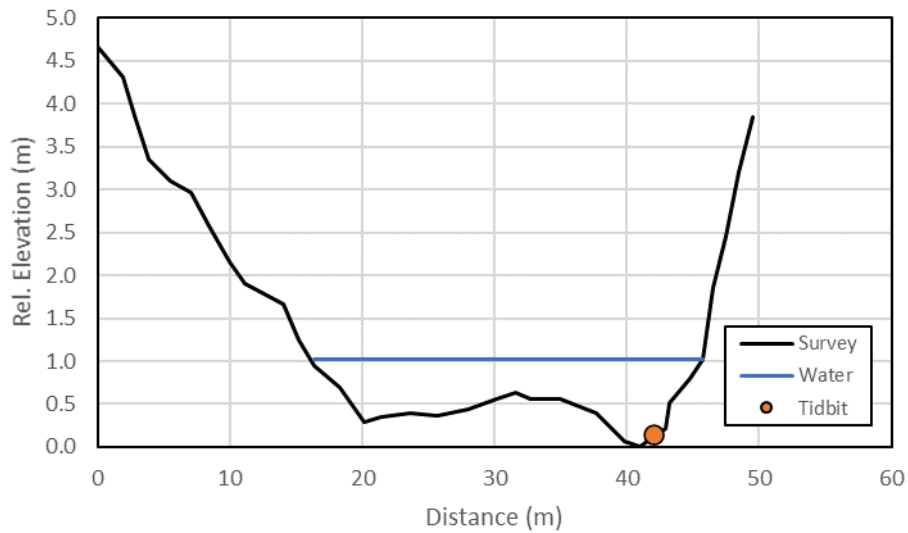


Figure 5. LBB cross-section and Tidbit location.

WATER YEAR 2017

Above Natural Area:

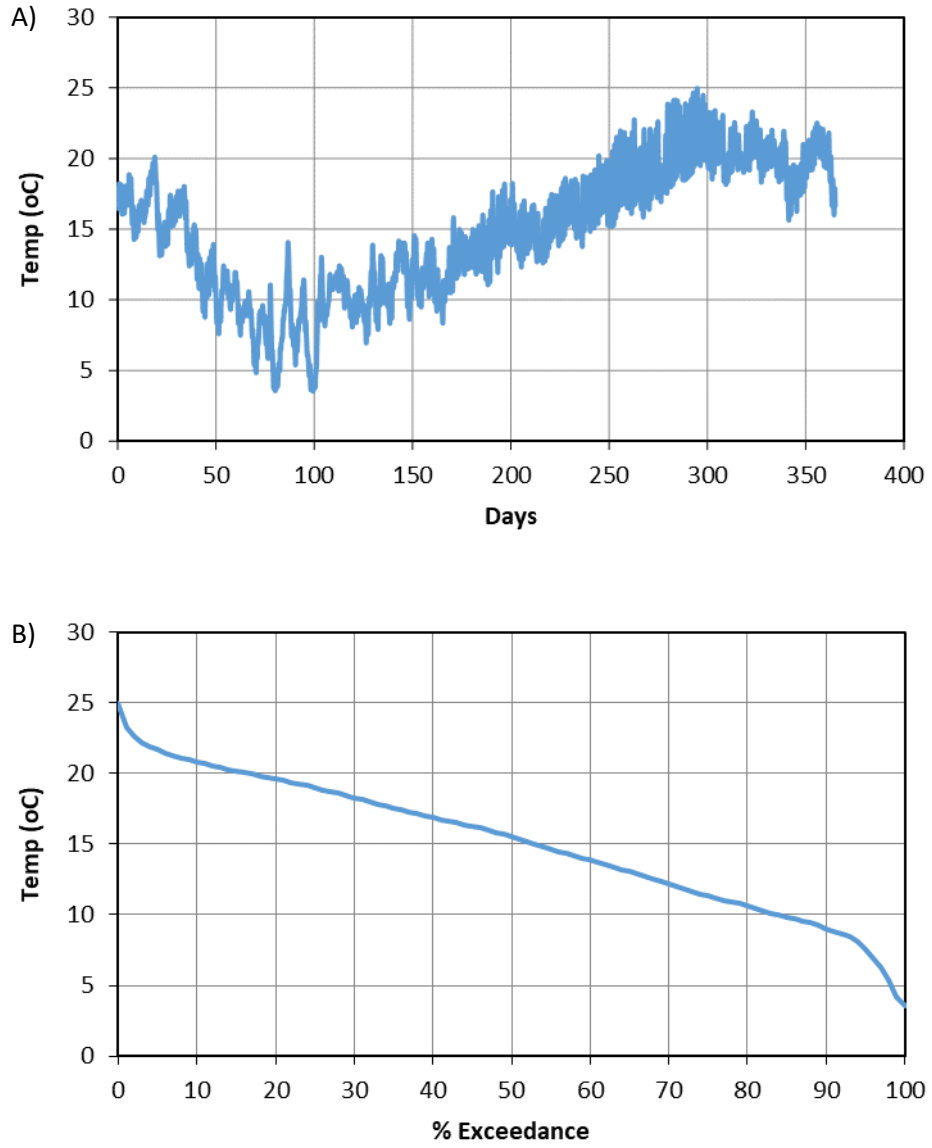


Figure 6. WY2017 A) 15-min temp data and B) annual temp duration curve for ANA.

Table 3. Daily Mean Water Temperature (°C) for WY 2017 at ANA station.

Day	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017
1	17.4	16.8	9.2	8.6	10.0	13.8	13.1	13.9	17.0	19.6	21.0	19.5
2	17.3	16.9	8.4	9.6	9.6	11.3	13.6	14.2	17.5	20.0	21.2	19.7
3	17.0	17.3	8.8	11.0	9.0	10.7	13.8	14.0	17.4	18.8	21.3	19.8
4	17.1	16.5	9.5	8.5	7.8	10.9	14.0	13.0	17.5	18.3	21.3	20.6
5	17.1	14.3	9.5	6.3	8.7	11.2	13.7	13.8	17.4	18.5	19.4	20.8
6	17.7	13.3	10.0	5.0	10.4	11.9	13.1	14.4	17.9	19.2	18.6	18.4
7	17.9	13.3	9.2	4.0	12.7	13.2	13.2	14.7	17.4	20.5	19.1	17.4
8	16.2	14.6	7.8	3.8	11.8	11.9	13.7	15.2	17.4	21.1	20.3	17.7
9	15.3	14.5	6.2	4.2	9.3	12.4	15.0	15.7	17.6	20.9	20.7	18.4
10	15.4	12.6	5.5	7.6	9.0	12.4	14.7	15.7	17.9	21.1	21.2	18.3
11	15.8	11.8	7.1	9.2	11.0	10.4	14.4	15.9	18.4	21.4	20.6	17.9
12	16.4	11.7	8.9	12.0	12.3	10.6	14.4	15.3	18.3	21.4	20.5	17.9
13	16.2	10.4	9.0	9.8	10.3	10.2	15.0	15.5	19.0	21.4	20.1	18.4
14	15.7	10.0	8.6	8.6	10.1	9.9	15.5	15.9	19.0	21.0	19.7	19.2
15	16.8	11.3	7.4	9.2	10.3	9.8	15.9	16.1	19.0	20.6	19.5	19.4
16	17.5	11.5	6.3	10.4	9.5	10.5	15.5	16.4	18.0	21.1	20.5	20.0
17	18.2	12.2	8.9	11.2	10.1	11.2	14.6	16.2	18.6	20.9	21.1	20.3
18	18.9	13.2	6.6	11.0	11.3	12.1	15.2	16.4	18.2	21.2	20.9	20.1
19	19.3	11.4	4.3	11.3	12.3	11.5	15.9	16.6	18.7	21.5	21.6	20.4
20	18.6	9.4	3.9	11.7	13.0	13.0	15.8	16.3	19.5	21.8	21.3	21.0
21	15.7	8.6	4.5	11.5	13.5	13.2	14.6	16.5	18.9	22.1	21.4	21.6
22	14.1	9.3	5.7	11.9	13.4	12.8	13.5	16.1	18.3	22.4	21.4	21.4
23	14.2	11.2	7.2	11.2	13.1	13.3	14.2	15.8	18.9	22.2	20.6	21.3
24	14.7	11.4	8.9	10.4	13.1	13.7	14.3	15.5	18.6	21.8	20.0	20.9
25	14.6	11.3	10.1	10.9	10.5	13.2	14.8	16.0	18.9	22.1	20.0	20.4
26	15.0	10.6	12.9	10.0	9.6	12.9	14.5	15.9	18.3	22.2	20.3	20.5
27	16.5	9.8	10.8	9.3	11.3	12.7	14.5	16.8	18.6	20.7	20.5	20.4
28	16.1	10.5	8.1	9.0	13.3	13.0	14.1	16.4	19.2	21.0	20.7	19.3
29	16.2	11.3	7.4	9.9		13.3	15.2	16.8	19.3	21.1	20.6	17.7
30	16.5	11.0	6.4	9.5		13.8	16.2	16.9	19.2	20.8	20.6	16.9
31	17.0		7.1	9.9		13.0		17.0		21.2	20.1	
Mean	16.5	12.3	7.9	9.2	10.9	12.1	14.5	15.6	18.3	20.9	20.5	19.5
Max	19.3	17.3	12.9	12.0	13.5	13.8	16.2	17.0	19.5	22.4	21.6	21.6
Min	14.1	8.6	3.9	3.8	7.8	9.8	13.1	13.0	17.0	18.3	18.6	16.9

Natural Area:

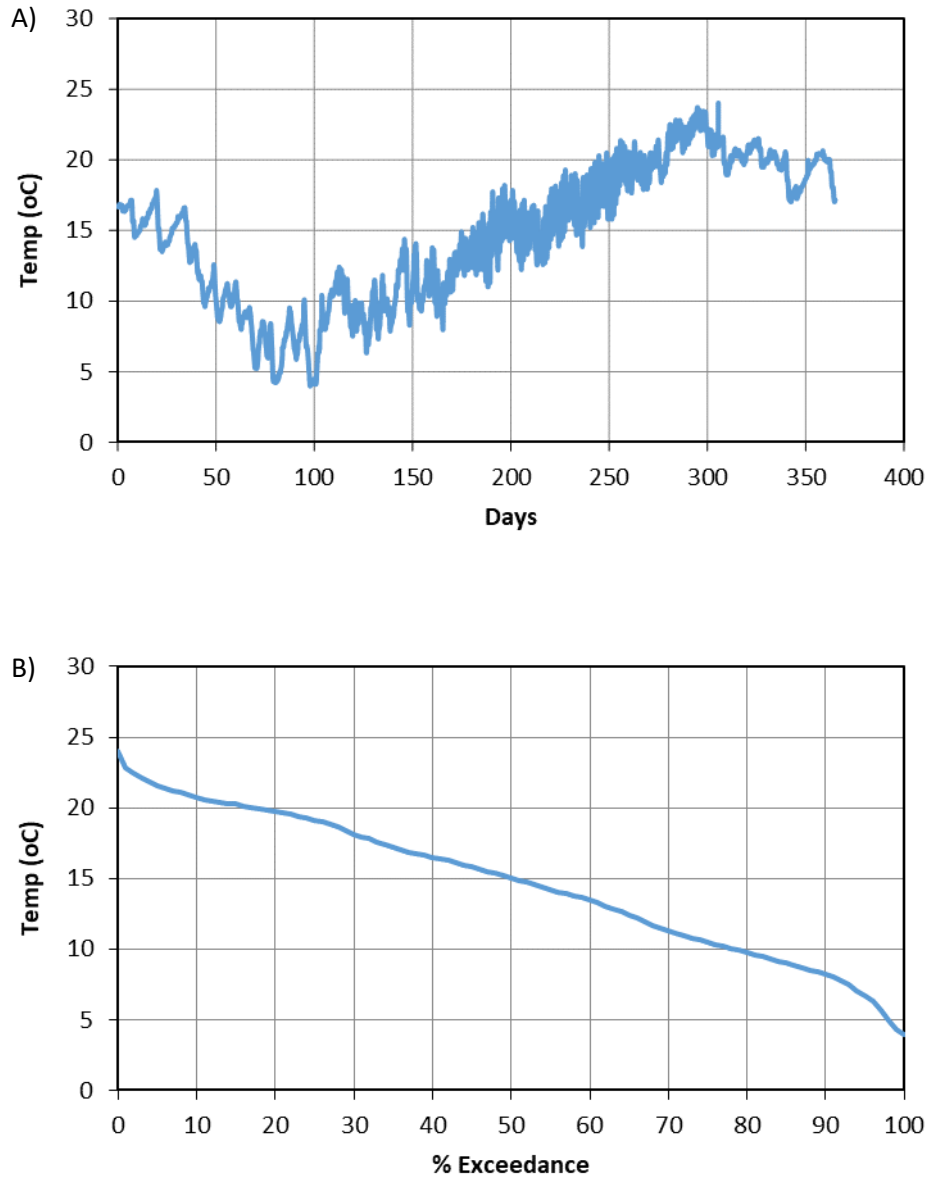


Figure 7. WY2017 A) 15-min temp data and B) annual temp duration curve for NAT.

Table 4. Daily Mean Temperature (°C) for WY 2017 at the NAT Temp Gage.

Day	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017
1	16.74	15.96	9.24	7.40	9.35	13.55	13.18	13.94	17.58	20.16	21.32	19.82
2	16.78	16.11	8.28	8.03	9.17	11.02	13.84	14.32	17.91	20.41	21.35	19.51
3	16.57	16.40	8.60	8.94	8.33	9.96	14.11	14.11	18.16	20.19	21.37	19.40
4	16.44	16.10	9.09	8.15	7.20	9.76	14.19	13.05	18.19	18.86	21.40	19.79
5	16.59	14.54	8.97	6.54	7.26	10.40	14.02	13.94	18.03	19.15	20.23	20.34
6	16.79	13.16	9.29	4.80	8.51	11.28	13.07	14.56	18.40	19.52	19.19	19.07
7	16.99	13.05	9.07	4.17	10.16	12.47	13.24	14.87	17.96	20.53	19.11	17.56
8	16.23	13.59	7.49	4.25	11.00	11.09	13.80	15.53	17.91	21.69	19.81	17.21
9	14.98	13.77	5.89	4.18	8.91	11.37	15.34	16.11	17.96	21.54	20.16	17.56
10	14.73	12.52	5.35	5.43	7.92	12.57	15.15	16.14	18.29	21.65	20.45	17.93
11	14.87	11.70	6.23	6.84	8.86	10.51	14.77	16.47	18.90	22.05	20.63	17.51
12	15.15	11.55	7.53	8.32	10.82	10.35	14.59	15.53	19.04	22.04	20.52	17.72
13	15.58	10.39	8.22	8.92	10.01	10.08	15.37	15.71	19.71	22.25	20.44	17.91
14	15.48	9.85	8.22	8.17	9.70	9.62	15.98	16.25	20.03	22.18	20.11	18.20
15	15.66	10.36	6.85	8.65	9.52	9.47	16.33	16.59	20.00	21.15	19.88	18.50
16	16.05	10.81	6.03	9.58	8.60	10.42	16.22	16.97	19.22	21.46	20.11	18.80
17	16.36	11.18	7.15	10.53	8.52	11.06	15.13	16.74	18.91	21.70	20.77	19.25
18	16.72	11.80	6.46	10.59	9.26	11.73	15.34	16.84	19.42	21.79	20.76	19.48
19	17.09	11.26	4.40	10.89	10.47	11.68	16.03	17.25	18.82	22.16	20.93	19.64
20	17.45	9.39	4.28	11.69	11.44	11.49	16.43	16.82	19.92	22.37	21.28	19.85
21	15.90	8.65	4.50	11.47	12.43	13.09	14.78	17.02	20.00	22.70	21.16	20.17
22	14.19	9.00	4.94	11.92	13.15	12.56	13.53	16.57	19.22	22.99	21.36	20.38
23	13.69	9.92	5.78	11.19	13.12	13.01	14.34	16.20	19.58	23.12	20.93	20.40
24	13.92	10.54	6.96	10.17	13.48	13.96	14.41	15.75	19.27	22.71	19.98	20.40
25	14.04	11.05	7.51	10.66	10.52	13.42	15.00	16.08	19.07	22.79	19.67	20.18
26	14.11	10.58	8.26	9.78	9.30	12.94	14.73	16.38	19.36	22.96	19.85	19.97
27	14.44	9.71	9.15	8.91	10.25	12.83	14.56	17.23	18.82	22.37	19.97	19.96
28	14.91	9.99	8.46	8.37	12.13	13.09	14.23	16.86	19.32	21.50	20.33	19.49
29	15.22	10.77	7.20	9.34		13.38	15.30	17.12	19.95	21.66	20.35	18.27
30	15.41	10.74	6.28	8.59		14.06	16.23	17.54	20.00	21.04	20.42	17.32
31	15.73		6.56	8.94		13.13		17.52		21.07	20.38	
Mean	15.64	11.81	7.17	8.56	9.98	11.79	14.77	16.00	18.96	21.54	20.46	19.05
Max	17.45	16.40	9.29	11.92	13.48	14.06	16.43	17.54	20.03	23.12	21.40	20.40
Min	13.69	8.65	4.28	4.17	7.20	9.47	13.07	13.05	17.58	18.86	19.11	17.21

Lower Big Barren:

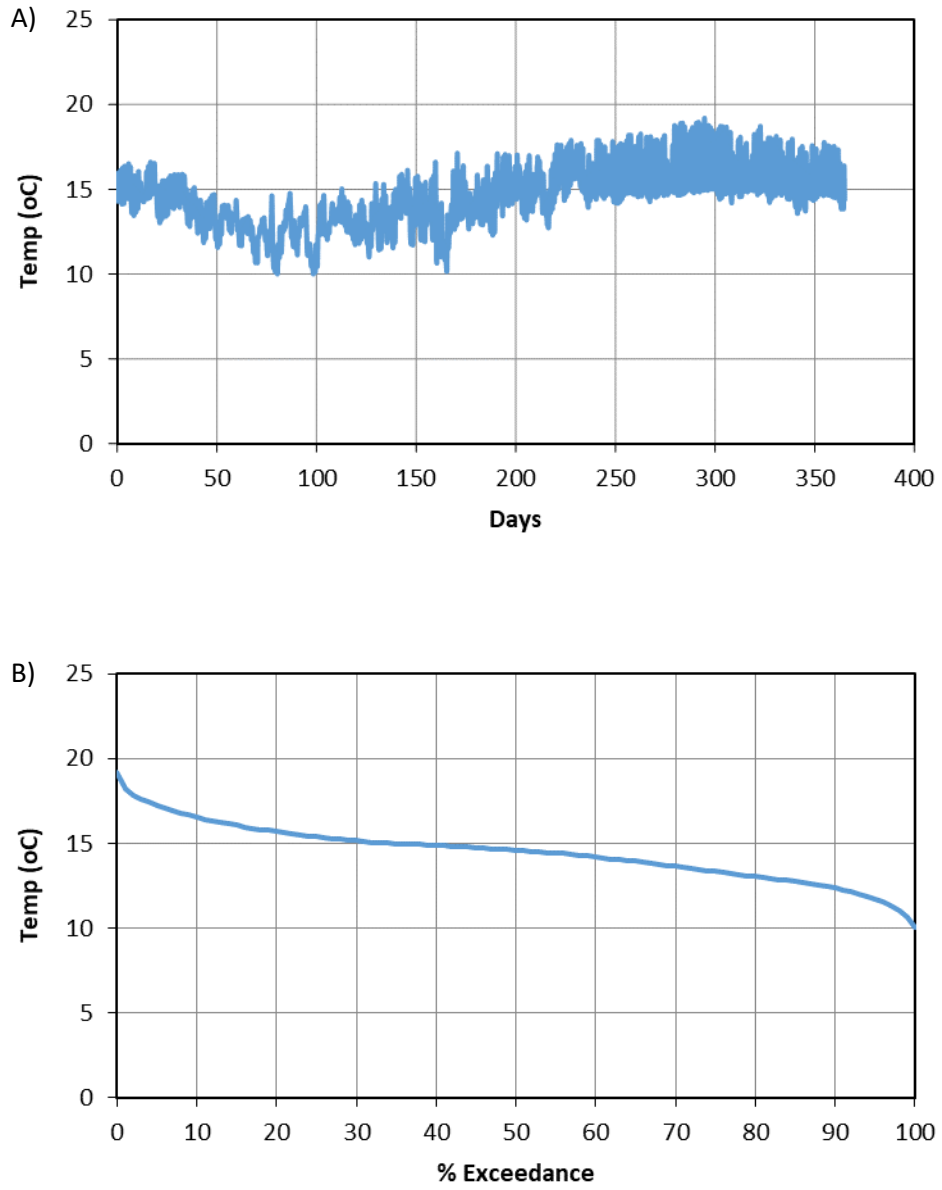


Figure 8. WY2017 A) 15-min temp data and B) annual temp duration curve for LBB.

Table 5. Daily Mean Temperature (°C) for WY 2017 at LBB Gage.

Day	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017
1	14.98	14.75	12.26	13.01	12.97	14.35	13.79	15.66	15.37	15.89	15.75	15.58
2	14.99	14.91	12.38	13.35	12.60	13.25	14.19	14.62	15.49	15.86	16.08	15.58
3	14.92	14.97	12.85	13.66	12.29	13.20	14.63	14.57	15.39	15.39	15.85	15.61
4	14.99	14.38	13.02	11.61	11.90	13.36	14.78	13.39	15.35	15.33	15.97	15.81
5	14.91	13.78	12.90	11.57	12.66	13.48	14.68	13.48	15.35	15.39	15.24	15.45
6	15.22	13.69	12.93	10.71	13.40	14.07	13.75	14.79	15.65	15.81	15.14	14.92
7	15.07	14.09	12.47	10.46	14.27	14.33	13.87	15.09	15.38	16.11	15.59	14.85
8	14.41	14.48	11.57	10.89	13.27	13.51	14.26	15.56	15.32	16.14	15.91	15.14
9	14.37	13.93	11.18	11.30	12.14	14.16	15.44	16.09	15.38	16.02	15.84	15.29
10	14.54	13.26	11.48	13.19	12.67	12.60	15.38	16.16	15.47	16.11	15.77	15.14
11	14.71	13.39	12.53	13.25	13.82	12.12	15.05	16.36	15.58	16.13	15.71	15.01
12	14.82	13.28	12.84	14.07	13.82	12.14	14.88	15.79	15.59	16.13	15.95	14.98
13	14.66	12.68	12.85	12.52	12.83	11.59	15.24	15.61	15.87	16.02	15.52	15.28
14	14.51	13.09	12.26	12.47	13.12	11.14	15.18	15.90	15.91	16.07	15.48	15.52
15	15.09	13.52	11.54	12.75	12.96	11.41	15.12	16.11	15.89	16.19	15.59	15.42
16	15.16	13.53	11.79	13.49	12.80	12.28	14.83	16.41	15.39	16.17	16.08	15.49
17	15.28	13.79	13.32	13.41	13.17	13.22	14.44	16.21	15.71	16.06	15.77	15.40
18	15.33	14.04	10.83	13.23	13.72	14.00	15.11	16.21	15.47	16.26	15.99	15.49
19	15.45	12.55	10.56	13.46	14.32	13.60	15.42	16.27	15.79	16.23	16.16	15.61
20	14.92	12.27	10.83	13.86	14.32	14.50	15.51	16.01	15.85	16.21	15.79	15.73
21	14.05	12.52	11.75	13.81	14.37	14.13	15.12	16.10	15.55	16.30	15.99	15.73
22	13.94	13.16	11.90	13.96	14.53	14.16	13.74	15.77	15.45	16.41	15.84	15.71
23	14.18	13.69	12.70	13.34	14.48	14.32	14.36	15.28	15.69	16.18	15.85	15.65
24	14.37	13.49	13.16	13.12	14.27	14.35	14.69	15.02	15.66	16.28	15.68	15.57
25	14.26	13.52	13.68	13.36	12.73	13.96	15.14	15.05	15.64	16.34	15.78	15.56
26	14.42	13.04	14.40	12.72	12.90	13.65	15.05	14.86	15.27	16.26	15.68	15.36
27	14.97	12.96	12.70	12.51	13.95	13.61	14.71	15.21	15.73	15.63	15.80	15.56
28	14.69	13.31	12.35	12.45	14.61	13.65	14.57	15.17	15.81	16.18	15.68	15.08
29	14.72	13.73	11.89	12.91		14.00	15.37	15.72	15.68	16.07	15.85	14.79
30	14.82	12.91	11.82	12.71		14.69	16.54	16.18	15.67	15.98	15.65	14.77
31	14.93		12.75	12.96		14.00		15.77		16.04	15.38	
Mean	14.76	13.56	12.31	12.78	13.39	13.45	14.83	15.50	15.58	16.04	15.75	15.37
Max	15.45	14.97	14.40	14.07	14.61	14.69	16.54	16.41	15.91	16.41	16.16	15.81
Min	13.94	12.27	10.56	10.46	11.90	11.14	13.74	13.39	15.27	15.33	15.14	14.77

WATER YEAR 2018

Above Natural Area:

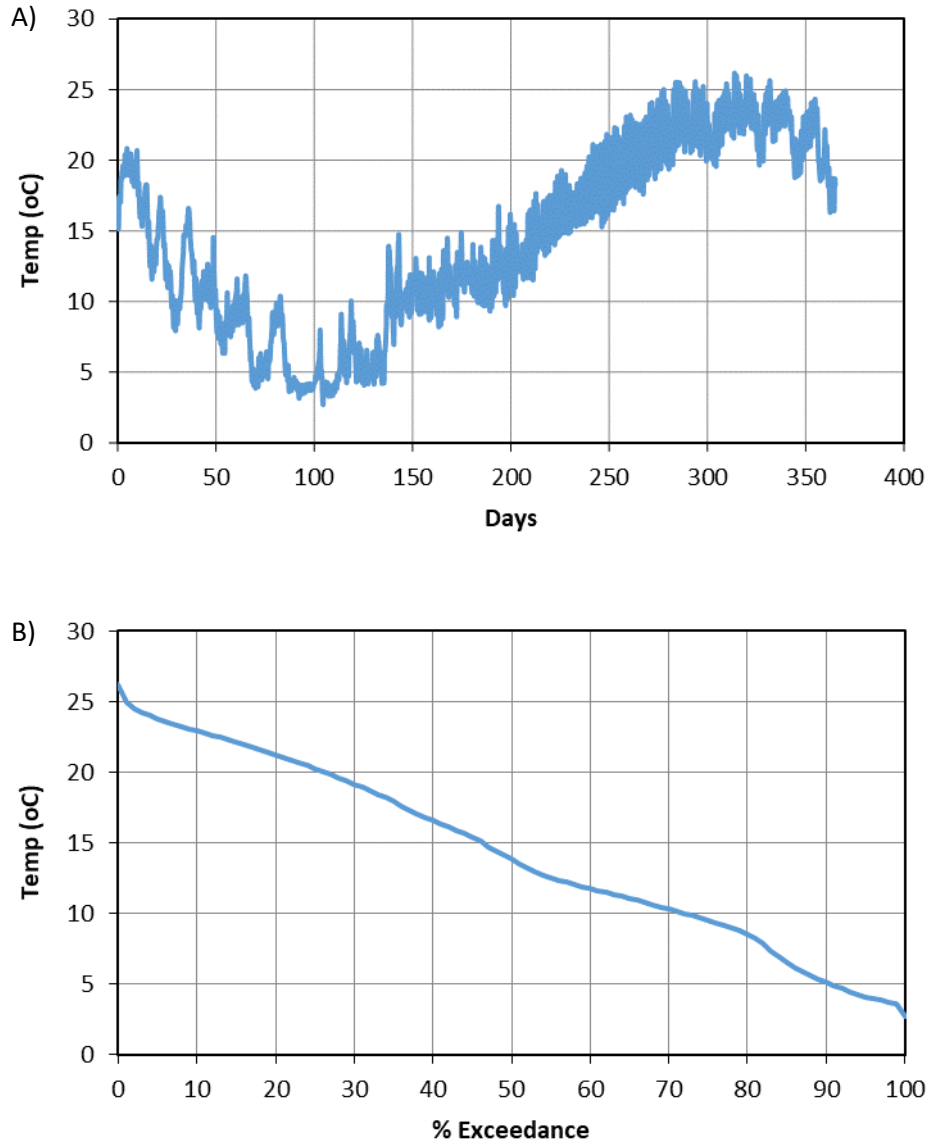


Figure 9. WY2018 A) 15-min temp data and B) annual temp duration curve for ANA.

Table 6. Daily Mean Water Temperature (°C) for WY 2018 at ANA station.

Day	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018
1	16.33	9.73	9.24	3.62	6.30	12.09	11.06	14.77	18.27	21.01	21.71	23.29
2	17.84	11.34	9.36	3.72	5.02	10.80	10.27	15.21	18.15	21.58	22.30	23.47
3	19.30	13.87	9.43	3.78	4.66	10.64	11.96	14.51	18.41	21.55	22.71	23.66
4	19.55	14.89	10.60	3.82	5.60	10.66	11.35	14.81	17.75	21.91	22.93	23.74
5	19.97	15.68	10.99	3.89	4.88	11.28	11.29	15.09	18.26	22.47	23.43	23.80
6	19.66	15.80	8.33	3.90	5.09	10.48	11.76	14.71	18.64	22.27	23.84	23.69
7	19.61	13.63	6.55	3.87	5.25	10.19	10.93	15.25	18.75	21.75	23.95	23.25
8	18.97	12.44	4.83	3.98	5.24	10.10	10.04	15.36	18.94	21.17	23.10	22.57
9	18.81	11.01	4.37	4.47	5.86	10.09	11.68	15.62	18.09	21.44	22.74	20.89
10	19.70	9.97	4.39	4.87	7.21	11.16	11.68	15.32	19.08	22.10	23.54	20.11
11	18.12	8.93	4.81	6.15	5.97	10.95	12.39	16.02	19.59	23.01	24.25	20.05
12	16.59	10.35	5.79	5.47	5.04	9.94	13.83	16.38	19.58	23.14	23.96	20.03
13	16.18	11.35	5.14	3.43	5.31	9.91	13.38	16.36	19.46	23.23	23.50	20.52
14	16.93	10.87	5.25	3.84	7.92	10.26	12.99	16.75	19.23	23.50	23.23	21.49
15	18.05	11.81	5.69	3.99	11.26	11.02	10.96	16.51	19.46	22.65	22.80	21.95
16	15.47	10.89	5.37	3.59	12.67	11.56	11.38	16.68	20.41	22.66	23.83	22.12
17	13.47	10.21	6.21	3.59	9.51	12.64	12.54	15.71	20.54	22.89	24.08	22.25
18	12.55	12.54	8.13	3.69	8.20	11.45	13.72	16.10	20.72	22.04	24.19	22.40
19	12.92	10.62	8.17	3.90	10.24	11.28	12.75	16.23	20.72	21.89	23.41	22.89
20	13.51	8.71	9.28	4.21	13.05	11.01	12.80	16.36	19.92	22.50	23.44	23.16
21	14.95	8.18	8.82	4.67	10.95	10.92	12.85	16.26	20.21	23.33	22.94	22.81
22	16.80	7.82	9.93	7.28	9.08	11.11	12.57	16.67	20.02	23.04	21.96	20.52
23	16.05	7.17	8.96	7.05	10.17	12.17	12.35	16.84	20.07	22.46	20.95	18.85
24	14.39	7.36	7.12	5.72	10.55	13.08	12.94	16.95	18.81	22.48	20.65	19.27
25	12.42	9.37	5.30	5.39	10.26	12.23	12.54	16.68	19.69	23.11	21.74	20.77
26	11.82	8.66	5.00	5.90	10.28	11.34	13.06	17.01	20.86	22.07	23.40	20.49
27	11.99	8.52	3.97	8.56	10.62	12.36	13.68	17.43	20.46	21.84	23.93	18.85
28	10.29	8.79	3.97	7.76	11.46	11.77	13.88	17.85	21.34	21.70	24.32	17.58
29	9.10	9.20	4.23	6.64		11.54	13.79	17.53	21.81	20.93	23.80	17.69
30	8.95	10.81	4.15	5.13		11.91	14.06	18.11	21.17	20.51	22.34	17.60
31	9.21		3.90	5.46		11.65		17.51		21.25	22.67	
Mean	15.47	10.68	6.69	4.88	8.13	11.21	12.35	16.21	19.61	22.18	23.08	21.32
Max	19.97	15.80	10.99	8.56	13.05	13.08	14.06	18.11	21.81	23.50	24.32	23.80
Min	8.95	7.17	3.90	3.43	4.66	9.91	10.04	14.51	17.75	20.51	20.65	17.58

Natural Area:

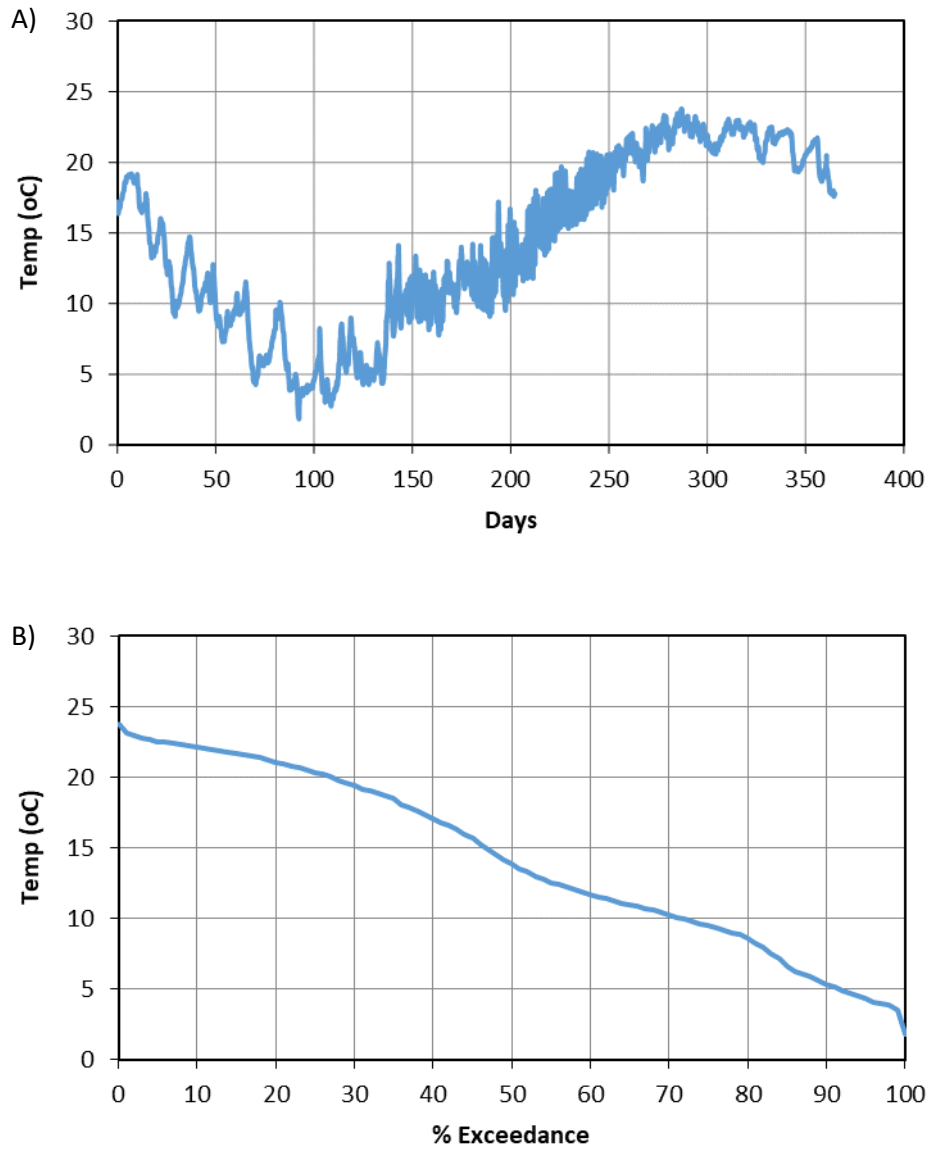


Figure 10. WY2018 A) 15-min temp data and B) annual temp duration curve for NAT.

Table 7. Daily Mean Water Temperature (°C) for WY 2018 at NAT station.

Day	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018
1	16.68	10.21	9.66	2.75	6.36	12.24	11.15	15.29	18.65	21.41	21.03	21.72
2	17.02	10.95	9.42	3.76	4.87	10.72	10.18	15.94	18.98	21.78	21.17	21.94
3	17.61	11.87	9.80	3.78	4.76	10.47	12.03	15.14	19.05	22.20	21.53	22.05
4	18.27	12.89	10.49	3.91	5.40	10.43	11.44	14.99	18.38	22.10	21.76	22.09
5	18.77	13.74	11.02	3.96	4.57	11.30	11.31	15.42	18.54	22.66	22.11	22.14
6	19.03	14.50	8.74	4.01	5.04	10.38	11.90	15.06	19.08	22.91	22.51	22.21
7	19.11	13.75	6.85	4.07	4.89	9.88	10.85	15.69	19.38	22.37	22.86	22.20
8	18.99	12.57	5.55	4.31	4.86	9.69	9.87	15.88	19.62	21.52	22.64	21.97
9	18.62	11.23	4.54	4.94	5.70	9.81	11.50	16.19	19.39	21.66	22.25	20.86
10	18.76	10.38	4.48	5.53	6.86	11.08	11.86	15.92	19.04	21.93	22.27	19.65
11	18.30	9.60	5.19	6.54	6.02	11.02	12.57	16.56	20.20	22.58	22.65	19.52
12	16.81	10.11	6.19	5.98	4.64	9.57	14.14	17.07	20.48	23.07	22.85	19.48
13	16.60	10.86	5.84	3.90	5.08	9.20	14.05	17.17	20.46	23.14	22.59	19.61
14	16.89	11.21	5.83	4.19	7.39	9.45	13.34	17.43	20.32	23.43	22.45	19.96
15	17.35	11.76	6.24	4.42	10.05	9.82	10.99	17.49	19.81	23.19	22.05	20.36
16	16.09	11.11	5.98	3.41	11.62	11.62	11.33	17.37	20.77	22.76	22.16	20.63
17	14.46	10.39	6.34	3.08	9.47	12.16	12.71	16.69	21.24	22.99	22.51	20.83
18	13.50	11.59	7.11	3.43	8.04	11.66	14.22	16.41	21.37	22.81	22.67	20.99
19	13.56	11.00	7.82	3.80	9.80	11.40	13.06	16.95	21.44	22.29	22.45	21.25
20	13.92	8.98	8.69	4.14	12.38	10.93	13.08	16.62	21.18	22.33	22.45	21.49
21	14.53	8.73	9.10	5.21	10.79	10.34	13.23	16.62	20.70	22.77	21.90	21.54
22	15.37	8.33	9.61	7.55	8.99	10.16	12.95	17.11	20.72	22.73	21.19	20.61
23	15.78	7.47	9.17	7.76	10.13	11.55	12.42	17.43	20.37	22.37	20.55	18.98
24	15.00	7.62	7.80	5.93	10.59	12.88	13.05	17.57	20.11	21.99	20.20	18.77
25	13.08	8.66	6.01	5.47	10.24	12.59	12.68	17.36	19.34	22.27	20.26	19.21
26	12.34	8.93	5.47	6.20	10.15	11.49	13.24	17.47	20.91	22.05	21.07	19.63
27	12.68	8.71	4.25	8.25	10.53	12.24	14.03	18.14	20.68	21.63	21.83	19.04
28	11.28	9.00	4.09	7.59	11.53	11.91	14.27	18.57	21.24	21.51	22.26	18.03
29	9.56	9.44	4.26	6.95		11.62	14.25	18.51	21.94	21.13	22.44	17.91
30	9.57	10.19	4.73	5.32		12.00	14.44	18.55	22.22	20.85	21.64	17.78
31	9.87		3.64	5.39		11.69		18.67		20.93	21.46	
Mean	15.46	10.53	6.90	5.02	7.88	11.01	12.54	16.82	20.19	22.24	21.93	20.42
Max	19.11	14.50	11.02	8.25	12.38	12.88	14.44	18.67	22.22	23.43	22.86	22.21
Min	9.56	7.47	3.64	2.75	4.57	9.20	9.87	14.99	18.38	20.85	20.20	17.78

Lower Big Barren:

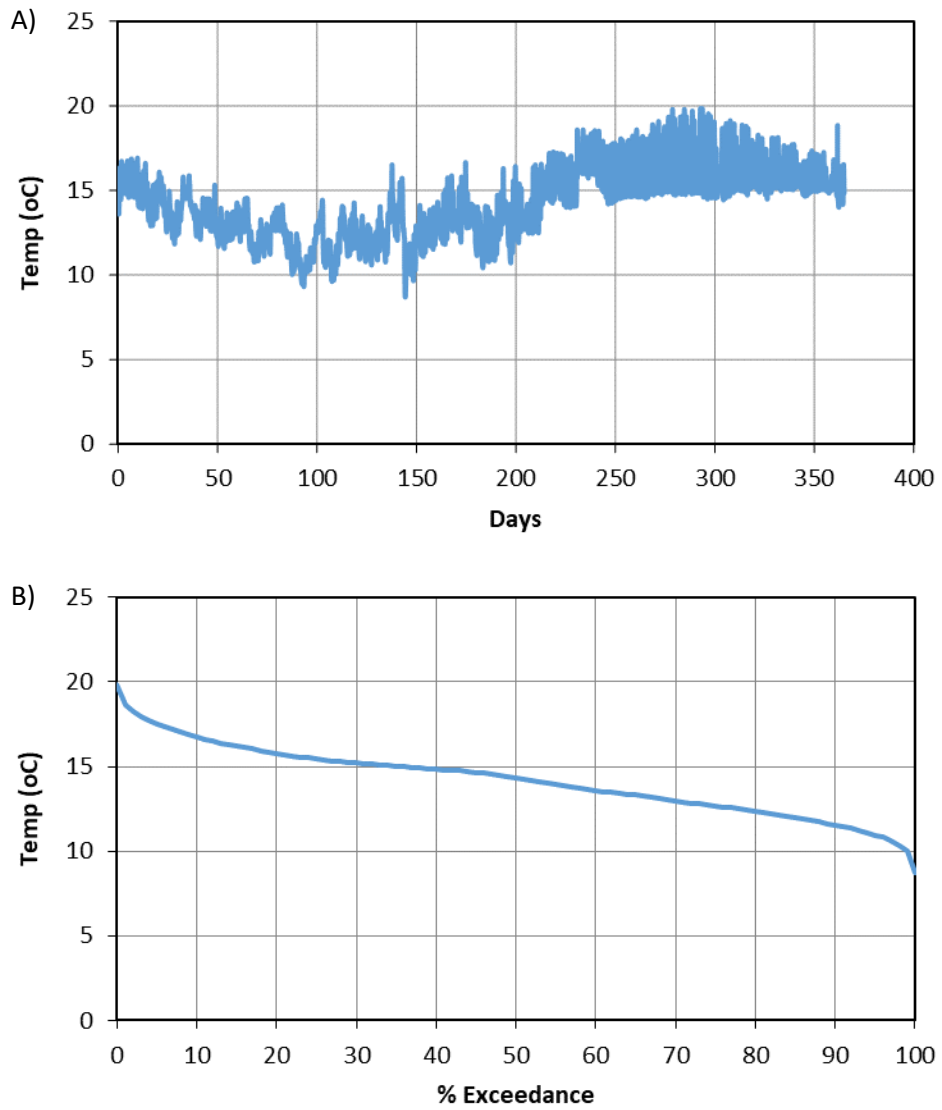


Figure 11. WY2018 A) 15-min temp data and B) annual temp duration curve for LBB.

Table 8. Daily Mean Water Temperature (°C) for WY 2018 at LBB station.

Day	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018
1	14.72	13.51	12.72	9.74	12.31	13.11	11.97	14.84	16.06	16.04	16.05	16.00
2	15.33	14.84	13.23	9.87	11.30	12.31	10.77	15.09	15.61	16.30	16.15	16.00
3	15.35	14.85	13.39	10.64	12.10	12.24	12.31	14.71	15.69	16.14	16.20	16.00
4	15.46	14.81	14.03	10.56	12.18	12.33	12.27	15.64	15.26	16.47	16.34	15.99
5	15.45	15.24	13.17	10.95	11.36	12.86	12.20	16.00	15.44	16.34	16.08	16.03
6	15.33	14.28	12.00	10.94	12.11	12.37	12.67	15.44	15.50	16.63	16.38	16.02
7	15.36	13.83	11.62	11.44	11.85	12.30	11.95	15.69	15.58	16.39	16.14	15.74
8	15.17	13.59	11.29	12.40	11.87	12.34	11.38	15.71	15.60	16.04	16.00	16.08
9	15.38	12.98	11.23	12.78	12.53	12.68	12.73	15.87	15.44	16.15	15.93	15.42
10	15.53	12.80	11.59	13.26	12.74	13.28	12.91	15.55	15.83	16.43	16.36	15.45
11	14.67	12.81	12.17	13.97	11.91	13.10	13.38	15.55	15.80	16.52	16.18	15.43
12	14.70	13.87	12.05	11.19	11.55	12.75	14.17	15.42	15.59	16.56	16.27	15.51
13	14.77	13.61	11.83	10.88	12.29	12.82	13.91	15.11	15.68	16.44	16.14	15.64
14	15.17	13.59	12.25	11.31	13.73	12.96	13.84	15.02	15.59	16.29	15.69	15.78
15	14.93	14.02	12.21	11.44	14.77	13.39	11.99	14.82	15.81	16.20	16.08	15.79
16	13.91	13.15	11.99	10.00	13.87	13.50	12.10	15.04	15.97	16.44	16.11	15.77
17	13.75	13.53	13.04	10.28	12.74	13.99	13.24	14.62	15.95	16.36	16.17	15.75
18	13.87	14.33	13.35	10.80	12.95	13.37	14.36	14.78	16.08	15.95	16.21	15.77
19	14.17	12.58	13.32	11.39	14.36	13.30	13.54	15.57	16.00	16.00	15.97	15.81
20	14.33	12.42	13.65	12.26	14.89	13.10	13.53	17.01	15.58	16.38	16.30	15.84
21	15.02	12.93	13.29	13.69	12.80	13.29	13.71	16.80	15.88	16.59	15.97	15.58
22	15.12	12.24	13.78	13.54	9.68	13.37	13.47	17.07	15.69	16.38	15.78	15.20
23	14.53	12.22	12.59	12.31	10.84	13.75	12.93	17.03	15.74	16.17	15.46	15.07
24	13.83	12.74	12.02	11.80	11.55	14.33	13.37	16.85	15.01	16.27	15.47	15.33
25	13.34	13.32	11.66	12.09	10.71	13.45	13.20	16.61	15.96	16.41	16.05	15.70
26	13.77	12.72	11.86	12.58	10.82	13.38	13.51	17.06	16.21	15.59	16.26	15.35
27	13.59	12.86	10.46	13.57	11.53	13.93	14.19	17.07	15.91	16.26	16.24	15.04
28	12.80	13.06	10.80	12.39	12.51	13.46	14.37	17.08	16.27	15.77	16.26	14.91
29	12.64	13.32	11.84	12.07		12.36	14.27	16.58	16.38	15.47	15.76	14.99
30	13.14	13.74	11.77	11.60		12.30	14.30	16.46	15.82	15.54	15.78	15.02
31	13.06		10.47	12.37		12.60		15.90		16.24	16.09	
Mean	14.46	13.46	12.28	11.74	12.28	13.04	13.09	15.87	15.76	16.22	16.06	15.60
Max	15.53	15.24	14.03	13.97	14.89	14.33	14.37	17.08	16.38	16.63	16.38	16.08
Min	12.64	12.22	10.46	9.74	9.68	12.24	10.77	14.62	15.01	15.47	15.46	14.91

WATER YEAR 2019

Above Natural Area:

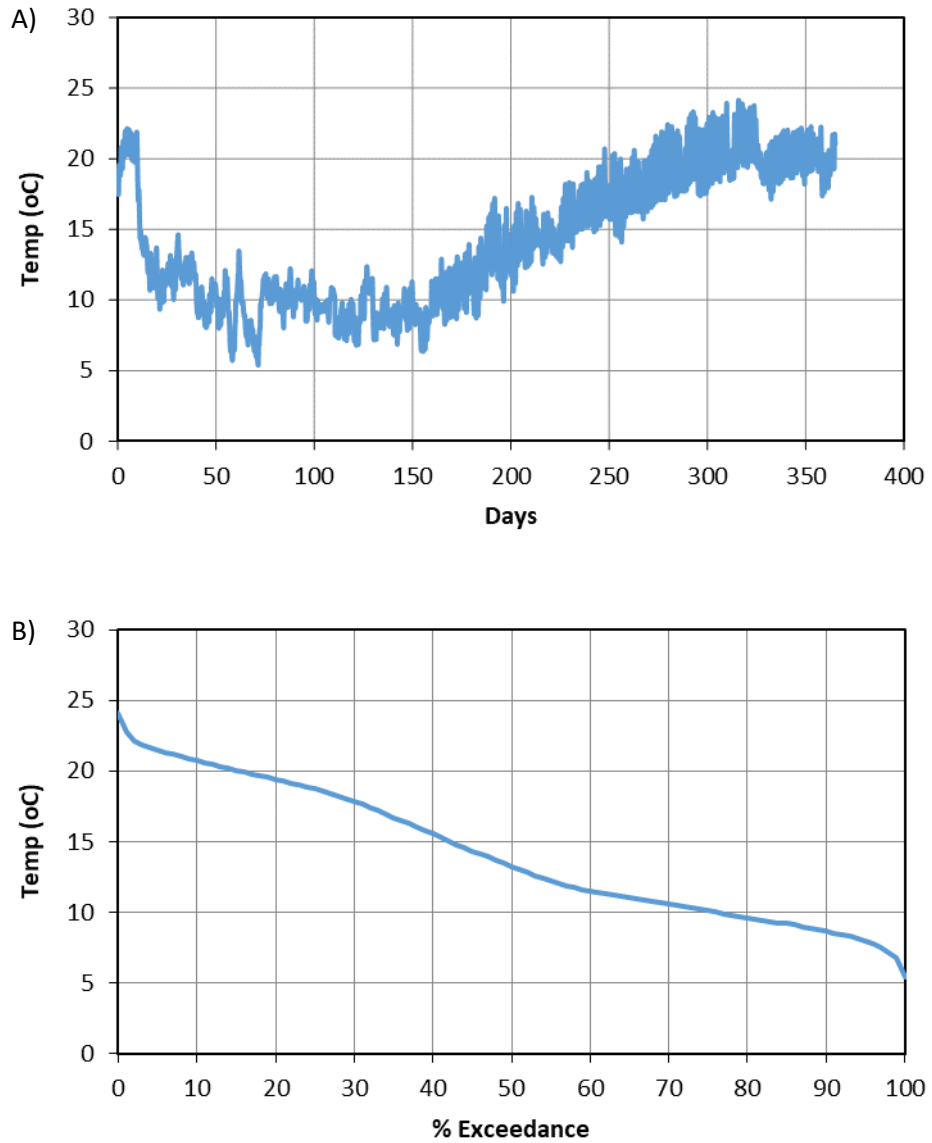


Figure 12. WY2019 A) 15-min temp data and B) annual temp duration curve for ANA.

Table 9. Daily Mean Water Temperature (°C) for WY 2019 at ANA station.

Day	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019
1	18.44	12.92	12.27	10.39	9.21	8.86	10.53	14.63	16.63	19.00	20.59	19.85
2	19.71	11.88	11.27	10.17	9.91	9.12	11.19	14.61	17.11	18.94	20.58	19.88
3	20.23	11.57	9.80	10.44	10.01	8.79	12.10	14.25	16.90	19.11	20.30	20.10
4	20.96	12.41	8.80	9.63	11.42	7.61	11.26	13.96	17.22	19.36	20.91	20.29
5	21.30	11.80	7.87	9.34	10.85	7.75	12.08	14.10	17.85	18.92	20.96	20.42
6	21.21	12.07	7.31	10.15	10.87	7.98	12.75	13.71	16.85	19.03	21.46	20.49
7	21.14	12.60	8.15	11.40	10.69	7.93	13.73	14.54	16.78	19.86	20.22	20.40
8	20.79	12.14	7.84	10.96	8.01	8.71	14.13	14.59	16.46	19.71	19.20	19.92
9	20.72	11.45	6.92	9.64	8.10	9.92	14.08	14.66	17.55	19.97	19.37	20.21
10	21.18	9.51	6.51	9.30	8.66	9.80	14.39	14.11	17.93	19.55	20.56	20.60
11	17.89	9.57	6.18	9.34	8.58	10.17	14.25	13.49	17.03	19.41	20.57	20.54
12	14.92	10.75	8.54	9.38	9.29	9.75	13.55	13.78	15.93	19.65	21.42	20.78
13	13.78	9.59	10.36	9.59	9.02	10.59	11.80	13.95	16.90	19.60	22.14	20.71
14	13.72	8.42	11.53	9.50	9.90	11.25	11.36	14.53	16.05	19.20	21.83	19.89
15	13.95	8.73	11.21	9.61	9.13	10.40	12.29	15.30	16.73	18.30	21.53	19.93
16	12.51	9.38	10.79	9.22	8.58	9.90	13.81	15.86	17.40	19.01	20.89	20.52
17	11.98	10.20	10.55	10.37	8.90	10.18	13.71	15.82	17.45	19.91	21.26	20.66
18	12.13	11.01	10.47	10.39	8.55	10.69	13.06	16.02	17.57	20.38	21.79	20.65
19	11.34	11.02	10.78	9.16	8.69	10.43	11.95	15.95	17.76	20.69	21.33	20.60
20	12.30	9.82	11.43	8.04	8.34	10.26	12.64	15.81	18.28	20.94	21.77	20.54
21	11.16	8.78	10.53	8.03	8.63	10.46	13.45	15.49	17.83	20.77	21.20	20.48
22	10.40	9.10	9.96	8.80	9.13	10.79	14.35	15.76	17.80	19.78	20.19	20.46
23	10.83	9.25	9.77	8.52	9.86	10.46	14.47	16.13	17.13	19.64	19.80	21.05
24	10.89	10.92	9.08	8.10	9.64	11.28	13.89	16.39	17.33	19.63	19.09	18.24
25	11.52	10.92	10.47	8.01	9.06	11.29	13.63	16.47	17.58	19.79	18.89	18.81
26	12.30	9.04	10.17	8.58	9.37	11.09	14.07	16.51	17.64	19.75	19.19	19.44
27	12.14	7.02	11.53	9.10	10.08	11.15	13.84	16.85	17.71	19.97	19.26	19.24
28	11.90	6.39	10.64	9.15	9.06	11.99	14.16	16.72	17.99	20.52	19.26	19.87
29	11.11	7.36	9.53	7.96		11.78	14.69	16.68	18.39	19.77	19.07	20.43
30	11.68	10.20	10.10	7.49		11.27	14.99	16.57	18.64	20.48	19.10	20.56
31	13.96		10.86	7.67		10.77		16.50		20.68	19.72	
Mean	15.10	10.19	9.72	9.27	9.34	10.08	13.21	15.28	17.35	19.72	20.43	20.19
Max	21.30	12.92	12.27	11.40	11.42	11.99	14.99	16.85	18.64	20.94	22.14	21.05
Min	10.40	6.39	6.18	7.49	8.01	7.61	10.53	13.49	15.93	18.30	18.89	18.24

Natural Area:

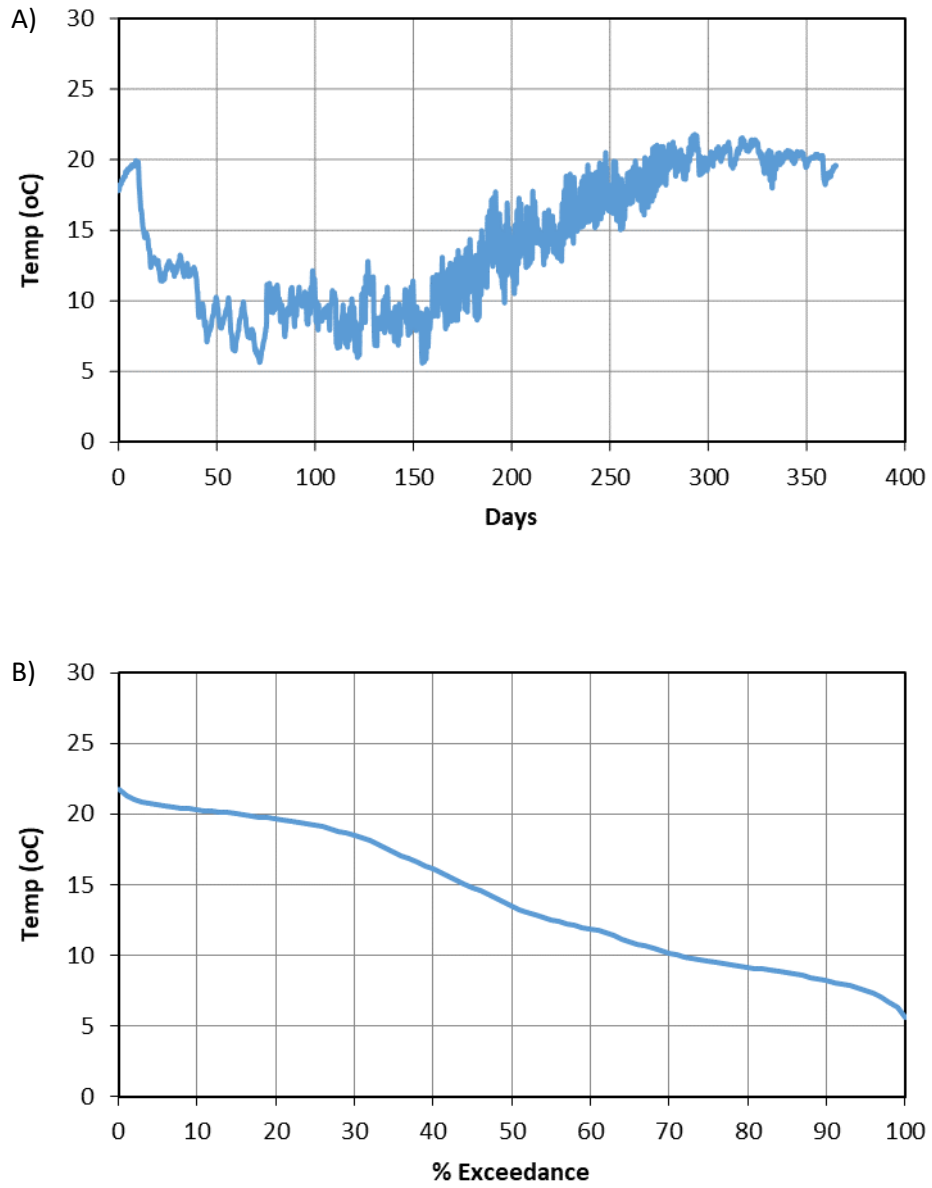


Figure 13. WY2019 A) 15-min temp data and B) annual temp duration curve for NAT.

Table 10. Daily Mean Water Temperature (°C) for WY 2019 at NAT station.

Day	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019
1	18.03	13.05	8.43	10.13	8.85	8.58	10.63	14.99	17.18	19.35	20.58	19.99
2	18.40	12.32	9.14	9.78	9.81	8.96	11.35	14.71	17.69	19.50	20.51	19.94
3	18.67	11.86	9.65	10.01	9.90	8.54	12.51	14.41	17.55	19.60	20.23	19.97
4	18.95	12.33	8.83	9.53	11.56	7.06	11.58	14.10	17.81	19.52	20.48	20.14
5	19.20	12.09	7.81	9.21	11.17	7.24	12.32	14.27	18.35	19.81	20.69	20.36
6	19.36	11.88	7.54	9.99	10.88	7.55	13.17	13.87	17.83	19.11	20.88	20.36
7	19.50	12.15	7.73	11.38	10.87	7.52	14.41	14.78	17.23	19.92	20.93	20.41
8	19.59	12.26	7.66	10.98	7.83	8.38	14.96	14.91	16.95	20.12	19.93	20.15
9	19.70	11.63	6.64	9.34	7.84	9.88	14.76	14.92	17.68	20.22	19.72	19.90
10	19.77	9.81	6.33	8.82	8.45	9.95	15.08	14.34	18.42	20.54	19.91	20.20
11	18.44	9.13	5.88	8.81	8.55	10.34	15.07	13.61	17.39	19.53	20.37	20.40
12	16.47	9.65	6.13	8.81	9.27	9.84	14.12	13.90	16.56	19.73	20.66	20.41
13	15.23	8.84	6.88	9.25	8.92	10.74	12.47	14.12	16.45	20.02	21.15	20.43
14	14.58	8.00	7.58	9.17	9.89	11.40	11.42	14.81	16.45	20.18	21.37	20.18
15	14.58	7.50	9.94	9.30	9.05	10.47	12.40	15.76	16.77	19.10	21.06	19.68
16	13.71	7.99	10.44	8.78	8.32	9.91	14.23	16.43	17.78	19.17	20.81	19.71
17	12.65	8.58	10.07	10.15	8.72	10.22	14.24	16.46	18.00	19.81	20.73	20.00
18	12.90	9.35	9.88	10.22	8.30	10.84	13.45	16.62	18.02	20.43	21.07	20.13
19	12.87	10.00	10.07	9.03	8.47	10.54	11.98	16.55	18.14	20.87	21.16	20.15
20	12.67	9.45	10.98	7.38	8.32	10.33	12.72	16.33	18.60	21.11	21.21	20.26
21	12.40	8.38	10.09	7.49	8.54	10.52	13.71	15.99	18.62	21.17	21.15	20.32
22	11.68	8.25	9.04	8.27	9.08	11.01	14.80	15.94	18.14	20.97	20.75	20.19
23	11.67	8.68	9.14	8.43	9.85	10.67	14.97	16.42	17.97	19.57	20.38	20.17
24	11.85	9.20	8.07	7.89	9.67	11.46	14.33	16.83	17.65	19.52	19.91	19.42
25	12.34	9.75	8.83	7.74	8.97	11.61	13.90	16.97	17.98	19.59	19.33	18.40
26	12.71	9.26	9.27	8.32	9.30	11.32	14.35	17.04	18.19	19.68	19.69	18.82
27	12.50	7.52	10.26	8.94	10.11	11.44	14.11	17.41	18.09	19.65	19.76	18.91
28	12.32	6.61	10.32	9.00	9.00	12.35	14.55	17.32	18.51	19.95	19.39	19.00
29	12.03	6.77	8.93	7.50		12.25	15.11	17.26	18.84	20.28	18.82	19.33
30	12.22	7.57	9.47	6.95		11.54	15.60	17.11	19.12	19.96	19.42	19.52
31	12.71		10.44	6.99		10.80		17.01		20.30	19.65	
Mean	15.15	9.66	8.76	8.96	9.27	10.11	13.61	15.65	17.80	19.94	20.38	19.90
Max	19.77	13.05	10.98	11.38	11.56	12.35	15.60	17.41	19.12	21.17	21.37	20.43
Min	11.67	6.61	5.88	6.95	7.83	7.06	10.63	13.61	16.45	19.10	18.82	18.40

Lower Big Barren:

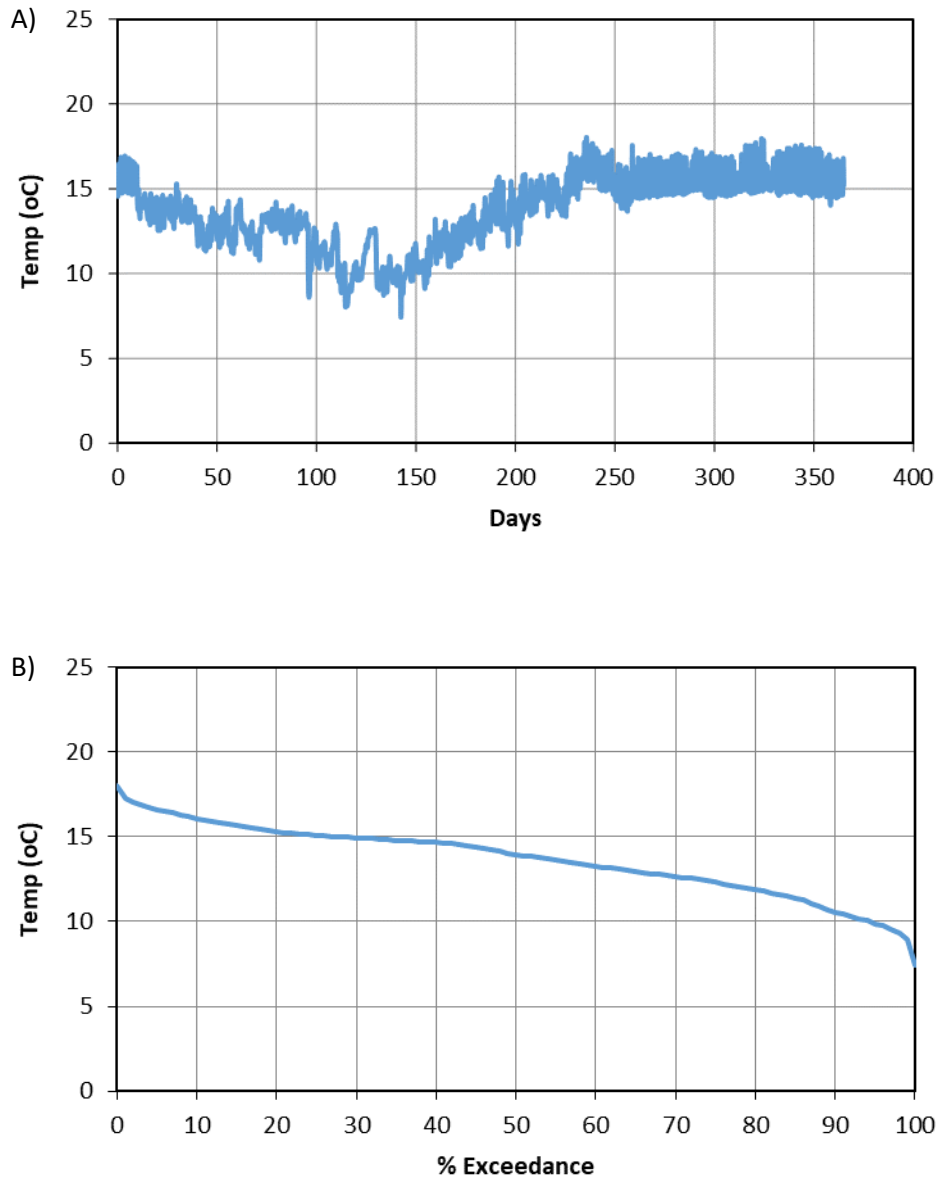


Figure 14. WY2019 A) 15-min temp data and B) annual temp duration curve for LBB.

Table 11. Daily Mean Water Temperature (°C) for WY 2019 at LBB station.

Day	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019
1	15.26	13.70	13.96	12.99	10.62	10.33	12.20	15.02	15.74	15.36	15.35	15.54
2	15.50	13.46	12.91	12.96	11.34	10.55	12.40	15.22	15.77	15.32	15.32	15.67
3	15.50	13.60	12.61	13.11	11.71	10.43	13.08	14.70	15.53	15.30	15.28	15.72
4	15.59	13.96	12.34	12.56	12.29	9.83	12.77	14.44	15.59	15.35	15.39	15.70
5	15.52	13.48	12.05	9.41	12.47	10.20	13.13	14.41	15.74	15.17	15.37	15.69
6	15.47	13.63	12.14	10.72	12.48	10.73	13.32	14.21	15.24	15.37	15.40	15.72
7	15.46	13.67	12.53	12.06	12.44	10.96	13.70	14.61	14.99	15.45	15.18	15.65
8	15.34	13.51	12.02	12.17	9.71	11.54	13.84	14.89	14.66	15.44	15.14	15.50
9	15.40	13.06	11.69	11.08	9.27	12.15	13.85	14.98	15.00	15.56	15.27	15.63
10	15.43	12.03	11.65	10.91	9.94	11.26	13.92	14.44	14.98	15.48	15.65	15.57
11	14.15	12.51	11.65	11.39	9.74	11.55	13.80	13.87	14.68	15.47	15.48	15.64
12	13.88	12.72	12.83	11.68	9.64	11.47	13.68	13.92	14.37	15.46	15.85	15.67
13	14.04	11.85	13.28	11.23	9.59	11.96	12.88	14.18	14.69	15.46	15.83	15.63
14	14.28	11.71	13.38	10.57	10.41	12.27	12.77	14.54	14.44	15.17	15.78	15.45
15	14.04	12.14	13.29	10.88	10.31	11.79	12.83	15.17	14.72	15.40	15.72	15.45
16	13.62	12.31	13.09	10.93	9.75	11.26	14.05	15.71	15.22	15.50	15.54	15.57
17	13.69	12.78	13.01	11.97	9.93	11.32	14.42	15.76	15.13	15.61	15.79	15.58
18	13.79	13.11	13.02	12.46	9.84	11.81	14.05	15.71	15.02	15.79	15.81	15.57
19	13.59	13.12	13.31	11.60	9.97	11.78	12.78	15.72	15.14	15.77	15.67	15.49
20	13.97	12.44	13.52	10.06	8.88	11.69	12.88	15.37	15.21	15.73	16.02	15.41
21	13.17	12.29	12.96	9.45	9.21	11.80	13.68	15.47	15.08	15.67	15.90	15.38
22	13.28	12.49	12.88	9.89	9.83	12.13	14.40	16.19	15.19	15.47	15.47	15.39
23	13.61	12.77	12.73	9.15	10.43	12.09	14.70	16.57	15.02	15.41	15.62	15.53
24	13.47	13.43	12.53	8.26	10.62	12.51	14.37	16.71	15.41	15.35	15.22	14.68
25	13.91	13.39	13.17	8.99	10.31	12.65	14.21	16.50	15.43	15.35	15.27	15.23
26	14.07	11.84	13.01	9.25	10.50	12.48	14.35	16.38	15.23	15.37	15.56	15.25
27	13.77	11.65	13.59	9.92	11.05	12.52	14.33	16.47	15.25	15.32	15.67	15.27
28	13.61	11.90	12.73	10.50	10.73	12.92	14.39	16.30	15.24	15.40	15.60	15.17
29	13.44	12.70	12.40	9.97		12.94	14.51	16.38	15.33	15.16	15.51	15.40
30	14.16	13.66	12.89	9.89		12.77	14.85	16.22	15.33	15.46	15.41	15.39
31	14.51		13.22	9.87		12.18		15.87		15.37	15.57	
Mean	14.34	12.83	12.79	10.83	10.46	11.67	13.67	15.35	15.15	15.43	15.54	15.48
Max	15.59	13.96	13.96	13.11	12.48	12.94	14.85	16.71	15.77	15.79	16.02	15.72
Min	13.17	11.65	11.65	8.26	8.88	9.83	12.20	13.87	14.37	15.16	15.14	14.68

WATER YEAR 2020

Above Natural Area:

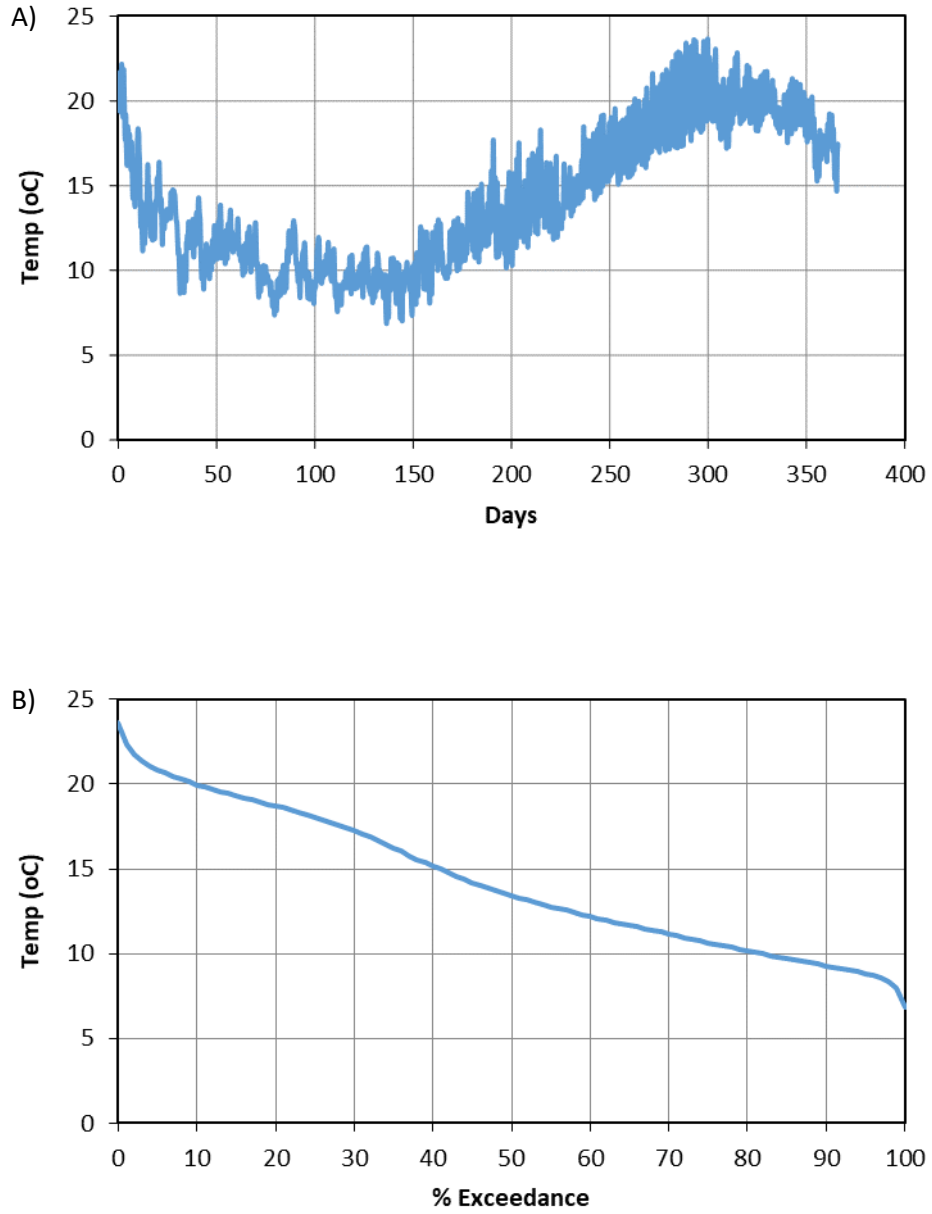


Figure 15. WY2020 A) 15-min temp data and B) annual temp duration curve for ANA.

Table 12. Daily Mean Water Temperature (°C) for WY 2020 at ANA station.

Day	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Apr 2020	May 2020	Jun 2020	Jul 2020	Aug 2020	Sep 2020
1	20.62	9.73	11.35	9.26	9.85	9.75	12.35	14.47	16.40	18.06	19.57	18.57
2	20.63	9.65	10.84	10.61	9.65	11.26	12.93	15.48	16.58	18.64	19.14	18.93
3	20.31	9.71	10.58	11.34	10.36	11.25	12.82	14.80	16.79	19.17	19.25	19.30
4	18.68	10.50	10.79	9.96	10.89	10.09	11.96	13.88	16.57	19.16	19.50	19.34
5	17.42	12.21	11.34	9.18	9.11	10.46	12.47	14.50	16.05	19.16	18.77	19.01
6	17.84	11.59	12.07	9.01	8.77	10.34	13.12	14.08	16.73	19.02	19.16	19.52
7	16.73	12.26	10.68	8.89	8.96	9.82	13.92	14.21	17.11	19.17	19.94	19.72
8	15.38	11.55	10.96	8.69	9.23	10.41	15.19	14.34	16.50	19.60	20.15	19.75
9	15.10	12.39	12.22	9.62	9.79	11.11	14.02	13.85	17.97	19.49	20.76	19.71
10	16.62	13.24	10.62	11.55	10.24	11.64	12.85	14.29	16.90	19.83	21.19	19.74
11	17.27	12.88	9.21	10.25	9.39	11.33	12.34	13.20	16.70	19.94	20.25	19.76
12	13.54	10.12	9.48	9.41	9.00	11.45	13.04	12.79	16.95	20.36	19.42	19.61
13	12.35	9.71	9.73	9.99	8.94	11.06	12.57	13.01	17.22	19.93	19.76	19.62
14	12.69	10.68	9.80	10.26	7.85	9.96	12.14	14.47	17.19	19.77	20.19	19.08
15	14.12	10.52	9.75	10.99	8.35	9.70	12.34	14.54	17.31	20.53	20.59	18.81
16	14.72	10.47	9.40	10.45	9.69	9.83	12.91	14.51	17.37	20.83	20.76	18.94
17	12.96	10.84	8.89	9.63	10.29	10.84	12.44	14.97	17.45	19.42	20.03	19.13
18	12.67	11.48	8.39	10.49	10.28	11.23	12.70	13.98	17.55	19.96	20.06	18.56
19	12.91	11.96	8.09	8.93	9.24	12.02	12.95	14.32	17.80	20.85	19.94	17.24
20	14.56	11.65	8.38	8.26	9.56	11.76	13.72	14.50	17.72	21.04	19.48	16.74
21	15.68	13.00	9.07	8.52	8.52	11.19	14.61	14.58	18.02	20.66	19.67	16.97
22	14.02	11.93	9.26	8.47	8.50	10.55	12.74	14.53	17.46	19.99	19.94	17.35
23	12.62	11.66	9.53	9.07	9.41	11.36	13.13	15.19	17.72	20.20	20.28	17.52
24	12.94	11.33	9.54	9.45	10.00	10.91	13.49	16.07	17.96	20.88	20.58	17.30
25	13.24	11.71	9.89	9.47	9.85	11.22	13.40	16.27	18.05	20.98	20.64	17.52
26	13.28	12.52	11.30	9.84	9.02	12.47	13.63	15.78	18.01	21.20	20.34	18.48
27	13.71	12.35	11.30	9.80	8.70	12.83	13.42	16.01	18.19	20.97	19.71	18.40
28	14.49	11.26	11.89	9.48	9.47	12.87	14.68	15.98	18.94	20.23	20.13	17.82
29	14.48	11.50	12.58	9.13	9.49	12.70	14.22	16.17	18.42	20.45	20.00	16.32
30	13.04	12.37	10.71	9.35		12.08	14.20	15.93	18.77	21.07	19.03	16.06
31	11.28		9.74	9.76		12.81		16.17		20.02	18.94	
Mean	15.03	11.43	10.24	9.65	9.39	11.17	13.21	14.74	17.41	20.02	19.91	18.49
Max	20.63	13.24	12.58	11.55	10.89	12.87	15.19	16.27	18.94	21.20	21.19	19.76
Min	11.28	9.65	8.09	8.26	7.85	9.70	11.96	12.79	16.05	18.06	18.77	16.06

Natural Area:

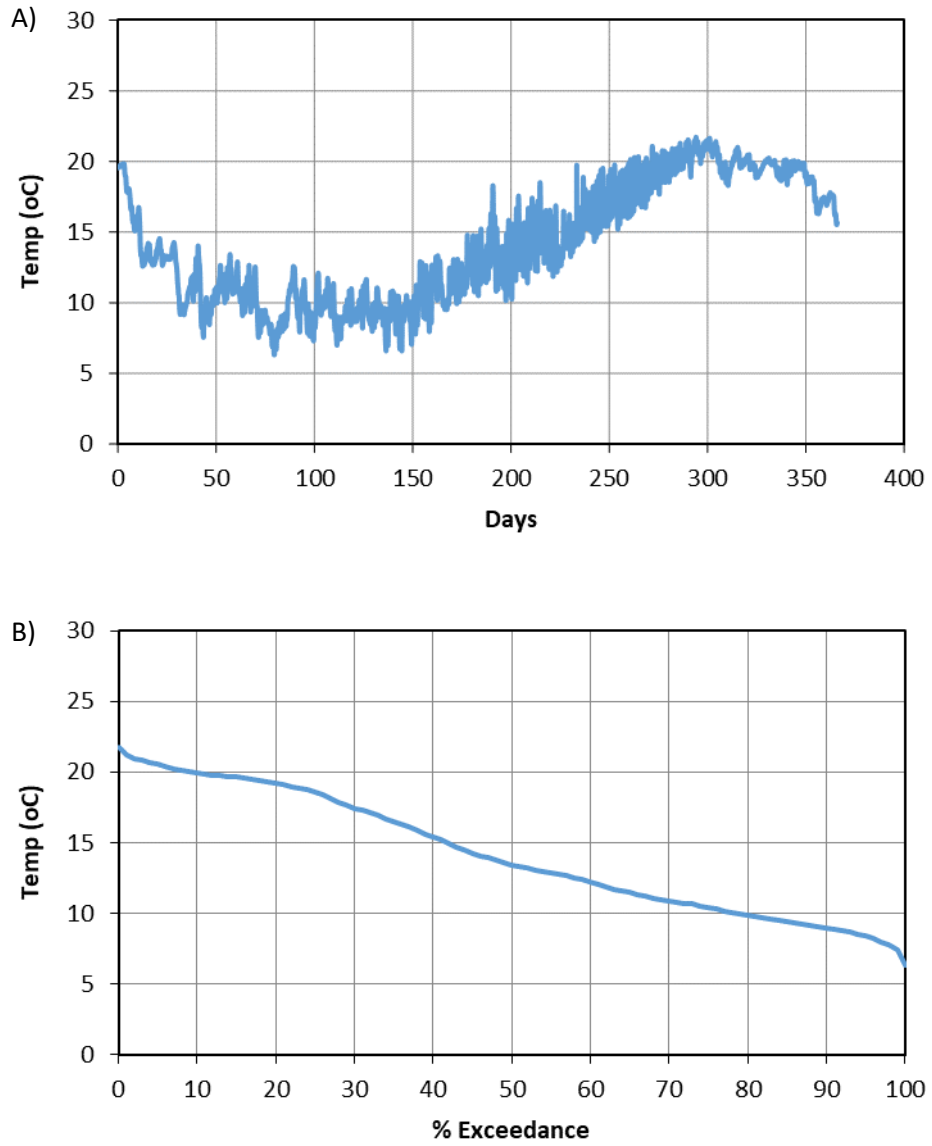


Figure 16. WY2020 A) 15-min temp data and B) annual temp duration curve for NAT.

Table 13. Daily Mean Water Temperature (°C) for WY 2020 at NAT station.

Day	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Apr 2020	May 2020	Jun 2020	Jul 2020	Aug 2020	Sep 2020
1	19.62	9.70	11.15	8.85	9.79	9.74	12.48	14.74	16.89	18.95	20.26	18.99
2	19.70	9.49	10.38	10.29	9.52	11.48	13.14	15.89	17.15	18.77	19.68	18.97
3	19.75	9.46	10.00	11.27	10.34	11.60	13.07	15.31	17.29	19.63	19.27	19.34
4	19.35	9.71	10.23	9.83	11.04	10.20	12.06	14.11	16.84	19.84	19.62	19.57
5	18.16	10.41	10.82	8.72	9.09	10.48	12.60	14.65	16.27	19.57	19.00	19.04
6	18.00	11.04	11.87	8.49	8.70	10.47	13.42	14.26	17.08	19.75	18.75	19.37
7	16.98	11.63	10.30	8.34	8.88	9.83	14.36	14.42	17.55	19.45	19.36	19.46
8	16.07	11.02	10.27	8.03	9.16	10.42	15.81	14.62	16.89	19.84	19.85	19.73
9	15.35	11.67	11.79	8.84	9.74	11.35	14.70	14.05	18.19	20.02	20.27	19.64
10	15.75	12.57	10.37	11.30	10.34	11.94	13.05	14.58	17.18	19.83	20.69	19.70
11	16.38	12.53	8.39	10.30	9.37	11.60	12.55	13.49	17.02	20.04	20.79	19.69
12	14.20	9.27	8.58	9.30	8.99	11.63	13.26	12.87	17.38	20.60	19.85	19.67
13	12.92	8.41	8.87	9.91	8.90	11.23	12.78	13.04	17.66	20.19	19.82	19.70
14	12.86	9.24	9.00	10.20	7.68	10.00	12.13	14.59	17.61	20.11	19.92	19.27
15	13.48	9.21	8.96	10.98	8.19	9.68	12.39	14.77	17.78	20.40	20.10	18.74
16	14.05	9.00	8.59	10.34	9.68	9.83	13.08	14.64	17.84	21.04	20.37	18.62
17	13.39	9.64	8.03	9.34	10.37	10.92	12.84	15.12	18.02	20.76	19.84	18.77
18	12.86	10.14	7.50	10.36	10.37	11.31	12.61	14.10	18.12	19.47	19.72	18.66
19	12.83	10.74	7.01	8.69	9.10	12.13	13.31	14.47	18.34	20.70	19.63	17.68
20	13.36	10.50	7.30	7.84	9.48	11.87	13.91	14.70	18.31	21.17	19.19	16.74
21	14.13	11.31	7.93	8.13	8.24	11.25	14.96	14.90	18.52	21.14	19.08	16.53
22	14.15	11.74	8.26	8.04	8.16	10.58	13.41	14.77	18.02	20.88	19.23	16.91
23	13.02	11.52	8.38	8.75	9.28	11.43	13.31	15.51	18.17	20.34	19.47	17.31
24	13.10	11.01	8.54	9.25	9.99	11.00	13.80	16.47	18.40	20.66	19.78	17.29
25	13.20	11.38	8.71	9.31	9.94	11.26	13.72	16.78	18.49	21.07	19.97	17.06
26	13.17	12.22	9.81	9.75	8.96	12.61	13.80	16.18	18.50	21.14	20.11	17.38
27	13.15	12.24	10.87	9.76	8.53	13.07	13.76	16.31	18.75	21.33	20.03	17.65
28	13.60	10.77	11.42	9.38	9.44	13.12	15.09	16.24	19.23	21.06	19.87	17.57
29	14.13	10.94	12.41	8.86	9.45	12.93	14.61	16.48	19.29	20.70	19.89	16.71
30	13.03	12.03	10.76	9.09		12.26	14.42	16.32	19.18	20.85	19.71	15.83
31	11.39		9.55	9.62		12.99		16.58		21.00	19.16	
Mean	14.88	10.68	9.55	9.39	9.34	11.30	13.48	15.00	17.86	20.33	19.75	18.39
Max	19.75	12.57	12.41	11.30	11.04	13.12	15.81	16.78	19.29	21.33	20.79	19.73
Min	11.39	8.41	7.01	7.84	7.68	9.68	12.06	12.87	16.27	18.77	18.75	15.83

Lower Big Barren:

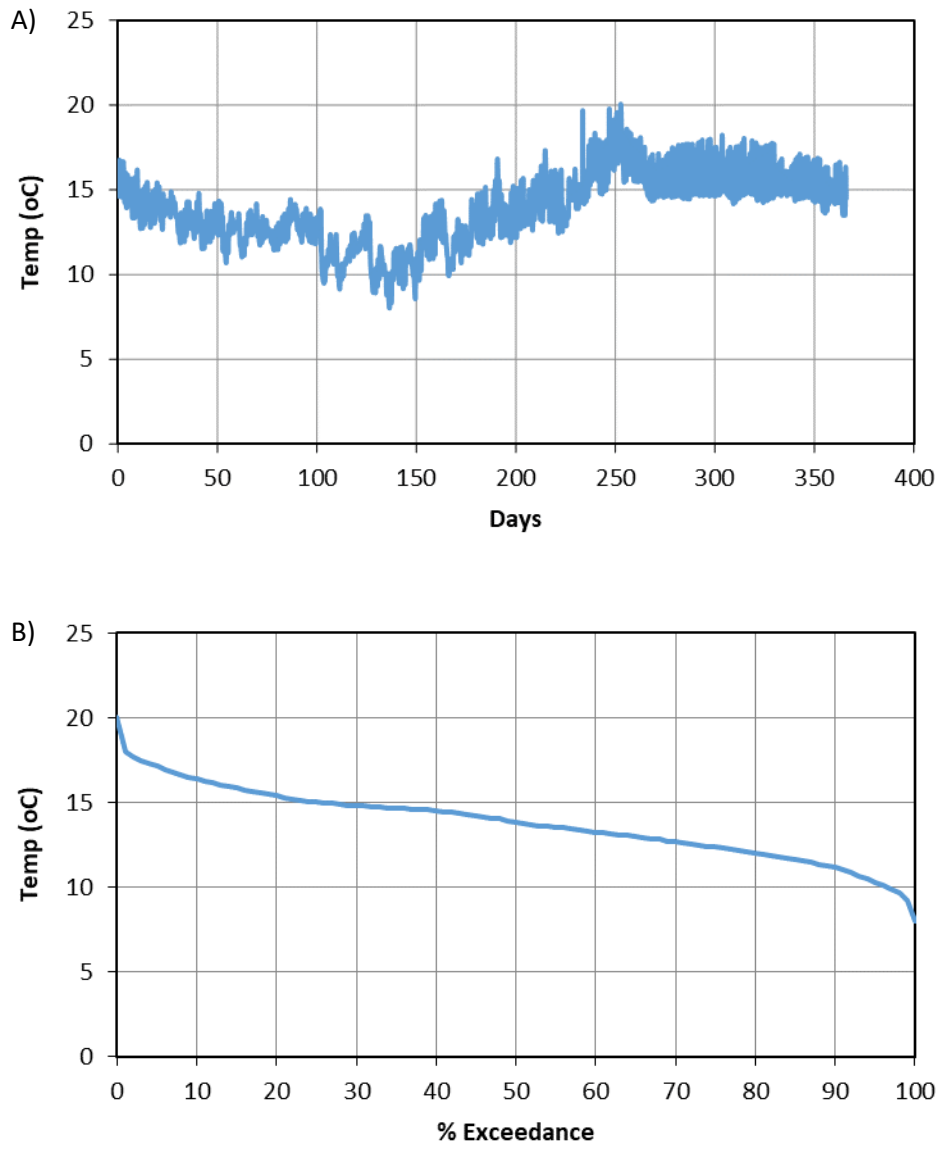


Figure 17. WY2020 A) 15-min temp data and B) annual temp duration curve for LBB.

Table 14. Daily Mean Water Temperature (°C) for WY 2020 at LBBT station.

Day	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Apr 2020	May 2020	Jun 2020	Jul 2020	Aug 2020	Sep 2020
1	15.38	12.58	11.95	12.57	12.21	11.13	13.08	14.77	16.31	15.03	15.46	15.16
2	15.32	12.66	11.37	13.37	12.26	12.43	13.44	15.60	16.42	15.34	15.48	15.19
3	15.34	12.76	11.64	13.57	12.65	12.63	13.42	15.31	16.73	15.44	15.48	15.30
4	14.90	13.15	12.26	12.69	12.46	11.82	12.71	14.46	18.39	15.48	15.38	15.22
5	14.72	13.73	12.83	12.56	9.93	11.94	12.91	14.59	17.01	15.53	15.29	15.16
6	14.78	13.21	13.21	12.46	9.16	12.05	13.60	14.35	17.46	15.28	15.39	15.28
7	14.60	13.07	12.77	12.42	9.54	11.90	14.30	14.46	17.91	15.56	15.48	15.30
8	14.20	12.68	13.09	12.40	10.04	12.28	15.35	14.61	17.20	15.63	15.47	15.25
9	14.29	13.21	13.59	12.91	10.60	12.65	14.56	14.01	18.49	15.51	15.67	15.23
10	14.88	13.61	12.53	13.69	11.17	13.04	13.43	14.32	17.70	15.61	15.80	15.29
11	14.50	13.14	12.27	10.99	10.29	12.93	13.16	13.52	16.82	15.61	15.47	15.33
12	13.49	11.98	12.44	9.58	10.02	12.67	13.53	13.17	16.95	15.74	15.42	15.21
13	13.63	12.19	12.54	10.43	9.25	12.43	13.10	13.28	17.14	15.52	15.55	15.30
14	13.85	12.70	12.59	10.91	8.75	11.15	12.92	14.39	17.12	15.51	15.73	15.15
15	14.40	12.55	12.50	11.74	9.13	10.12	12.97	14.96	16.95	15.69	15.72	15.05
16	13.94	12.62	12.28	11.40	10.38	10.56	13.33	14.75	16.64	15.70	15.68	15.17
17	13.58	12.87	12.07	10.85	11.12	11.14	13.08	15.34	16.53	15.42	15.45	15.18
18	13.74	13.20	11.87	11.53	11.25	11.76	13.30	14.44	16.47	15.72	15.49	14.91
19	13.87	13.28	11.95	10.24	10.48	12.47	13.31	14.56	16.48	15.74	15.43	14.57
20	14.52	13.20	12.13	9.70	10.82	12.63	13.67	14.70	16.13	15.84	15.28	14.56
21	14.60	13.88	12.33	10.14	10.19	11.57	13.91	14.80	16.13	15.64	15.42	14.65
22	13.65	12.53	12.66	10.28	10.38	11.46	13.23	14.64	15.52	15.54	15.44	14.69
23	13.58	11.63	12.59	10.76	11.16	11.90	13.56	15.13	15.38	15.71	15.50	14.75
24	13.85	11.50	12.61	11.10	11.53	11.67	13.72	15.94	15.31	15.76	15.60	14.66
25	13.93	12.07	12.81	11.19	10.92	11.58	13.84	16.50	15.23	15.64	15.59	14.94
26	13.86	12.88	13.54	11.67	10.06	12.78	14.00	16.28	15.09	15.62	15.30	15.06
27	14.04	12.92	13.44	11.78	9.71	13.43	14.05	16.86	15.24	15.61	15.19	15.01
28	14.32	12.68	13.76	11.69	10.57	13.46	14.68	16.76	15.47	15.40	15.85	14.84
29	14.09	12.95	13.77	11.46	10.77	13.34	14.94	16.57	15.15	15.46	15.34	14.34
30	13.45	13.22	12.81	11.69		12.76	14.66	16.16	15.30	16.32	15.06	14.51
31	12.73		12.60	12.07		13.30		16.20		15.56	15.21	
Mean	14.19	12.82	12.61	11.61	10.58	12.16	13.66	15.01	16.49	15.59	15.47	15.01
Max	15.38	13.88	13.77	13.69	12.65	13.46	15.35	16.86	18.49	16.32	15.85	15.33
Min	12.73	11.50	11.37	9.58	8.75	10.12	12.71	13.17	15.09	15.03	15.06	14.34

WATER YEAR 2021

Above Natural Area:

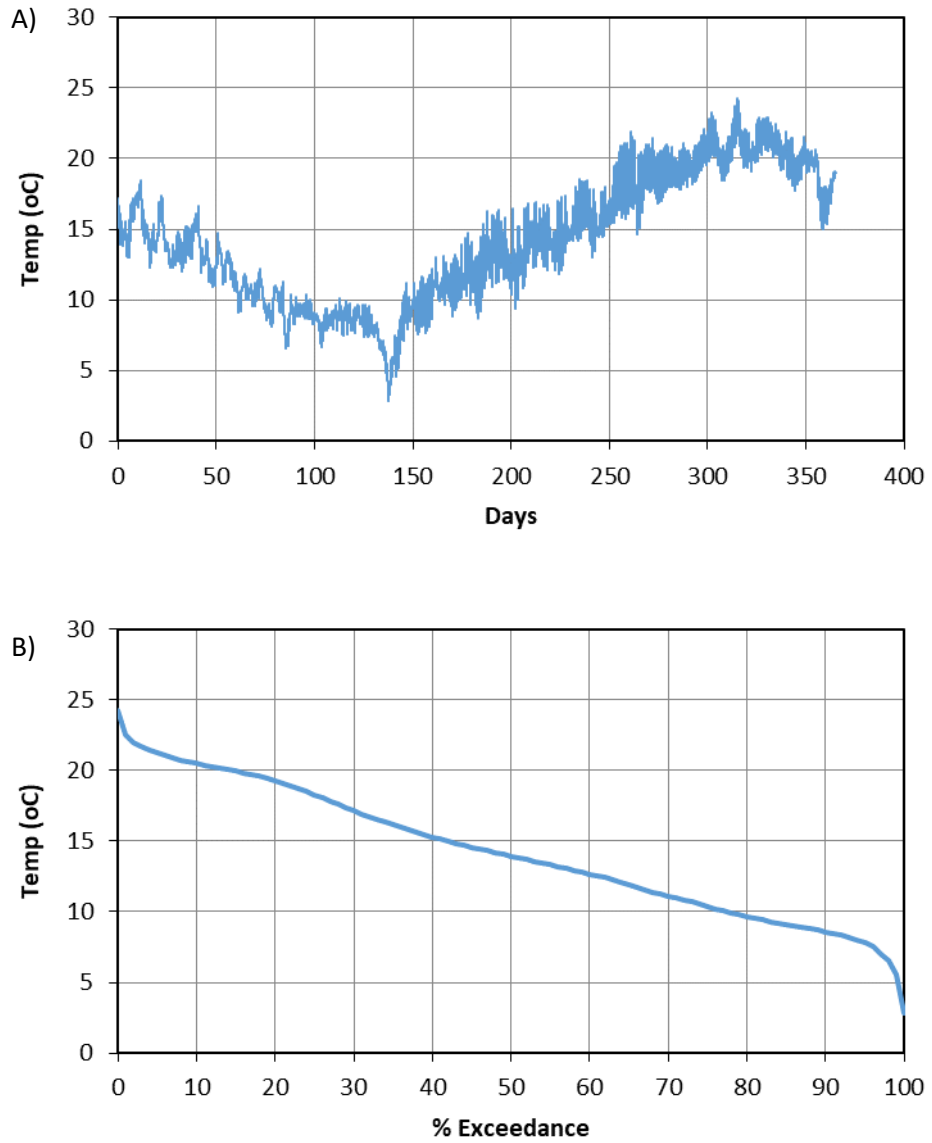


Figure 18. WY2021 A) 15-min temp data and B) annual temp duration curve for ANA.

Table 15. Daily Mean Water Temperature (°C) for WY 2021 at ANA station.

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	2020	2020	2020	2021	2021	2021	2021	2021	2021	2021	2021	2021
1	16.03	13.71	9.78	9.24	8.53	9.16	11.05	14.46	14.82	18.13	21.00	21.26
2	14.91	13.04	9.94	9.25	8.74	8.92	10.97	13.70	14.77	18.37	20.33	20.70
3	14.43	13.52	11.11	9.28	8.47	9.35	11.67	14.80	15.81	18.62	19.91	20.08
4	14.78	13.97	11.56	9.47	8.88	9.80	12.59	13.29	15.94	18.69	19.75	20.10
5	14.01	14.20	10.71	9.44	8.50	9.29	12.80	14.27	16.21	18.85	19.61	20.86
6	14.24	14.12	10.50	9.26	8.37	9.24	13.61	14.11	15.93	19.23	19.88	20.06
7	15.50	14.10	10.78	9.22	7.92	9.62	13.58	14.25	15.94	19.38	20.39	19.89
8	16.45	14.87	10.17	8.70	7.79	9.94	12.63	14.17	16.21	19.33	20.76	20.30
9	16.60	15.42	10.29	8.90	8.03	10.43	13.16	13.97	16.39	19.44	21.32	19.30
10	17.10	15.82	10.67	8.67	7.24	10.94	13.73	13.66	17.24	19.43	22.18	18.92
11	17.32	14.43	10.90	8.09	6.75	11.78	13.45	13.46	17.71	19.02	22.73	19.19
12	17.77	12.80	11.66	7.53	6.76	11.02	13.69	14.53	18.07	18.90	22.95	19.45
13	15.78	12.91	10.67	8.01	6.23	10.37	13.77	14.29	18.35	19.18	21.57	19.65
14	14.96	13.04	9.62	8.63	5.26	10.76	13.39	14.55	18.11	19.23	20.94	20.50
15	15.14	13.55	9.14	8.35	3.75	11.21	13.42	13.60	18.26	19.64	20.75	20.40
16	14.21	12.06	9.57	8.50	4.43	11.09	12.91	15.06	18.16	19.48	20.82	19.91
17	13.10	11.79	8.79	8.73	5.37	11.14	12.62	14.65	18.10	19.17	20.72	19.88
18	14.21	11.51	8.95	8.68	6.30	10.51	12.16	14.49	19.01	19.58	20.22	20.06
19	14.27	11.86	10.48	9.21	6.09	10.73	13.14	14.74	18.91	19.35	20.02	19.76
20	13.84	13.31	10.73	8.52	6.54	10.67	12.32	15.17	18.76	19.26	20.40	19.74
21	15.41	13.69	10.36	9.42	7.46	11.06	11.34	16.15	17.43	19.56	20.80	19.94
22	16.49	13.21	9.71	9.04	8.45	11.03	12.45	15.96	17.18	19.77	21.28	18.09
23	16.59	11.78	10.35	8.04	8.80	11.60	12.80	16.20	17.77	20.08	21.50	16.77
24	14.48	11.89	8.79	9.10	9.75	11.83	12.80	16.29	17.53	20.43	21.63	16.17
25	13.77	13.01	6.96	8.88	9.26	11.36	13.37	16.06	18.75	20.72	22.11	16.82
26	13.64	12.91	7.47	8.98	8.91	12.19	14.07	16.53	19.37	20.60	21.87	16.49
27	12.48	12.13	8.78	8.52	9.30	12.39	14.69	16.49	19.44	20.82	21.71	17.15
28	12.91	11.65	9.50	8.52	10.01	12.41	13.88	16.16	19.15	21.14	21.78	17.71
29	13.02	11.33	8.60	8.51		11.68	14.76	14.45	19.51	21.53	21.47	18.30
30	13.34	10.92	9.49	9.01		11.80	14.26	15.17	19.44	21.51	21.06	18.91
31	13.72		9.16	9.19		11.70		15.27		21.28	21.44	
Mean	14.85	13.08	9.84	8.80	7.57	10.81	13.04	14.84	17.61	19.67	21.06	19.21
Max	17.77	15.82	11.66	9.47	10.01	12.41	14.76	16.53	19.51	21.53	22.95	21.26
Min	12.48	10.92	6.96	7.53	3.75	8.92	10.97	13.29	14.77	18.13	19.61	16.17

Natural Area:

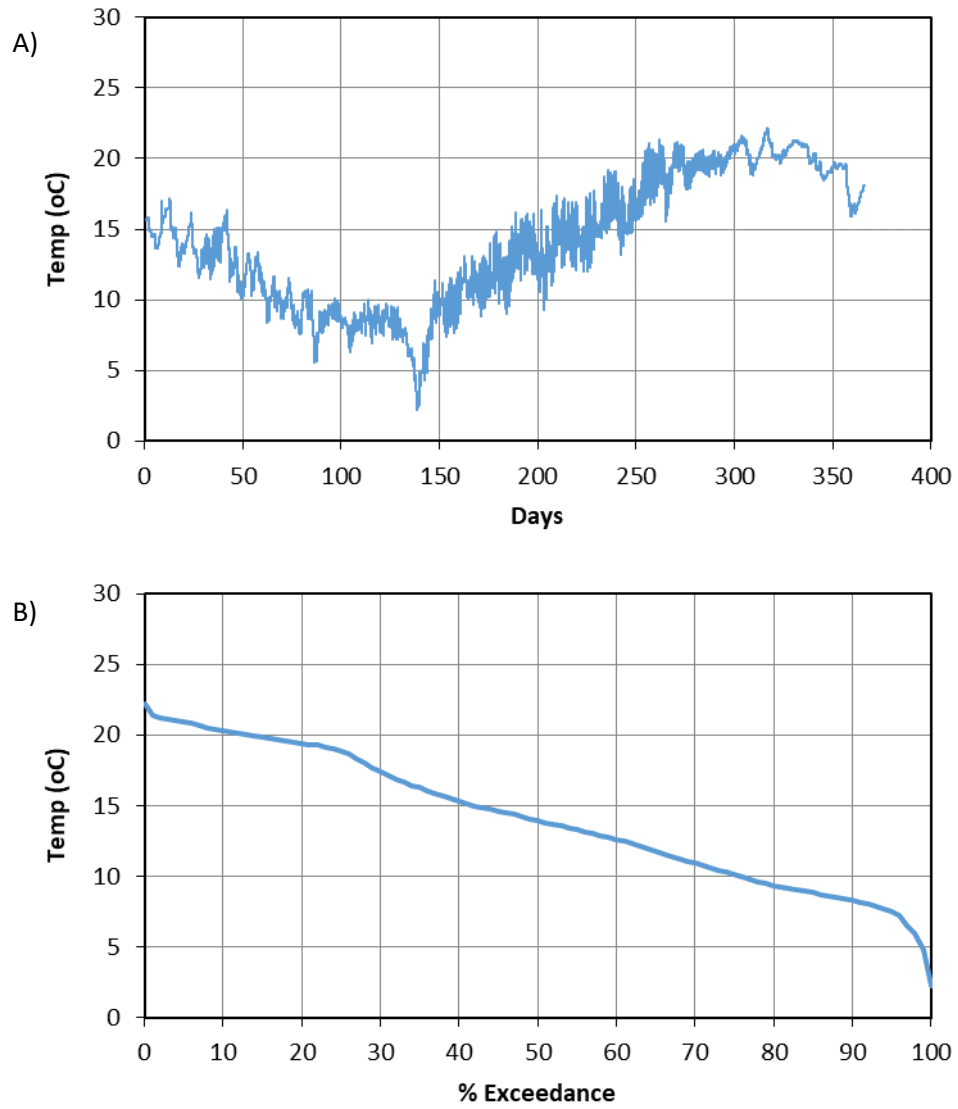


Figure 19. WY2021 A) 15-min temp data and B) annual temp duration curve for NAT.

Table 16. Daily Mean Water Temperature (°C) for WY 2021 at NAT station.

Day	Oct 2020	Nov 2020	Dec 2020	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	Jun 2021	Jul 2021	Aug 2021	Sep 2021
1	15.75	13.54	9.18	8.80	8.41	9.20	11.17	14.73	15.26	19.31	21.23	20.94
2	15.21	12.65	9.16	9.20	8.64	8.90	11.06	13.91	14.98	18.65	20.69	20.43
3	14.65	13.10	10.37	9.14	8.34	9.35	11.75	15.06	16.07	18.85	20.12	19.89
4	14.55	13.69	11.08	9.30	8.79	9.89	12.79	14.79	16.35	18.85	19.55	19.80
5	14.04	14.01	10.06	9.31	8.32	9.53	13.26	14.40	16.67	19.13	19.21	20.16
6	13.75	13.91	9.89	9.06	8.24	9.17	13.95	14.29	16.42	19.49	19.38	19.68
7	14.18	13.76	10.11	9.05	7.71	9.72	14.23	14.46	16.30	19.71	19.80	19.28
8	15.04	14.63	9.37	8.40	7.46	10.10	13.16	14.39	16.65	19.91	20.20	19.51
9	15.68	15.32	9.17	8.59	7.75	10.59	13.36	14.17	16.87	19.78	20.53	19.02
10	16.12	15.82	9.60	8.38	7.00	11.26	14.28	13.80	17.76	20.13	21.05	18.59
11	16.42	14.48	9.94	7.77	6.27	12.02	13.69	13.60	18.54	19.66	21.60	18.70
12	16.78	12.13	11.26	7.13	6.28	11.59	14.10	14.81	18.86	19.51	21.92	18.96
13	15.67	12.28	10.23	7.54	5.74	10.52	14.31	14.57	19.18	19.42	21.60	19.02
14	14.68	12.37	9.14	8.23	4.71	10.83	14.05	14.91	18.87	19.44	21.08	19.19
15	14.86	13.15	8.50	8.10	3.04	11.33	13.77	13.96	19.05	19.86	20.46	19.56
16	13.74	11.27	8.95	8.09	3.24	11.24	13.35	15.36	18.78	20.23	20.19	19.49
17	12.77	10.92	8.23	8.42	4.49	11.25	12.96	15.24	18.90	19.48	20.10	19.40
18	13.23	10.59	8.27	8.34	5.47	10.57	12.35	14.84	19.58	19.90	20.16	19.54
19	13.73	10.72	9.83	8.93	5.53	10.76	13.14	15.00	19.78	19.91	19.91	19.55
20	13.49	11.92	10.39	8.27	6.02	10.72	12.82	15.44	19.57	19.45	20.18	19.36
21	14.17	13.03	10.02	9.01	6.94	11.20	11.21	16.74	18.76	19.53	20.30	19.43
22	14.84	12.90	9.30	8.88	8.02	11.17	12.33	16.59	16.98	19.79	20.45	18.29
23	15.59	10.95	9.78	7.82	8.61	11.78	13.18	16.87	17.90	20.14	20.74	16.91
24	14.31	11.21	8.58	8.58	9.81	12.02	13.15	17.01	18.28	20.43	20.87	16.25
25	13.45	12.49	6.30	8.78	9.59	11.57	13.62	16.86	18.98	20.69	21.07	16.53
26	13.21	12.77	6.27	8.91	9.14	12.35	14.51	17.19	20.15	20.80	21.24	16.39
27	11.93	11.96	7.66	8.45	9.37	12.64	15.22	17.30	20.27	20.81	21.22	16.59
28	12.20	11.34	8.87	8.38	10.21	12.77	14.43	16.82	20.04	20.90	21.15	17.04
29	13.01	10.87	8.08	8.36		11.86	14.90	14.89	20.02	21.14	21.03	17.46
30	13.23	10.48	8.64	8.89		12.05	14.45	15.34	20.23	21.39	20.99	17.90
31	13.57		8.61	9.21		11.90		15.76		21.38	20.90	
Mean	14.32	12.61	9.19	8.56	7.25	10.96	13.35	15.26	18.20	19.92	20.61	18.76
Max	16.78	15.82	11.26	9.31	10.21	12.77	15.22	17.30	20.27	21.39	21.92	20.94
Min	11.93	10.48	6.27	7.13	3.04	8.90	11.06	13.60	14.98	18.65	19.21	16.25

Lower Big Barren:

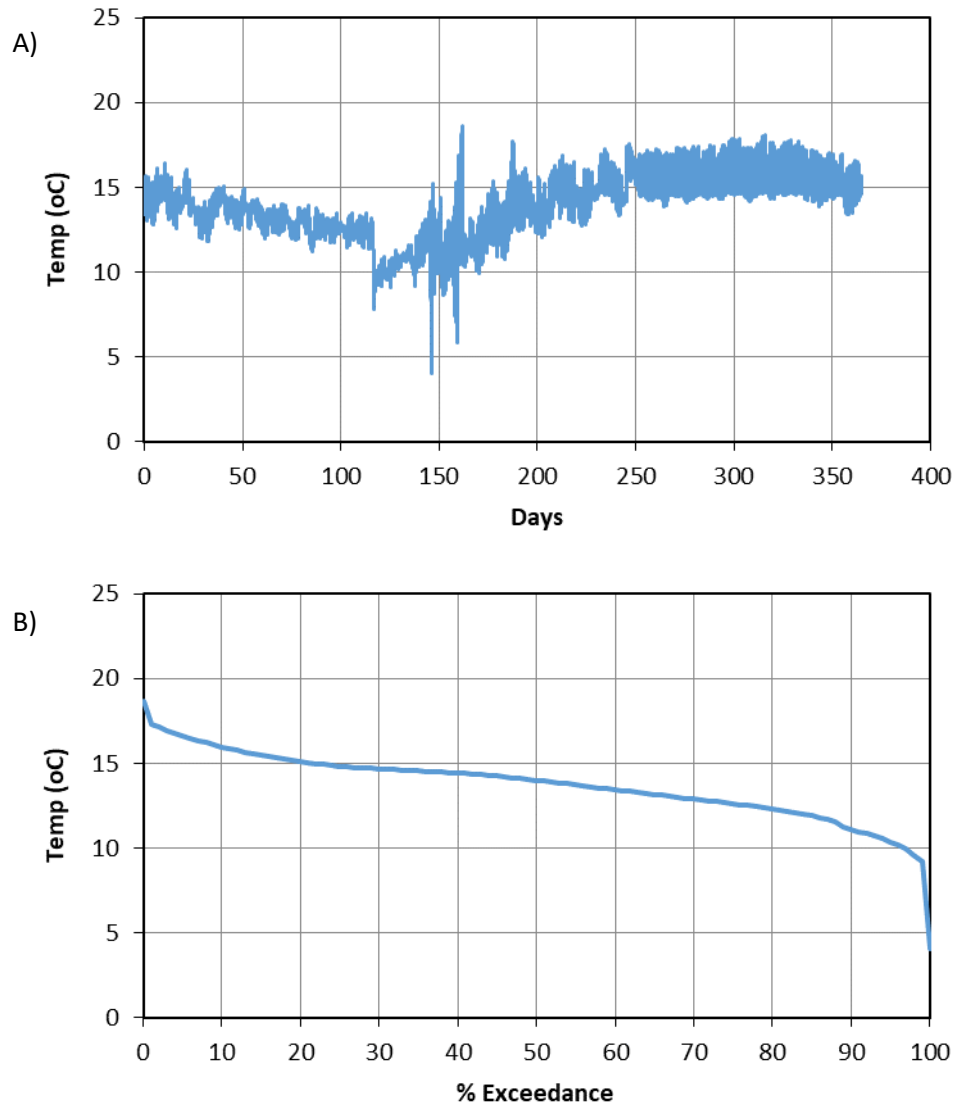


Figure 20. WY2021 A) 15-min temp data and B) annual temp duration curve for LBB.

Table 17. Daily Mean Water Temperature (°C) for WY 2021 at LBBT station.

Day	Oct 2020	Nov 2020	Dec 2020	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	Jun 2021	Jul 2021	Aug 2021	Sep 2021
1	14.29	13.08	12.50	12.59	9.70	10.04	12.26	15.01	14.08	15.06	15.55	15.47
2	14.01	12.72	12.76	12.86	9.97	9.97	12.26	14.33	14.24	15.38	15.28	15.24
3	13.98	13.21	13.31	12.37	9.91	10.52	12.73	14.97	15.81	15.20	15.29	15.10
4	14.26	13.59	13.30	12.27	10.42	11.16	13.31	15.13	16.49	15.16	15.25	15.26
5	13.78	13.81	12.94	12.32	10.44	10.94	13.77	14.56	16.31	15.23	15.23	15.59
6	14.07	13.88	12.97	12.64	10.66	10.97	14.31	14.53	16.01	15.33	15.26	15.12
7	14.55	13.94	13.05	12.56	10.44	11.00	14.35	14.56	15.81	15.33	15.40	15.18
8	14.62	14.29	12.75	12.55	10.61	10.18	13.35	14.45	15.56	15.11	15.45	15.21
9	14.78	14.39	12.96	12.58	10.87	10.42	13.57	14.27	15.36	15.38	15.60	14.91
10	14.78	14.48	13.06	12.50	10.78	13.17	14.08	13.93	15.32	15.27	15.77	14.97
11	15.00	13.78	13.22	12.21	10.88	15.49	14.12	13.71	15.20	15.21	15.77	15.07
12	14.85	13.54	13.41	12.07	11.15	11.25	14.38	14.39	15.32	15.20	15.78	15.05
13	14.06	13.52	12.89	12.28	11.01	11.32	14.37	14.23	15.34	15.27	15.26	15.17
14	14.18	13.85	12.49	12.52	10.50	11.39	13.91	14.43	15.22	15.30	15.44	15.31
15	14.18	13.63	12.41	12.19	9.85	11.98	13.79	13.93	15.22	15.44	15.41	15.18
16	13.67	13.19	12.68	12.43	10.74	11.98	13.49	14.69	15.15	15.05	15.43	15.17
17	13.59	13.18	12.37	12.39	11.00	11.84	13.33	14.57	15.17	15.38	15.39	15.10
18	14.37	13.11	12.69	12.43	11.44	11.12	13.08	14.44	15.40	15.30	14.91	15.20
19	13.84	13.43	13.28	12.61	11.36	11.15	13.54	14.77	15.32	15.23	15.50	15.01
20	14.13	13.99	13.29	12.17	11.55	11.45	13.00	15.30	15.30	15.29	15.16	15.27
21	14.75	13.93	13.12	12.70	11.86	11.91	12.95	15.88	14.75	15.33	15.50	14.84
22	14.81	13.69	12.82	12.23	12.26	11.93	13.29	15.55	14.97	15.39	15.54	14.56
23	14.58	13.09	13.30	11.94	11.57	12.45	13.41	15.56	15.06	15.57	15.39	14.38
24	13.69	13.42	11.91	12.67	9.24	12.75	13.36	15.45	14.93	15.54	15.61	14.45
25	13.92	13.87	11.66	10.52	10.86	12.34	13.93	15.20	15.41	15.61	15.66	14.67
26	13.65	13.70	12.19	9.34	10.53	12.98	14.55	15.11	15.39	15.67	15.54	14.52
27	13.16	13.50	12.80	9.65	11.08	13.35	15.05	14.85	15.29	15.66	15.54	14.82
28	13.57	13.19	12.78	9.70	12.40	13.39	14.56	14.91	15.40	15.61	15.51	14.83
29	12.72	13.15	12.40	9.90		12.68	15.44	13.98	15.46	15.49	15.56	14.98
30	12.76	12.68	12.85	10.44		12.64	14.80	14.37	15.54	15.68	15.46	14.91
31	13.15		12.49	10.22		12.69		14.29		15.55	15.53	
Mean	14.06	13.56	12.79	11.87	10.82	11.82	13.74	14.69	15.33	15.36	15.45	15.02
Max	15.00	14.48	13.41	12.86	12.40	15.49	15.44	15.88	16.49	15.68	15.78	15.59
Min	12.72	12.68	11.66	9.34	9.24	9.97	12.26	13.71	14.08	15.05	14.91	14.38

PHOTOS



Photo 4. Concrete housing is cabled to a tree root along the bank (April 14, 2021).



Photo 5. Temperature sensor inside PVC pipe and concrete housing (April 14, 2021).



Photo 6. PVC pipe being removed from the bottom of the concrete housing (April 14, 2021).



Photo 7. Temperature sensor inside secured inside PVC pipe (April 14, 2021).



Photo 8. Temperature sensor protected by rubber boot inside PVC pipe (April 14, 2021).



Photo 9. Temperature sensor is removed from rubber boot (April 14, 2021).



Photo 10. The Onset Hobo TidbiT Temperature Logger (April 14, 2021).



Photo 11. Temperature logger data is downloaded by waterproof shuttle (April 14, 2021).