

Contents

Introduction	1
2017 Seepage Results	2
2018 Seepage Results	4
2019 Seepage Results	6
Conclusions	8
Appendix A Measurement Location Descriptions	13
List of Figures	
Figure 1. Map of Trail Creek	1
Figure 2. Results of the October 4, 2017 Trail Creek seepage survey	3
Figure 3. Map of October 4, 2017 seepage results	4
Figure 4. Results of the November 7, 2018 Trail Creek seepage survey	5
Figure 5. Map of November 7, 2018 seepage results	
Figure 6. Results of the November 22, 2019 Trail Creek seepage survey	7
Figure 7. Map of November 22, 2019 seepage results	8
Figure 8. Results of 2017, 2018, and 2019 seepage surveys	9
Figure 9. Trail Creek measurements with reach gains and losses	10
Figure 10. Net gains and losses of the three seepage surveys.	11
Figure 11. Temperature surveys of Trail Creek	12
Figure 12. Map of Measurement Location #1	14
Figure 13. Map of Measurement Location #2	15
Figure 14. Map of Measurement Location #3	
Figure 15. Map of Measurement Location #4	17
Figure 16. Map of Measurement Location #5	18
Figure 17. Map of Measurement Location #6	
Figure 18. Map of Measurement Location #7	
Figure 19. Map of POD #1	21
List of Tables	
Table 1. October 4, 2017 Trail Creek Data	า
Table 2. November 7, 2018 Trail Creek Data	
Table 3. November 22, 2019 Trail Creek Data	
Table 3. November 42, 2013 Hall Cleek Dald	

Introduction

A series of seepage surveys were conducted on the lower six miles of Trail Creek during the fall of 2017, 2018, and 2019. Trail Creek is a tributary stream to the Big Wood River with a confluence near the town of Ketchum, Idaho (Figure 1). The purpose of the seepage surveys was to determine and attempt to quantify streamflow gains or losses that occur within this section of the creek in support of the Big Wood Ground Water Flow Model that was recently developed in the Big Wood River basin.

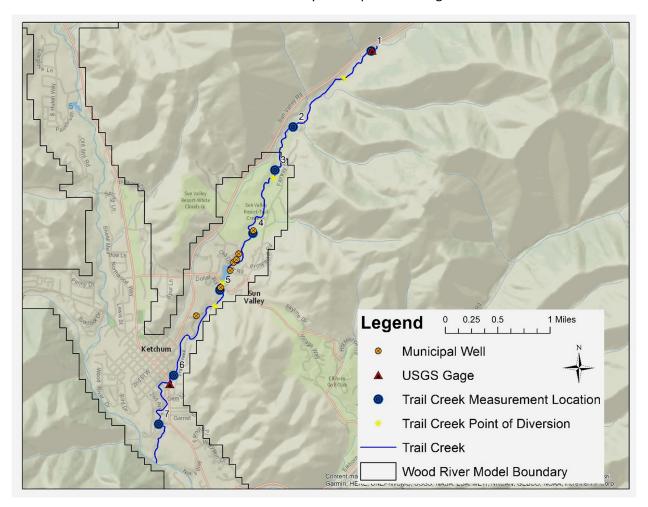


Figure 1. Map of Trail Creek

A StreamPro Acoustic Doppler Current Profiler (ADCP) was the primary source of equipment used to collect the flow measurements. A few locations and site conditions did not provide suitable cross sections to accurately operate the StreamPro, therefore, the hand held SonTek Flow Tracker was used. Each crew measured flows at the pre-determined locations, starting at the furthest upstream location and progressing downstream. The measurement locations remained constant throughout the annual seepage surveys.

Two USGS stream gage stations are located within this reach of Trail Creek. USGS Gage #13137300 is located at the start of the seepage run near measurement location 1. Gage #13137500 is located in the

town of Ketchum, between measurement locations 6 and 7. USGS gage records from these two stations were used for comparison purposes during the seepage runs.

Four tributary drainages were identified as potential sources of inflow to the system within this reach of Trail Creek. All four drainages were inspected for flow at or near the confluence with Trail Creek each day of the seepage runs.

IDWR records indicate there are five surface water right Points of Diversion (POD) on Trail Creek (Figure 1) within the seepage run reach. All five Trail Creek PODs were inspected for flow and/or measured on the day of each seepage run.

Multiple ground water wells, including seven municipal wells, exist within this reach of Trail Creek. Pumping records for the municipal wells were provided by Sun Valley Water and Sewer District and the city of Ketchum for the days of the seepage runs. Additional domestic ground water rights exist in the lower portion of the Trail Creek Valley. Pumping records for these withdrawals were not available.

2017 Seepage Results

The first Trail Creek seepage run occurred on October 4, 2017. Seven measurement locations (Figure 1 and Appendix A) were identified, starting at the National Forest Service Boundary Creek Campground, approximately 1.5 miles upstream of the Big Wood Valley ground water flow model boundary, and measuring downstream to the confluence of Trail Creek and the Big Wood River.

Flow rates during the 2017 seepage run were approximately 35 cubic feet per second (cfs), the highest of the three seepage runs. The higher flows of the first run resulted in a noticeable amount of leaf material and debris suspended in the water column, and yielded slightly higher than the average uncertainty in the individual flow measurements. However, measurements collected near the USGS gage stations indicated results close to the reported USGS values (Figure 2).

During the 2017 seepage run, a large diversion was actively diverting surface water between measurement locations #1 and #2 at river mile 0.4. Flow at the diversion's head gate was measured with a hand held Flow Tracker (6.2 cfs) and was accounted for in the net gain/loss calculation (Table 1). All other diversions were inspected and were not actively diverting during the seepage run. No contributing inflows were observed in any of the tributary basins.

Pumping records during the 2017 seepage run indicated that five of the seven municipal ground water diversions were active, and approximately 1.6 million gallons of water were pumped on the day of the seepage run (Table 1). This is the highest volume of water pumped during the three seepage runs.

Overall, the measurements from the 2017 seepage run indicate that Trail Creek is a losing reach within the model boundary from measurement location 3 to 7 (Figure 3). Upstream of the model boundary, measured Trail Creek flows indicate this reach was gaining during the seepage run. However, due to the uncertainty in the measurements with respect to the magnitude of the flow changes, gains or loses cannot be quantified with confidence.

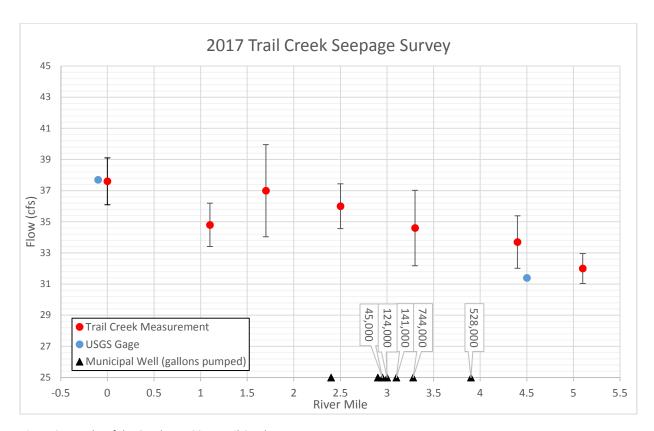


Figure 2. Results of the October 4, 2017 Trail Creek seepage survey.

Table 1. October 4, 2017 Trail Creek Data.

			6.				_	Gain (+)	Net Gain	
	Creek Measurements	Site	Stream	Flow	- 1	Uncertainty	- 1			
		No.	Mile	(cfs)	(%)	(cfs)	(F)	(cfs)	(-) (cfs)	
		1	0	37.60	4.0%	1.50	39.0	0	0	
		POD#1	0.4	6.20	2.0%	0.12	38.3	NA	0	
	eas	2	1.1	34.80	4.0%	1.39	40.8	3.40	3.40	
	M	3	1.7	37.00	8.0%	2.96	42.9	2.2	5.60	
	eek	4	2.5	36.00	4.0%	1.44	43.5	-1	4.60	
	TrailCr	5	3.3	34.60	7.0%	2.42	45.8	-1.4	3.20	
Data		6	4.4	33.70	5.0%	1.69	45.5	-0.9	2.30	
		7	5.1	32.00	3.0%	0.96	45.3	-1.7	0.60	
2017			4	verages	5.0%	1.56				
		Munici	oal Well	Production (Gallons)						
		Sun Val	ley Sewe	124,000						
	on	Sun Val	ley Sewe	45,000						
	ucti	Sun Val	ley Sewe	0						
	Well Production	Sun Val	ley Sewe	0						
		Sun Val	ley Sewe	141,000						
		Sun Val	ley Sewe	528,000						
		City of I	Ketchum	744,000						
		Total							1,582,000	

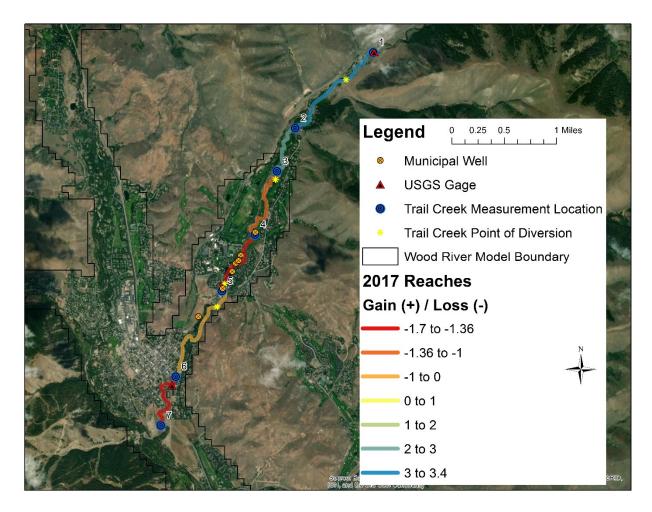


Figure 3. Map of October 4, 2017 seepage results.

2018 Seepage Results

The 2018 Trail Creek seepage run occurred on November 7, 2018. The same seven measurement locations that were measured in 2017 were used, starting at the National Forest Service Boundary Creek Campground and measuring downstream to the confluence of Trail Creek and the Big Wood River.

Flow rates during the 2018 seepage run were approximately 20 cfs, significantly lower than what was measured in 2017. The lower flow rates provided favorable conditions (more laminar flow with less debris) to collect high quality flow measurements with relatively low measurement uncertainty. However, the measurements collected near the USGS gage stations both indicated significantly higher flow than the estimated values reported by the USGS.

During the 2018 seepage run, none of the Trail Creek points of diversion were active and no measurements were required. No contributing inflows were observed out of any of the tributary basins.

Pumping records during the 2018 seepage run indicated that three of the seven municipal ground water diversions were active, and approximately 243,000 gallons of water were pumped the day of the seepage run (Table 2).

Overall, the measurements from the 2018 seepage run indicate that Trail Creek is a losing reach within the model boundary between measurement locations 5 to 7 (Figure 5). Upstream of these measurements, Trail Creek appears to been gaining during the seepage run. Due to the uncertainty in the measurements with respect to the magnitude of the flow changes, gains or loses cannot be quantified with confidence above measurement location 5.

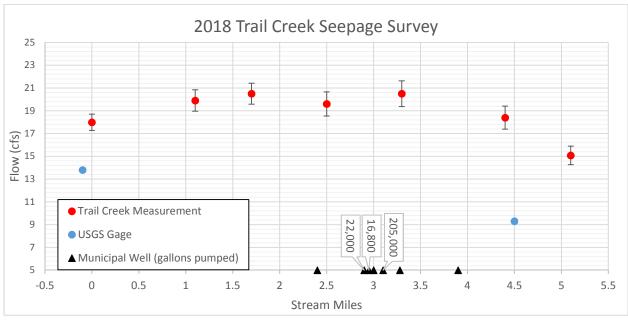


Figure 4. Results of the November 7, 2018 Trail Creek seepage survey.

Table 2. November 7, 2018 Trail Creek Data

	ts	Site	Stream	Flow	Uncertainty	Uncertainty	Temp	Gain (+) or	Net Gain (+) or Loss
	Trail Creek Measurements	No.	Mile	(cfs)	(%)	(cfs)	(F)	Loss (-) (cfs)	(-) (cfs)
		1	0	17.99	4.0%	0.72	34.1	0	0
		2	1.1	19.90	4.7%	0.94	35.4	1.91	1.91
		3	1.7	20.50	4.5%	0.92	36.6	0.6	2.51
		4	2.5	19.60	5.4%	1.06	38.5	-0.9	1.61
		5	3.3	20.50	5.4%	1.11	39.5	0.9	2.51
e,		6	4.4	18.40	5.5%	1.01	39.6	-2.1	0.41
Data		7	5.1	15.08	5.4%	0.81	38.7	-3.32	-2.91
2018			A۱	verages	5.0%	0.94			
20		Muni	cipal Well	Production	(Gallons)				
	Well Production	Sun V	alley Sewe	r and Wa	0				
		Sun V	alley Sewe	16,800					
		Sun V	alley Sewe	22,000					
		Sun V	alley Sewe	0					
		Sun V	alley Sewe	r and Wa	205,000				
		Sun V	alley Sewe	0					
		City o	f Ketchum	Well #2	0				
							Total	243,	800

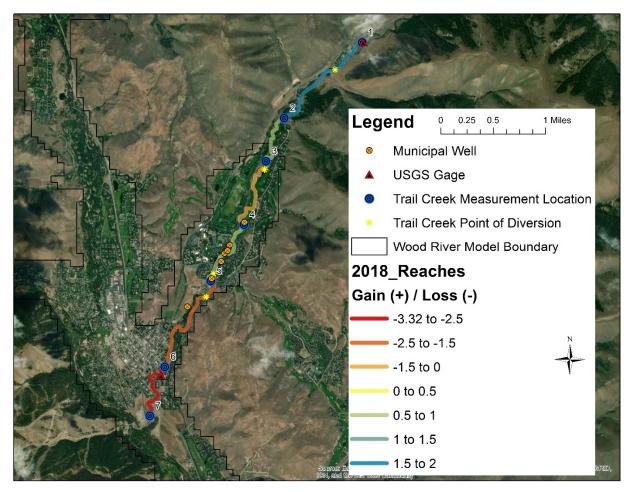


Figure 5. Map of November 7, 2018 seepage results.

2019 Seepage Results

The 2019 Trail Creek seepage run occurred on November 22, 2019, using the same seven measurement locations from 2017 and 2018. Starting at the National Forest Service Boundary Creek Campground (measurement location 1), flows were measured in order downstream to the confluence of Trail Creek and the Big Wood River (measurement location 7).

Flow rates during the 2019 seepage run were approximately 15 cfs, the lowest conditions of the three seepage runs. The lower flow rates provided favorable conditions to collect high quality measurements with moderate measurement uncertainty. Comparison of the measurements collected near the USGS gage stations indicated the upstream measurement was slightly higher and the downstream measurement was slightly lower than the provisional estimates reported by the USGS.

During the 2019 seepage run, none of the Trail Creek points of diversion were active and no measurements were required. No contributing inflows were observed out of any of the tributary basins.

Pumping records during the 2019 seepage run indicated that three of the seven municipal ground water diversions were active, pumping the lowest amount during the three seepage runs. The reported diversions were approximately 99,700 gallons the day of the seepage run (Table 3).

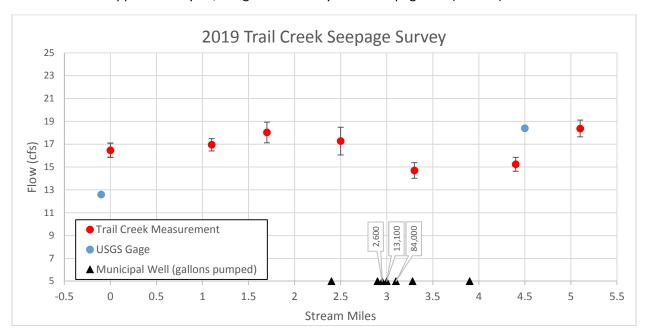


Figure 6. Results of the November 22, 2019 Trail Creek seepage survey.

Table 3. November 22, 2019 Trail Creek Data

	ts	Site	Stream	Flow	Uncertainty	Uncertainty	Temp	Gain (+) or Loss (-)	Net Gain (+) or Loss (-)
	Trail Creek Measurements	No.	Mile	(cfs)	(%)	(cfs)	(F)	(cfs)	(cfs)
		1	0	16.47	3.8%	0.63	32.5	0	0
		2	1.1	16.95	3.0%	0.51	32.5	0.48	0.48
		3	1.7	18.03	3.2%	0.58	34.1	1.08	1.56
		4	2.5	17.27	5.0%	0.86	32.5	-0.76	0.8
		5	3.3	14.70	7.0%	1.03	32.5	-2.57	-1.77
Ę		6	4.4	15.24	4.7%	0.72	32.0	0.54	-1.23
Data		7	5.1	18.37	4.0%	0.73	32.1	3.13	1.9
2019			Av	erages	4.4%	0.72			
20		Muni	cipal Well		Production (Gallons)				
	Well Production	Sun V	alley Sewe	er and W	13,100				
		Sun V	alley Sewe	er and W	2,600				
		Sun V	alley Sewe	er and W	0				
		Sun V	alley Sewe	er and W	0				
		Sun V	alley Sewe	er and W	84,000				
		Sun V	alley Sewe	er and W	0				
		City o	f Ketchum	Well #2	0				
		·	•	•	99,700				

Overall, the measurements from the 2019 seepage run indicated that Trail Creek is a losing reach within the model boundary between measurement locations 3 and 5, and gaining within the model boundary between measurement locations 5 and 7 (Figure 7). Upstream of the model boundary, Trail Creek appears to have been gaining during the seepage run. Due to the uncertainty in the measurements with respect to the magnitude of the flow changes, gains or loses cannot be quantified with confidence.

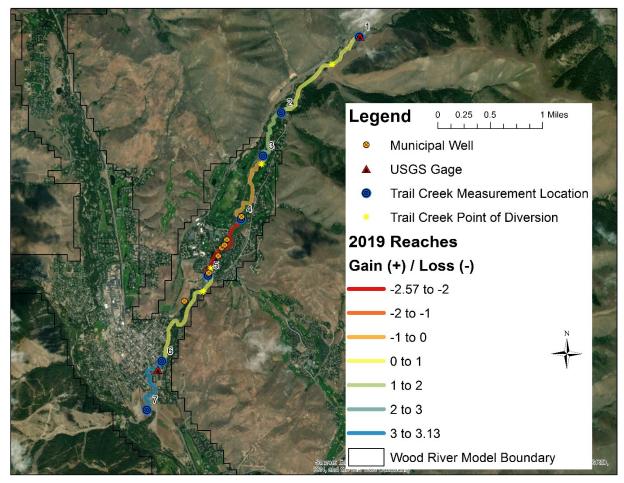


Figure 7. Map of November 22, 2019 seepage results.

Conclusions

Seepage data were collected on Trail Creek in the fall of 2017, 2018, and 2019. Results indicate that the measured reach of Trail Creek upstream and crossing the Wood River Model boundary between measurement location 2 and 3 is gaining, while it is losing just inside the model boundary between measurement location 3 and 4 (Figures 8 and 9). Farther within the model boundary, downstream of measurement location 3, data indicate that Trail Creek has reaches of gain and loss. Results from the seepage runs are qualitative, as it was difficult to precisely quantify gains or losses due to the uncertainty in the measurements with respect to the relatively small changes in flow rates between measurement locations.

Finally, active municipal well withdrawals contribute to reach losses between measurement locations 4 and 7. Reach losses are also affected by other potential ground water pumping in the area, and changes

in stream stage relative to ground water levels. Additional data are needed to evaluate the relationship between losing reaches and ground water withdrawals.

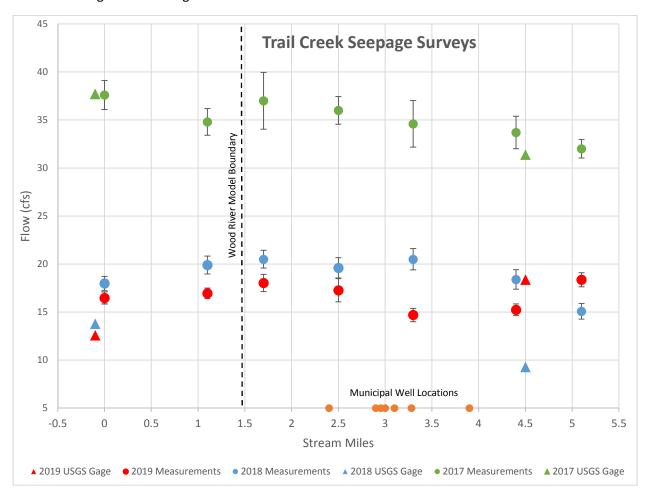


Figure 8. Results of 2017, 2018, and 2019 seepage surveys.

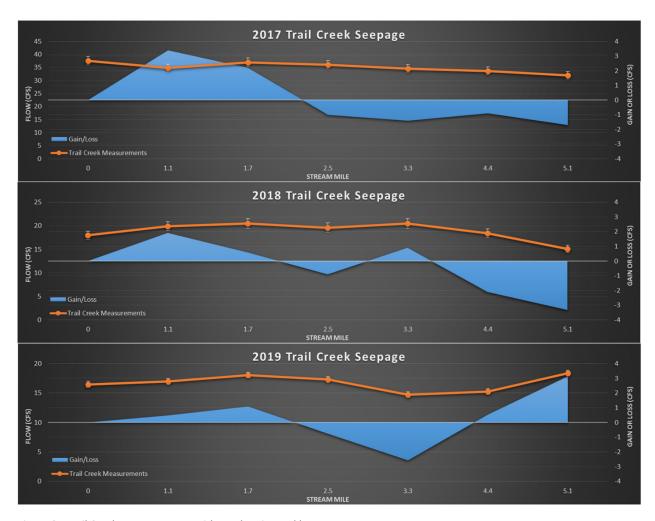


Figure 9. Trail Creek measurements with reach gains and losses.

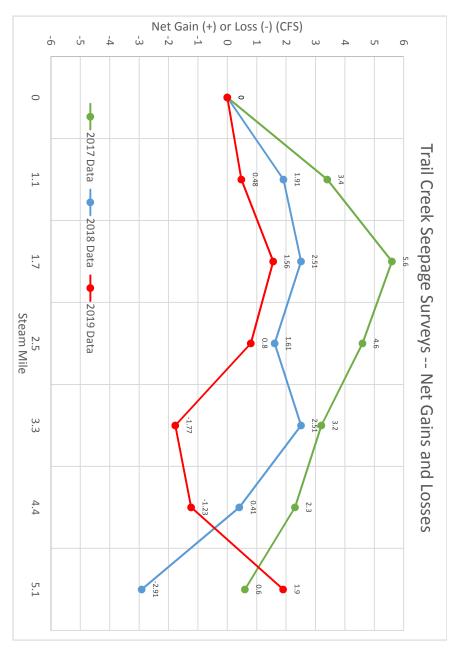


Figure 10. Net gains and losses of the three seepage surveys.

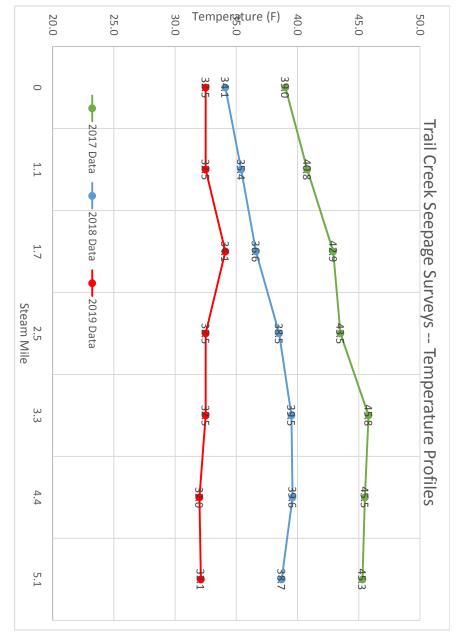


Figure 11. Temperature surveys of Trail Creek.

Appendix A -- Measurement Location Descriptions

<u>Measurement Location #1</u>: Farthest upstream measurement site located at a footbridge across Trail Creek at the National Forest Service Boundary Creek Campground. USGS Stream Gage #13137300 was located just upstream.



Figure 12. Map of Measurement Location #1

<u>Measurement Location #2</u>: Near the golf course restaurant at the northern end of the golf course property. A bridge across Trail Creek was selected as the measurement site.

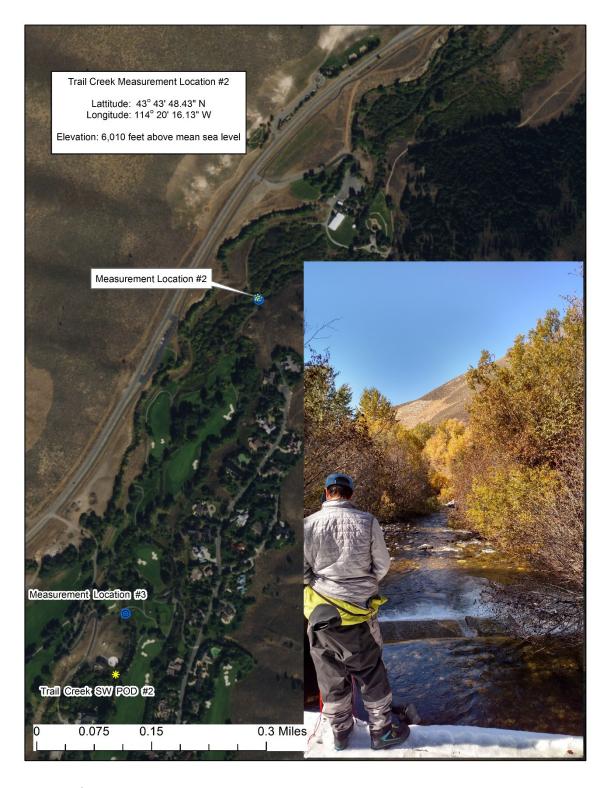


Figure 13. Map of Measurement Location #2

<u>Measurement Location #3:</u> Located on the Sun Valley Golf Course and accessed off of Golf Lane approximately 0.5 miles downstream from Location #2. The measurement site was just downstream from a golf cart bridge across Trail Creek.

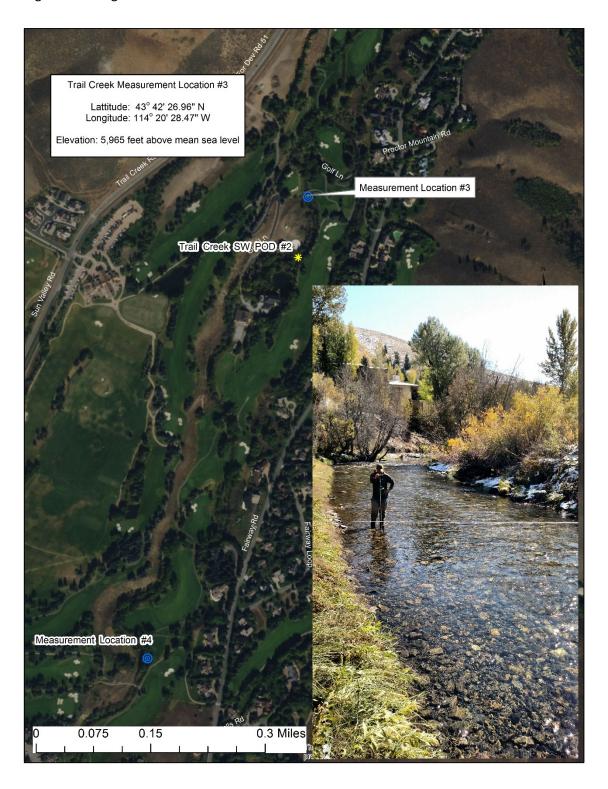


Figure 14. Map of Measurement Location #3.

<u>Measurement Location #4</u>: Located on the Sun Valley Golf Course with access via a golf cart bridge that crosses Trail Creek.

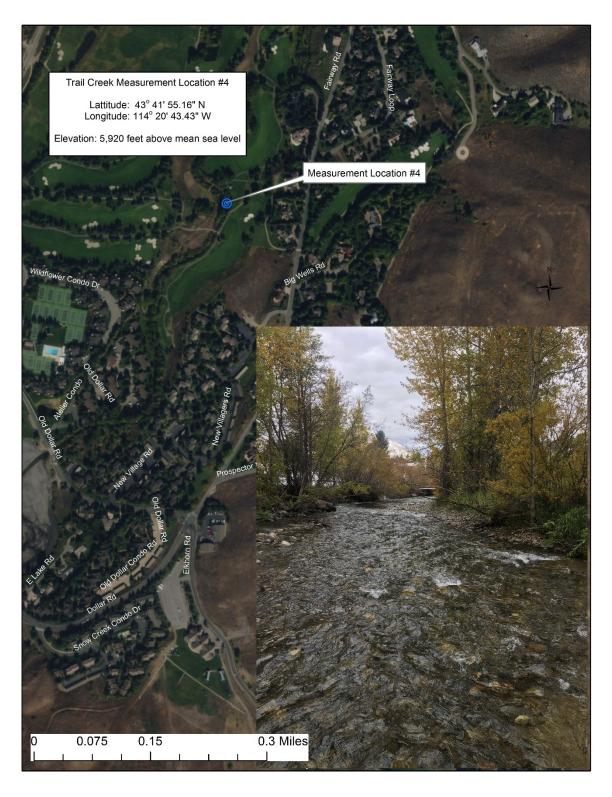


Figure 15. Map of Measurement Location #4.

<u>Measurement Location #5</u>: Downstream of the dam south of Sun Valley, approximately 0.6 miles downstream from Location #4.



Figure 16. Map of Measurement Location #5.

<u>Measurement Location #6</u>: Located in the residential portion of the town of Ketchum, accessed at the bridge over Trail Creek on Leadville Road. This location was approximately 1 mile downstream from Measurement Location #5.



Figure 17. Map of Measurement Location #6.

<u>Measurement Location #7</u>: Near the mouth of Trail Creek and the Big Wood River, just downstream of the Serenade Lane Bridge that crosses Trail Creek.

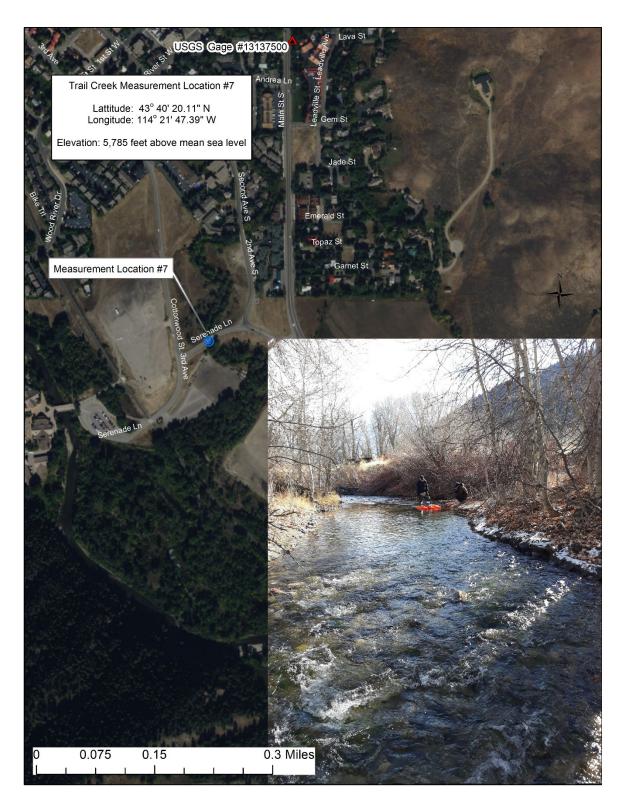


Figure 18. Map of Measurement Location #7.

<u>POD #1 Location</u>: Approximately 0.5 miles downstream from the Boundary Creek Campground measurement location, a surface water diversion for the Sun Valley Golf Course was located (POD #1). This diversion was active and the flow rate near the head gate off of Trail Creek was measured at 6.2 cfs, measured using a Flow Tracker.

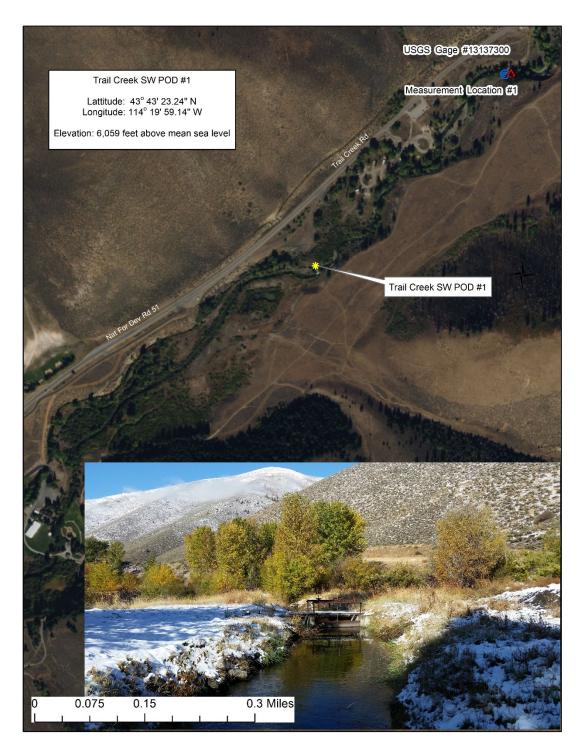


Figure 19. Map of POD #1