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# Technical Memorandum

**December 21, 2016**

**To:** Rita Baker, Coordinator, Greater Oregon City Watershed Council

**From:** John Runyon, Cascade Environmental Group

**RE:** **Abernethy Creek and Tributary Water Temperature Monitoring, 2016**

## Introduction

This technical memorandum summarizes the findings of the summer 2016 Abernethy Creek and tributary stream water temperature monitoring study. The purpose of the monitoring study is to generally characterize water temperature patterns in Abernethy Creek and its tributaries. Understanding water temperature patterns throughout the watershed will assist the Greater Oregon City Watershed Council with targeting restoration projects that will benefit Abernethy Creek's water quality and fish populations.

## Water Temperature Monitoring Locations

Cascade Environmental Group placed continuous water temperature loggers (Onset HOBO Temperature Loggers; http://www.onsetcomp.com/) at 7 stream locations in Abernethy Creek and tributary streams (See attached map; Table 1): Abernethy Creek (3 sites); lower and upper Holcomb Creek (2 sites); upper Potter Creek (1 site); and lower Newell Creek (1 site). The loggers collected water temperature readings at 30 minute intervals beginning August 23 and ending September 28, 2016. To minimize spurious temperature readings resulting from thermal stratification within the water column, the loggers were placed in stream riffles or other locations with adequate flows to create thermal mixing.

**Table 1. Abernethy Creek and Tributary Stream Water Temperature Logger Locations and Monitoring Period**

| Stream System | Water Temperature Logger Location | 2016 Monitoring Period | Notes |
|---|---|---|---|
| Abernethy Creek | Upper Abernethy Creek Below Beaver Lake | August 23 – Sept. 28 | |
| | Abernethy Creek Below Hidden Lake | August 23 – Sept. 28 | NO DATA: Logger malfunctioned |
| | Lower Abernethy Creek Above (approx. 10 yds.) Confluence with Holcomb Creek | August 23 – Sept. 28 | |
| Holcomb / Potter Creek | Upper Holcomb Creek | August 23 – Sept. 28 | |
| | Lower Holcomb Creek Above (approx. 3 yds.) Confluence with Abernethy Creek | August 23 – Sept. 28 | |
| | Upper Potter Creek | August 29 – Sept. 13 | Logger exposed to the air sometime after Sept. 13; previous data is OK. |
| Newell Creek | Lower Newell Creek Above (approx. 3 yds.) Confluence with Abernethy Creek | August 29 – Sept.?? | NO DATA: Logger lost/stolen |

## Background

Water temperatures are influenced by solar radiation, stream shade, ambient air temperatures, channel morphology, groundwater inflows, and stream velocity, volume, and flow. In general, water temperatures increase as a stream progresses from its source to a larger system. A small, high gradient headwater stream with abundant shade and cold groundwater inflows is generally cooler than a large, low gradient valley stream with less shade and limited groundwater interaction. Surface water temperatures may also be warmed by human activities such as changing stream width or depth, reducing stream shading, and water withdrawals. Pacific Northwest streams usually experience sustained maximum water temperatures in late summer and early fall periods (July – mid-October) when stream flows are the lowest and solar radiation / air temperatures are at annual highs.

Water temperatures affect the physiology and biological cycles of aquatic species. For example, the timing of aquatic insect hatches and fish feeding cycles are largely determined by water temperature patterns. Water temperatures are a critical factor in maintaining and restoring healthy trout and salmon populations. The Oregon Department of Environmental Quality (DEQ) employs the seven-day-average maximum temperatures as a method to summarize and gauge the impact of temperatures on aquatic organisms. Because maximum water temperatures are averaged over a moving seven-day window, this method of summarizing the data accounts for longer periods of high water temperatures when fish and other aquatic organisms are the most stressed by sustained high water temperatures.

DEQ has established the following water temperature standards for salmon and trout (i.e., salmonids):

For a stream identified as having salmon and trout rearing, the seven-day-average of maximum temperatures may not exceed 64.4 degrees Fahrenheit (18.0 degrees Celsius).

For a stream identified as a trout or salmon migration corridor, the seven-day-average maximum temperature may not exceed 68.0 degrees Fahrenheit (20.0 degrees Celsius). In addition, the stream system must have cold water refugia that are sufficiently distributed so as to allow salmon and steelhead migration without significant adverse effects from higher water temperatures elsewhere in the stream system.

## Abernethy Creek and Tributary Stream Water Temperature Monitoring Findings

The data from the water temperature loggers were downloaded and the data were summarized as the seven-day-average of maximum temperatures. Water temperature data were not available for two monitoring locations: Abernethy Creek below Hidden Lake (logger malfunctioned) and Newell Creek above the confluence with Abernethy Creek (logger lost).

Figure 1 shows the seven-day-average of maximum temperatures for the five monitoring sites. In general, water temperatures track maximum daily air temperatures with a slight time lag because water responds more slowly than air to increased thermal inputs. The highest water temperatures occurred at the beginning of the monitoring period when there was sustained maximum air temperatures above 90.0 degrees Fahrenheit. As the monitoring period extended into September, there was a moderate increase in water temperatures as air temperatures warmed from September 10 to September 16, followed by cooler water as air temperatures declined through the end of September.

In general, the smaller tributary streams of Holcomb and Potter Creek had cooler water temperatures than larger Abernethy Creek. The highest tributary stream monitoring site in the system, Upper Holcomb Creek, had the coolest water temperatures. Interestingly, both Lower Holcomb Creek and Upper Potter Creek show similar water temperature patterns despite very different locations in the watershed. Usually temperatures are cooler higher in the watershed due to more groundwater inputs and less exposure to solar radiation. Thus, Upper Potter Creek, with its location high in the watershed, should be cooler than Lower Holcomb Creek which near the bottom of the drainage, but this does not hold true. Without additional information it is difficult to evaluate why the two sites have similar water temperatures. Local groundwater inputs in Lower Holcomb Creek or other factors could account for Holcomb Creek's cool temperatures at its confluence with Abernethy Creek.

The two Abernethy Creek monitoring sites sustained the highest water temperatures throughout the monitoring period. The Abernethy Creek site below Beaver Lake had considerably higher water temperatures than the site lower in the stream system (Abernethy Creek above Holcomb Creek confluence). The higher water temperatures at the upper Abernethy Creek site may be due to warm water originating from Beaver Lake. Beaver Lake has extensive open water areas exposed to solar radiation which could contribute to increased water temperatures.

Figure 2 shows the water temperature patterns for the five monitoring sites. Included in the graph are the DEQ water temperature standards for salmonid rearing and migration. Upper Holcomb Creek is the only site where water temperature patterns remained below the rearing and migration standards throughout the monitoring period. During the period of high air temperatures at the beginning of the monitoring effort, the lower Holcomb and upper Potter Creek sites exceeded the rearing standard (seven-day-average maximum temperature exceeding 64.4 degrees Fahrenheit). During the same period of sustained high air temperatures, the two Abernethy sites exceeded both the rearing and migration water temperature standards (exceeding 68.0 degrees Fahrenheit).

Holcomb Creek is a source of cool water to Abernethy Creek. Throughout the monitoring period, lower Holcomb Creek remained several degrees cooler than Abernethy Creek at the confluence of the two streams. Cold water tributaries offer trout and juvenile salmon cold water refuge areas where they can escape Abernethy Creek's high water temperatures.

## Recommendations

With a small number of sites, the 2016 water temperature monitoring results provide a limited evaluation of the water temperature patterns in the Abernethy Creek Watershed. In conjunction with stream/riparian habitat and fish inventories, the GOCWC should continue to monitor water temperatures at a variety of stream locations in order evaluate temperature patterns throughout the watershed. Additional water temperature information will assist with understanding how water temperatures in Abernethy Creek and tributaries influence fish distributions, including identifying key areas that provide thermal refugia. More water temperature monitoring data, collected strategically across the watershed, will help target restoration projects, such as planting native vegetation to shade streams and reduce water temperatures.

Future monitoring should focus on collecting water temperature data at a wider array of Abernethy Creek and tributary locations and over a longer duration, including:

- During the full extent of the summer period in order to better understand when water temperatures, particularly in Abernethy Creek, could be impairing fish rearing and migration.
- Over the length of Abernethy Creek, including above and below impoundments (e.g., Beaver and Hidden Lakes), in order to better understand temperature patterns as Abernethy Creek progresses downstream.
- In the lower and upper portions of tributary streams to understand broad patterns, identify areas of thermal refugia where fish can escape warm water areas, and to help target riparian restoration activities.

**Figure 1. Abernethy Creek and Tributary Stream Water Temperatures and Maximum Daily Air Temperatures Measured at Oregon City, 2016. Note: the upper Holcomb Creek logger was placed on August 29; water temperature data collection ended on September 13 when the logger was exposed to the air because of diminished stream flows.**

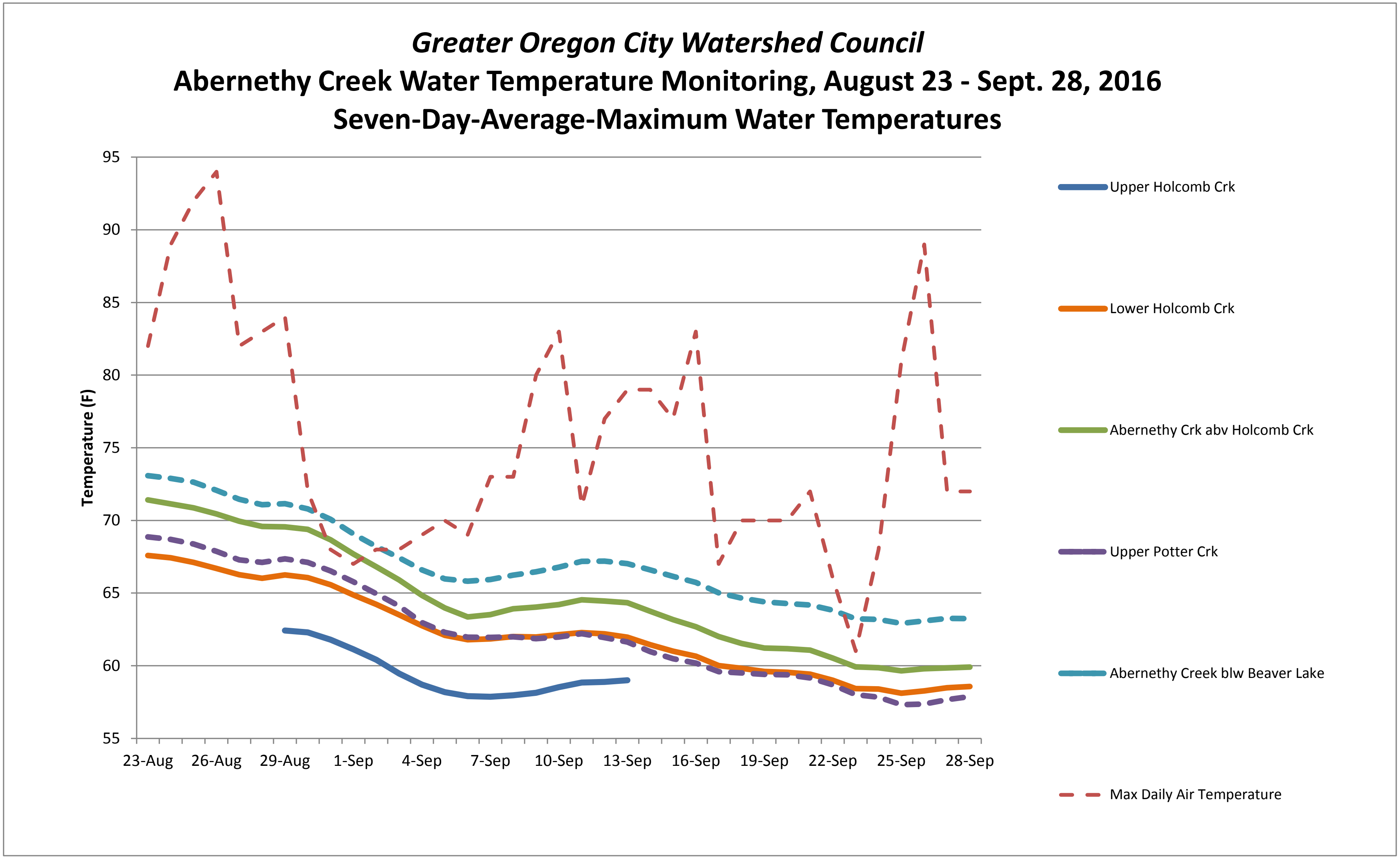
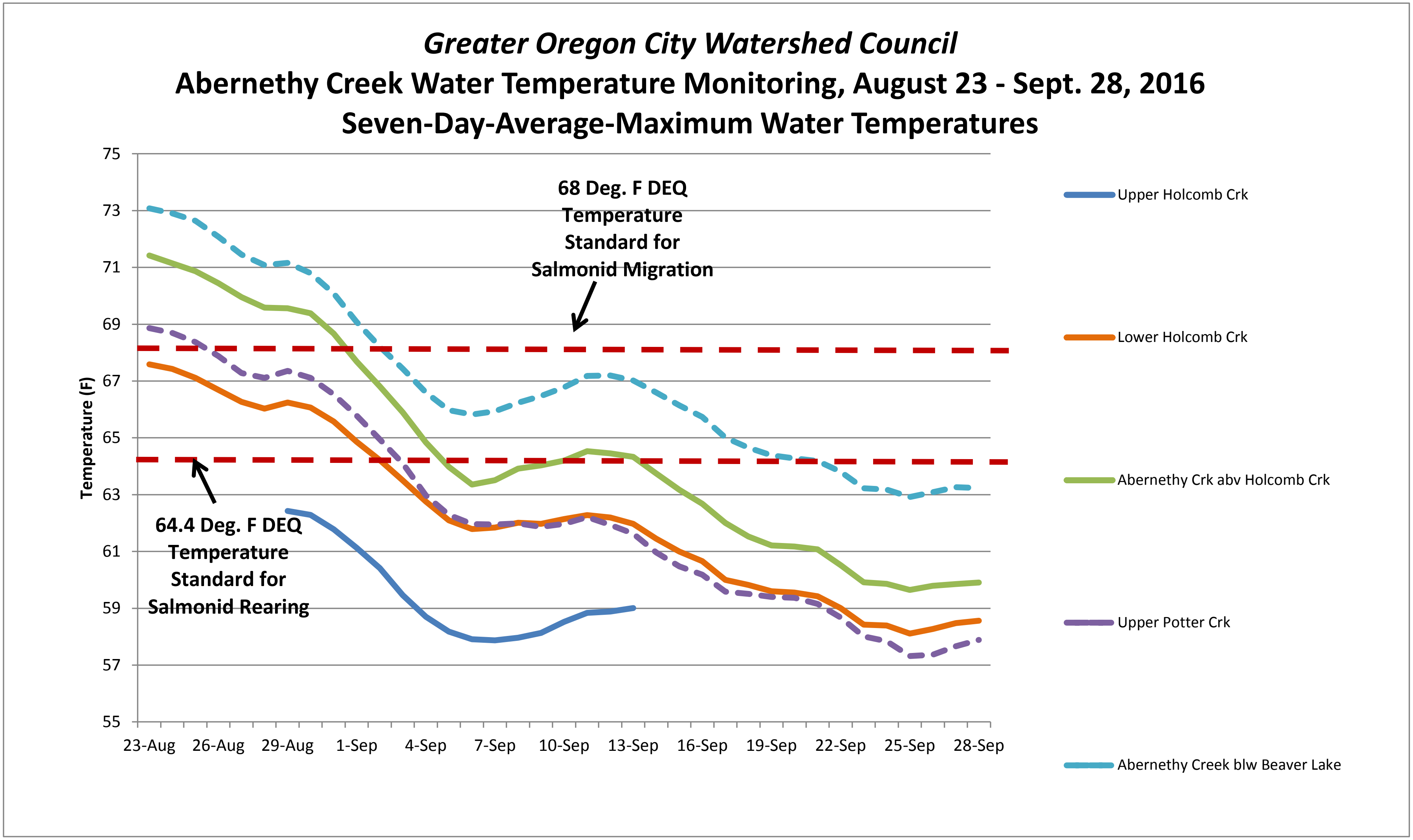
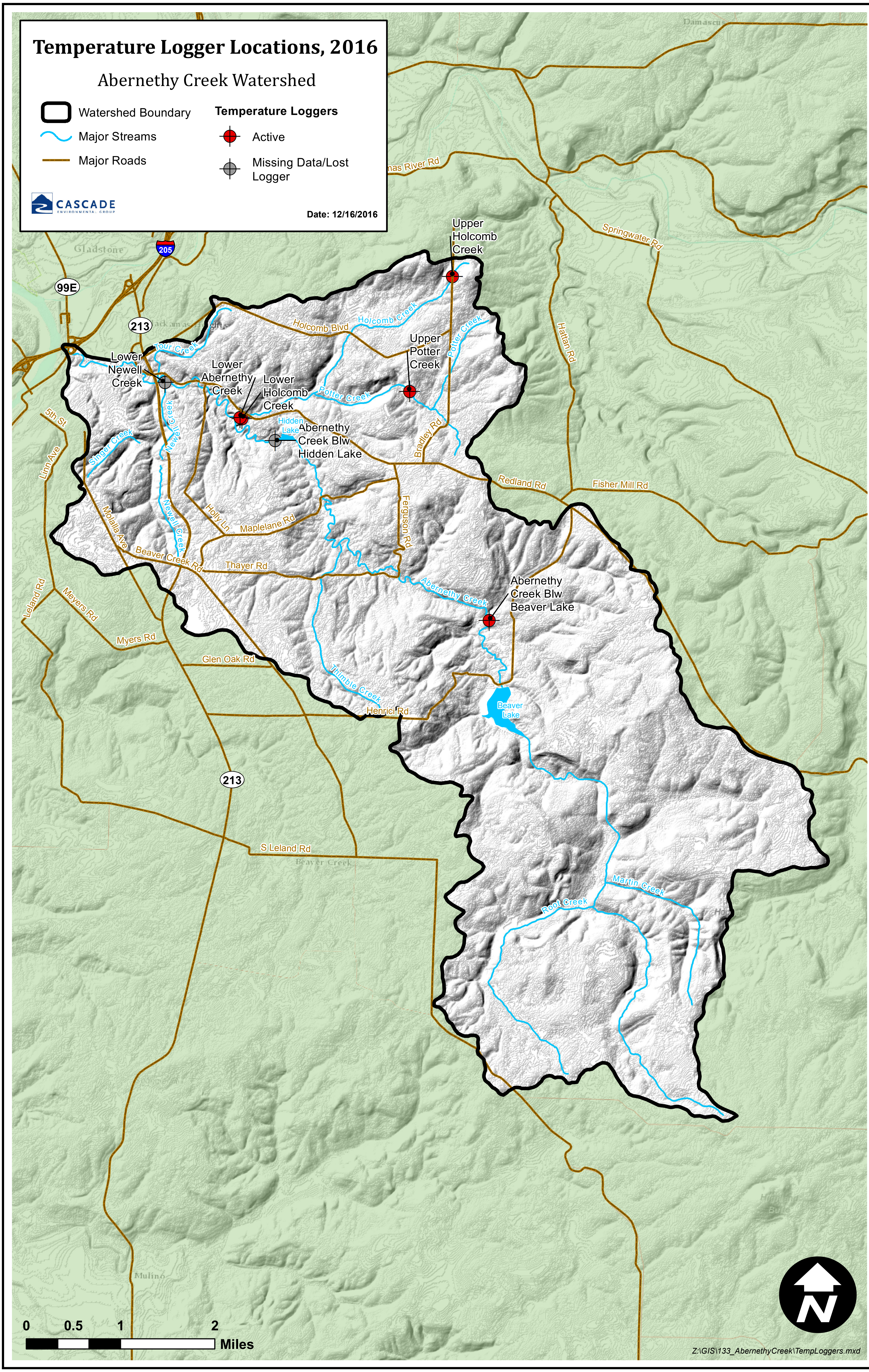


**Figure 2. Abernethy Creek and Tributary Stream 2016 Water Temperatures and the DEQ Water Temperature Standards for Salmon and Trout Migration and Rearing.**





Temperature Logger Locations, 2016
Abernethy Creek Watershed
Watershed Boundary
Major Streams
Major Roads
Temperature Loggers
Active
Missing Data/Lost Logger
CASCADE
Date: 12/16/2016
Damascus
Gladstone
205
99E
213
Upper Holcomb Creek
Upper Potter Creek
Lower Newell Creek
Lower Abernethy Creek
Lower Holcomb Creek
Abernethy Creek Blw Hidden Lake
Hidden Lake
Abernethy Creek Blw Beaver Lake
Beaver Lake
Holcomb Blvd
Holcomb Creek
Potter Creek
Tour Creek
Newell Creek
Singer Creek
Abernethy Creek
Thimble Creek
Martin Creek
Root Creek
Springwater Rd
Hattan Rd
Redland Rd
Fisher Mill Rd
Bradley Rd
Ferguson Rd
Holly Ln
Maplelane Rd
Thayer Rd
Beaver Creek Rd
Molalla Ave
5th St
Linn Ave
Leland Rd
Meyers Rd
Myers Rd
Glen Oak Rd
Henrici Rd
S Leland Rd
Beaver Creek
Mulino
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2
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