Natural Lake Level Recommendation:
Square Top Lakes

Contact Information:

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Introduction:

This document contains the necessary information to form the scientific and biological basis for natural lake level (NLL) recommendations for the two lakes that make up Square Top Lakes in Clear Creek County, Colorado. These two natural lakes are currently being managed as future reintroduction sites for greenback cutthroat trout (*Oncorhynchus clarki stomias*). Greenback cutthroats are currently listed as a threatened species under the Endangered Species Act and by the State of Colorado; greenback cutthroat trout is also designated as Colorado's state fish. Maintaining a natural lake level in both of these lakes is a critical aspect of CPW's efforts to recover this subspecies of cutthroat trout. In 2014, CPW and CWCB were contacted by members of the Park County Advisory Board on the Environment (ABE); ABE is a citizen advisory sub-committee that was established by the Park County Board of County Commissioners (BOCC) to assist them with community outreach on environmental issues in the county. ABE's initial interest in instream flow (ISF) and NLL protection in the county was triggered by some of the Colorado Water Plan public meetings that were going on at that time in various locations around the state. CPW and CWCB met with ABE and the Park County BOCC to discuss existing ISF water rights in the county and places where significant resource values exist in the county without ISF protection. After several meetings that included ABE, the BOCC and local representatives of the Colorado Cattlemen Association, a list of priority streams and lakes in Park County was generated by CPW, CWCB and ABE; the Square Top Lakes were on that list of priority water bodies that emerged from this collaborative process. While the Square Top Lakes are not in Park County, the rest of the watershed downstream of the Lakes is entirely in Park County and they are managed by the CPW Park County staff. CPW believes that the information compiled in this document provides the basis for the findings necessary for a NLL appropriation stated in the ISF statutes and in ISF Program Rule 5(i).

The State of Colorado's Instream Flow and Natural Lake Level Program (ISF/NLL Program) was created in 1973 when the Colorado General Assembly passed Senate Bill 97. This bill recognized, "the need to correlate the activities of mankind with some reasonable preservation of the natural environment (C.R.S. §37-92-102 (3))." Creation of this state program identified the CWCB as the only state agency with the ability to appropriate and acquire instream flow and natural lake level water rights. In an effort to promote participation in the ISF/NLL Program

by other entities the state statute requires the Board to consider instream flow recommendations by local, state, or federal agencies. CPW is recommending both the upper and lower lake of Square Top Lakes complex for inclusion in the ISF/NLL Program because we believe that there is a natural environment that can be preserved to a reasonable degree with a natural lake level water right.

CPW is sending these natural lake level recommendations to the Board in order to meet CPW's legislative declaration, "… that the wildlife and their environment are to be protected, preserved, enhanced, and managed for the use, benefit, and enjoyment of the people of this state and it's visitors… and that, to carry out such program and policy, there shall be a continuous operation of planning, acquisition, and development of wildlife habitats and facilities for wildlife-related opportunities (C.R.S. § 33-1-101 (1))," and, "… that the natural, scenic, scientific, and outdoor recreation areas of this state are to be protected, preserved, enhanced and managed for the use, benefit, and enjoyment of the people of this state and visitors of this state… and that to carry such program and policy there shall be a continuous operation of acquisition, development, and management of outdoor recreation lands, waters, and facilities (C.R.S. §33-10-101 (1))."

In addition to these broad statutory guidelines, CPW's current strategic planning document (*CPW Strategic Plan*, 2015) explains current agency goals to, "[c]onserve wildlife and habitat to ensure healthy sustainable populations and ecosystems." In order to, "protect and enhance water resources for fish and wildlife populations," by pursuing, "partnerships and agreements to enhance instream flows, protect reservoir levels, and influence water management activities," and to, "[a]dvocate for water quality and quantities to conserve aquatic resources." In addition to the CPW strategic plan, the agency's fish and wildlife conservation activities are also directed by the State Wildlife Action Plan (2002, Revised 2015). The goals and priorities from these documents direct CPW to advocate for the preservation of the state's fish and wildlife resources and natural environment, and therefore link CPW's mission to the goals and priorities of CWCB's ISF/ NLL Program.

Lake Location Information

The upper lake of Square Top Lakes:
UTM North: 4382761.79641; UTM East: 436070.94003
Elevation: 12,322.38 feet
Surface Area: 328,674 square feet (7.55 acres)
CPW Water Code: 56588
Calculated Approximate Volume: 113.14 acre-feet

The lower lake of Square Top Lakes:
UTM North: 4382635.16306; UTM East: 436470.85292
Elevation: 12, 083.77 feet

Surface Area: 304,377 square feet (6.99 acres)
CPW Water Code: 56576
Calculated Approximate Volume: 26.79 acre-feet

Water Division: 1
Water District: 80
County: Clear Creek County
Major Drainage Basin: South Platte
USGS quad maps: Mt. Evans

NOTE: The approximate volumes and elevations of the above lakes were determined by bathymetric data collected by CPW personnel, GPS and GIS measurements (for elevation and surface area), and subsequent AUTOCAD calculations (performed by CPW design engineers) based on this information.

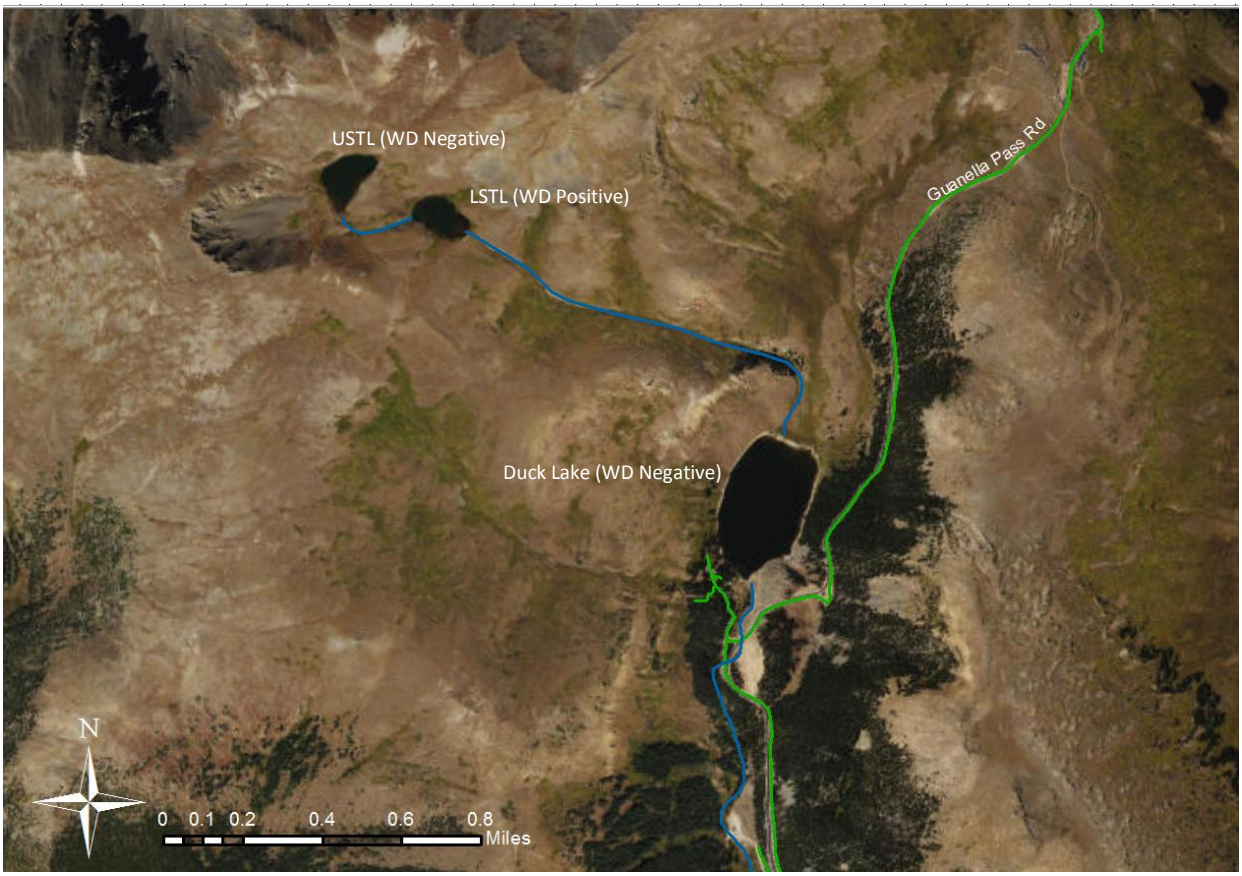


Figure 1. Map showing the location of the upper (USTL) and lower (LSTL) lakes of the Square Top Lakes complex.

Natural Environment

The greenback cutthroat trout was designated Colorado's state fish in 1994. This subspecies of cutthroat trout has been listed as a threatened species by both the state and federal government. Following the listing of the greenback cutthroat trout under the authorities on the Endangered Species Act of 1973, state and federal fish and wildlife managers have engaged in efforts to establish new populations of this subspecies around the state of Colorado. The greenback cutthroat trout recovery plan's overall goal is as follows:

> "The objective of the greenback cutthroat trout recovery plan is the removal of this subspecies from the list of Threatened and Endangered Species. This subspecies will be considered recovered when 20 stable greenback cutthroat trout populations are documented representing a minimum of 50 hectares of lakes and ponds and 50 kilometers of stream habitat within its native range. A minimum of five of these will exist in the Arkansas River drainage. Once recovery objectives have been met, a long range management strategy will be implemented for the continued restoration of the species." (Greenback Cutthroat Trout Recovery Team, 1977)

Establishing new conservation populations of greenback cutthroat trout and protecting the habitat where these populations reside will be critical to the success of the identified conservation efforts, actions and activities. CPW believes that if Square Top Lakes are protected by an NLL water right, this action can be a critical step in the overall preservation and conservation of greenback cutthroat trout.

The upper and lower Square Top Lakes are high elevation alpine lakes found east of Square Top Mountain in Clear Creek County. These lakes are cirque basin lakes that are situated above timberline and as such are characteristic of cold water aquatic habitat. The upper Square Top Lake (USTL) has a maximum depth of 38.7 feet, and a surface area of 328,674 square feet. The lower Square Top Lake (LSTL) has a maximum depth of 11.5 feet, and a surface area of 304,377 square feet. The main source of water for these natural lakes is snowmelt runoff, and any occasional precipitation events that occur during the year; USTL is truly a headwaters lake since no identifiable creeks flow into the lake. USTL is located just a quarter of a mile west of LSTL. Water from USTL flows into LSTL and then into Duck Lake via a small un-named tributary.

Several years ago, CPW researchers and aquatic biologists discovered whirling disease (WD) in the Square Top Lake drainage basin. The WD lifecycle is complex and involves an intermediate host with specific genetics - the tubifex worm. LSTL was found to be whirling disease positive. *Myxobolus cerebralis* (Mc) is a parasite that causes WD in fish; it has a two-stage life cycle where it lives in two alternate hosts. The first stage of this Mc's life cycle is in the aquatic worm, *Tubifex tubifex*. The second host is the salmonid where Mc lives in the cranial cartilage. The Mc life cycle is complicated by the fact that only a specific lineage of the tubifex worm can serve as the intermediate host for Mc (lineage III) (Nehring 2014). The other lineages (I, IV, and IV) are

not able to transmit and therefore sustain Mc infection of a water body. LSTL has lineage III tubifex worms and is therefore WD positive. USTL has only lineage VI worms and is therefore incapable of sustaining a WD infection. Since Square Top Lakes are high elevation cold water habitats the water might be too cold for any WD infection to be considered severe. The tubifex genetics dataand the cold water makes these lakes good candidates for "clean up" by simply interrupting the Mc lifecycle.

Interrupting the life cycle of Mc should result in a situation where the disease is removed from the system over time. The viability of Mc decreases exponentially when one of the hosts are eliminated, and it is thought that this can occur over a time span of about one year (Nehring 2014). In 2010 CPW made the decision to remove all cutthroat trout out of LSTL by the use of gill nets, and keep the lake free of fish for 2-3 years (Nehring 2014). Gill nets were routinely set in LSTL each summer for several weeks to ensure movement of fish did not occur between the two lakes. Additionally, nets were set at the outlet of USTL, and at the inlet of LSTL isolating LSTL from fish movement into the lake, and removing all fish from the lake. All fish have been removed from USTL as well, but this was for the purpose of avoiding hybridization of the greenback cutthroat with the non-native species that were present.

Once the disease has been removed from the system these lakes will become ideal water bodies for conservation activities to aid in the recovery of this listed species; recall from the above discussion that greenback cutthroats are listed by both the State and Federal government as threatened.

Another fortunate aspect of the Square Top Lakes system as it relates to Greenback cutthroat conservation activities is that these high, alpine lakes are completely isolated and do not interact with any other water body. Once the greenback cutthroat trout are introduced to these lakes they will be completely isolated from any other species, they will have little risk of a re-infection by Mc, they will not have competition for food resources, and they will not be at risk of hybridization with other trout.

NLL Recommendation:

It is Colorado Parks and Wildlife's opinion that if the CWCB appropriates water rights in the volumes and water surface levels recommendation herein, that the natural environment will be preserved to a reasonable degree. It is also our opinion that if the CWCB takes this action that this will aid CPW in our efforts to recover these fish and a future de-listing of this species might be possible.

Citations

AFS Blue Book, Characteristics of *Myxobolus cerebralis* and other Myxozoans common to salmonid fish, 2014.

Greenback Cutthroat Trout Recovery Team, and David L. Langlois, 1977, Greenback cutthroat trout recovery plan, US Fish and Wildlife Service.

Kowalski, D., 2013, Colorado River Aquatic Resource Investigations- Federal Aid Project F-237-R20, Colorado Parks and Wildlife.

Nehring, B.R., 2014, Fishery management interventions to eliminate *Myxobolus cerebralis* infection in Lower Square Top Lake, Clear Creek County, Colorado (1998-2014), Colorado Parks and Wildlife.

Photos:

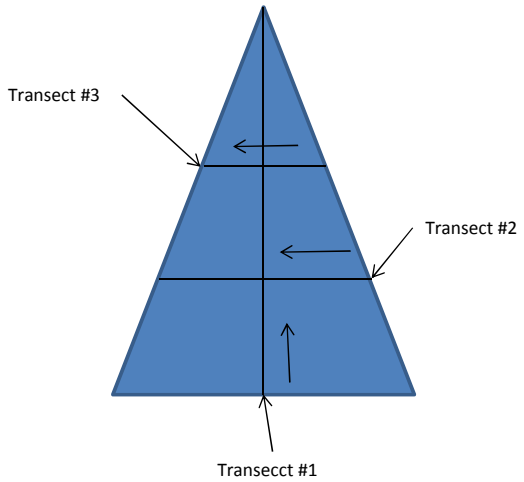
Figure 2: Upper (left) and Lower (right) Square Top Lake from the hiking trail to Square Top Mountain (html: http://www.schnizer.com/SOTAblog/sota-trip-report/w0cpr018-square-top-mountain-4196-13794-ft/)

Figure 3. Upper Square Top Lake below Square Top Mountain (html: http://www.protrails.com/gallery/448/colorado/summit-county-eagle-county-clear-creek-county/square-top-lakes)

Figure 4. Lower Square Top Lake (html: http://www.protrails.com/gallery/448/colorado/summit-county-eagle-county-clear-creek-county/square-top-lakes)

Upper Square Top Lake

Avg. Water Surface Elevation	Transect #1 (depths) (m)	Transect #1 (depths) (ft)	Transect #2 (depths) (m)	Transect #2 (depths) ft)	Transect #3 (depths) (m)	Transect #3 (depths) (ft)
3755.861 m	0.8	2.62	1.4	4.59	0.5	1.64
12322.38 ft	1.8	5.91	2.5	8.20	0.3	0.98
	2.8	9.19	4.5	14.76	0.3	0.98
Transect #1 width (miles/ft)	3.2	10.50	6.3	20.67	0.5	1.64
0.12 miles/ 633.6 ft	3.4	11.15	7.7	25.26	1.4	4.59
	3.6	11.81	8.4	27.56	2.5	8.20
Transect #2 width (miles/ft)	5.4	17.72	9.3	30.51	3.3	10.83
0.09 miles/ 475.2 ft	6.7	21.98	10.6	34.78	4	13.12
	6.4	21.00	11	36.09	4.2	13.78
Transect #3 width (miles/ft)	7.6	24.93	11.2	36.75	4.3	14.11
0.06 miles/ 316.8 ft	7.8	25.59	11.5	37.73	4.4	14.44
	7.8	25.59	11.8	38.71	4.2	13.78
Lake Surface Area (ft^2)	8.3	27.23	11.1	36.42	3.8	12.47
328, 674 ft^2	8	26.25	10.3	33.79	2.1	6.89
	8	26.25	10.1	33.14	1.6	5.25
Avg. width between each measurement on transect #1(ft)	8.1	26.57	9.6	31.50	1.2	3.94
	8.2	26.90	9.4	30.84	0.6	1.97
12.42352941	8.3	27.23	9.3	30.51		
	8.5	27.89	8.8	28.87		
Avg. width between each measurement on transect #2 (ft)	8.6	28.22	8.5	27.89		
	8.5	27.89	8.2	26.90		
16.97142857	9	29.53	8.1	26.57		
	9.2	30.18	7.5	24.61		
Avg. width between each measurement on transect #3 (ft)	9.3	30.51	7.1	23.29		
	9.6	31.50	6.9	22.64		
18.63529412	9.5	31.17	4.8	15.75		
	9.7	31.82	2.8	9.19		
	9.7	31.82	0.9	2.95		
	9.9	32.48				
	9.8	32.15				
	10.2	33.46				
	10.2	33.46				
	10.3	33.79				
	10.1	33.14				
	10.1	33.14				
	9.8	32.15				
	9.5	31.17				
	9.4	30.84				
	8.7	28.54				
	8.4	27.56				
	7.9	25.92				
	7.4	24.28				
	7.1	23.29				
	6	19.69				
	4.8	15.75				
	3.2	10.50				
	2.6	8.53				
	1.2	3.94				
	0.6	1.97				
	0.4	1.31				
	0.4	1.31				



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111	0 Track 1	TRKPT	2016-07-11	3680.913	436333.1	4382666
112	0 Track 1	TRKPT	2016-07-11	3680.764	436331.1	4382664
113	0 Track 1	TRKPT	2016-07-11	3680.562	436329.3	4382661
114	0 Track 1	TRKPT	2016-07-11	3680.756	436327.9	4382658
115	0 Track 1	TRKPT	2016-07-11	3681.004	436327.6	4382655
116	0 Track 1	TRKPT	2016-07-11	3681.178	436327	4382652
117	0 Track 1	TRKPT	2016-07-11	3681.114	436325.5	4382649
118	0 Track 1	TRKPT	2016-07-11	3680.915	436325	4382645
119	0 Track 1	TRKPT	2016-07-11	3680.462	436324.6	4382642
120	0 Track 1	TRKPT	2016-07-11	3680.346	436324.3	4382639
121	0 Track 1	TRKPT	2016-07-11	3680.05	436323.8	4382635
122	0 Track 1	TRKPT	2016-07-11	3679.711	436322.9	4382632
123	0 Track 1	TRKPT	2016-07-11	3679.457	436322.6	4382629
124	0 Track 1	TRKPT	2016-07-11	3679.361	436322	4382626
125	0 Track 1	TRKPT	2016-07-11	3679.52	436322	4382622
126	0 Track 1	TRKPT	2016-07-11	3679.281	436322.2	4382619
127	0 Track 1	TRKPT	2016-07-11	3678.442	436324.8	4382615
128	0 Track 1	TRKPT	2016-07-11	3678.123	436325.7	4382612
129	0 Track 1	TRKPT	2016-07-11	3678.184	436326.6	4382611
130	0 Track 1	TRKPT	2016-07-11	3679.215	436330.7	4382611
131	0 Track 1	TRKPT	2016-07-11	3680.59	436333.8	4382610
132	0 Track 1	TRKPT	2016-07-11	3681.701	436337.2	4382609
133	0 Track 1	TRKPT	2016-07-11	3682.088	436340.5	4382609
134	0 Track 1	TRKPT	2016-07-11	3681.92	436343.2	4382611
135	0 Track 1	TRKPT	2016-07-11	3682.272	436349	4382610
136	0 Track 1	TRKPT	2016-07-11	3683.454	436352.1	4382608
137	0 Track 1	TRKPT	2016-07-11	3683.799	436355	4382607
138	0 Track 1	TRKPT	2016-07-11	3684.53	436358.4	4382605
139	0 Track 1	TRKPT	2016-07-11	3684.666	436362.3	4382604
140	0 Track 1	TRKPT	2016-07-11	3685.844	436365.8	4382603
141	0 Track 1	TRKPT	2016-07-11	3686.594	436369.4	4382602
142	0 Track 1	TRKPT	2016-07-11	3686.827	436372.2	4382599
143	0 Track 1	TRKPT	2016-07-11	3686.041	436373.2	4382596
144	0 Track 1	TRKPT	2016-07-11	3683.813	436373.4	4382593
145	0 Track 1	TRKPT	2016-07-11	3681.014	436373.6	4382589
146	0 Track 1	TRKPT	2016-07-11	3678.86	436375.1	4382586
147	0 Track 1	TRKPT	2016-07-11	3678.239	436376.8	4382583
148	0 Track 1	TRKPT	2016-07-11	3678.993	436379.4	4382580
149	0 Track 1	TRKPT	2016-07-11	3680.13	436380.1	4382576

150	0	Track 1	TRKPT	2016-07-11	3680.451	436382.2	4382573	
151	0	Track 1	TRKPT	2016-07-11	3679.877	436385.3	4382572	
152	0	Track 1	TRKPT	2016-07-11	3679.289	436389.1	4382571	
153	0	Track 1	TRKPT	2016-07-11	3679.51	436392.3	4382570	
154	0	Track 1	TRKPT	2016-07-11	3680.144	436396.1	4382569	
155	0	Track 1	TRKPT	2016-07-11	3680.263	436400.5	4382569	
156	0	Track 1	TRKPT	2016-07-11	3680.621	436404	4382567	
157	0	Track 1	TRKPT	2016-07-11	3682.197	436406.3	4382564	
158	0	Track 1	TRKPT	2016-07-11	3682.792	436408.6	4382562	
159	0	Track 1	TRKPT	2016-07-11	3682.686	436412.5	4382561	
160	0	Track 1	TRKPT	2016-07-11	3681.696	436415.6	4382559	
161	0	Track 1	TRKPT	2016-07-11	3682.216	436418.6	4382557	
162	0	Track 1	TRKPT	2016-07-11	3682.541	436420.5	4382553	
163	0	Track 1	TRKPT	2016-07-11	3683.039	436423.1	4382551	
164	0	Track 1	TRKPT	2016-07-11	3683.025	436426.4	4382550	
165	0	Track 1	TRKPT	2016-07-11	3684.256	436427.4	4382547	
166	0	Track 1	TRKPT	2016-07-11	3685.433	436433.3	4382545	
167	0	Track 1	TRKPT	2016-07-11	3687.04	436435.8	4382543	
168	0	Track 1	TRKPT	2016-07-11	3688.074	436439.5	4382542	
169	0	Track 1	TRKPT	2016-07-11	3688.8	436443.5	4382543	
170	0	Track 1	TRKPT	2016-07-11	3689.398	436446.8	4382543	
171	0	Track 1	TRKPT	2016-07-11	3689.772	436449.6	4382540	
172	0	Track 1	TRKPT	2016-07-11	3689.803	436452.2	4382538	
173	0	Track 1	TRKPT	2016-07-11	3689.495	436455.4	4382537	
174	0	Track 1	TRKPT	2016-07-11	3688.717	436458.7	4382536	
175	0	Track 1	TRKPT	2016-07-11	3688.603	436462.3	4382535	
176	0	Track 1	TRKPT	2016-07-11	3688.602	436466.2	4382535	
177	0	Track 1	TRKPT	2016-07-11	3688.568	436468.6	4382533	
178	0	Track 1	TRKPT	2016-07-11	3688.45	436470.3	4382530	
179	0	Track 1	TRKPT	2016-07-11	3687.735	436471.7	4382527	
180	0	Track 1	TRKPT	2016-07-11	3686.779	436475.2	4382527	
181	0	Track 1	TRKPT	2016-07-11	3686.233	436477.8	4382525	
182	0	Track 1	TRKPT	2016-07-11	3686.592	436484.3	4382525	
183	0	Track 1	TRKPT	2016-07-11	3687.77	436488.1	4382525	
184	0	Track 1	TRKPT	2016-07-11	3688.481	436491.8	4382525	
185	0	Track 1	TRKPT	2016-07-11	3688.003	436495.2	4382526	
186	0	Track 1	TRKPT	2016-07-11	3686.784	436498.1	4382528	
187	0	Track 1	TRKPT	2016-07-11	3685.983	436500.7	4382531	
188	0	Track 1	TRKPT	2016-07-11	3685.225	436504.6	4382531	
189	0	Track 1	TRKPT	2016-07-11	3684.837	436507.8	4382532	
190	0	Track 1	TRKPT	2016-07-11	3684.78	436506.8	4382535	
191	0	Track 1	TRKPT	2016-07-11	3685.205	436504.1	4382538	
192	0	Track 1	TRKPT	2016-07-11	3685.19	436506.6	4382540	
193	0	Track 1	TRKPT	2016-07-11	3685.735	436510.2	4382540	
194	0	Track 1	TRKPT	2016-07-11	3686.028	436513.5	4382538	
195	0	Track 1	TRKPT	2016-07-11	3687.237	436516.6	4382537	
196	0	Track 1	TRKPT	2016-07-11	3686.916	436520.1	4382538	
197	0	Track 1	TRKPT	2016-07-11	3686.102	436523.9	4382538	
198	0	Track 1	TRKPT	2016-07-11	3685.204	436527.4	4382539	
199	0	Track 1	TRKPT	2016-07-11	3684.655	436530.3	4382542	
200	0	Track 1	TRKPT	2016-07-11	3685.505	436532.1	4382539	
201	0	Track 1	TRKPT	2016-07-11	3685.928	436531.1	4382536	
202	0	Track 1	TRKPT	2016-07-11	3686.666	436529.2	4382534	
203	0	Track 1	TRKPT	2016-07-11	3688.15	436534.6	4382533	
204	0	Track 1	TRKPT	2016-07-11	3689.678	436534.6	4382533	
205	0	Track 1	TRKPT	2016-07-11	3691.826	436531.5	4382536	
206	0	Track 1	TRKPT	2016-07-11	3688.573	436534.3	4382539	
207	0	Track 1	TRKPT	2016-07-11	3686.065	436535.4	4382542	
208	0	Track 1	TRKPT	2016-07-11	3682.269	436537	4382545	
209	0	Track 1	TRKPT	2016-07-11	3682.66	436539.5	4382548	
210	0	Track 1	TRKPT	2016-07-11	3682.206	436542.3	4382551	
211	0	Track 1	TRKPT	2016-07-11	3682.897	436544.4	4382553	
212	0	Track 1	TRKPT	2016-07-11	3682.606	436547	4382556	
213	0	Track 1	TRKPT	2016-07-11	3682.38	436546.7	4382560	
214	0	Track 1	TRKPT	2016-07-11	3681.733	436545.7	4382563	
215	0	Track 1	TRKPT	2016-07-11	3682.547	436548.8	4382562	
216	0	Track 1	TRKPT	2016-07-11	3683.31	436552.2	4382561	
217	0	Track 1	TRKPT	2016-07-11	3683.948	436551.8	4382564	
218	0	Track 1	TRKPT	2016-07-11	3683.602	436554.9	4382566	
219	0	Track 1	TRKPT	2016-07-11	3683.203	436557	4382563	
220	0	Track 1	TRKPT	2016-07-11	3682.393	436555.2	4382566	
221	0	Track 1	TRKPT	2016-07-11	3682.59	436554.1	4382570	12083.77
					3683.133			

General Site Field Visit Data Report *(Filters: Name begins with Lower Square;)*

Type		Div	Name	CWCB Case Number	Segment ID	Visit Date	Location Description
Lake		1	Lower Square Top Lake		16/1/A-010	7/20/2016	Duck Creek (?) and Square Top Lakes

Remarks

Date	Remark
20/07/16 13:12	Track 1 on Trimble GPS Hunt is the circumnavigation of Upper Square Top Lake. The lake has three surface inflows and three springs inflowing at edge of lake. Abundant wildflowers ringing lake.

GPS Log

GPS Date	Device	GPSPoint Name	Latitude	Longitude	UTM Zone	UTM Easting	UTMNorthing	Horizontal Accuracy	GPSDescription
20/07/16 11:48	Phone (BJE)	STL001			13N	438777	4383292		Parking lot, location of truck. On iPhone map Trimble (GPS Hunt).
20/07/16 12:27	Phone (BJE)	STL002	39.590877	-105.737819				5.000000	Location from which picture 705, Lower Square Top Lake taken.
20/07/16 12:53	Phone (BJE)	STL003	39.591139	-105.744836				5.000000	Upper Square Top Lake outflow.

Photo Log

Photo Date	Camera	Media Type	Photo Video ID	Caption	Photo Comment
20/07/16 12:28		Photograph	705	Lower Square Top Lake	Taken from GPS STL002. LSTL with Square Top Mountain in background.
Link:					
20/07/16 13:31		Photograph	706	Upper Square Top Lake	Photo taken from the south west side of the lake.
Link:					
20/07/16 13:33		Photograph	707	Upper Square Top Lake	Photo taken from the south west side of the lake. Wildflowers in the foreground.
Link:					
20/07/16 13:36		Photograph	709	Upper Square Top Lake	Photo taken from the south west side of the lake. Mt. Bierstadt and the Sawtooth in the background. Left portion of a panoramic, completed by 710.
Link:					
20/07/16 13:36		Photograph	708	Upper Square Top Lake	Photo taken from the south west side of the lake. Mt. Bierstadt and the Sawtooth in the background.
Link:					
20/07/16 13:37		Photograph	710	Upper Square Top Lake	Photo taken from the south west side of the lake. Mt. Bierstadt and the Sawtooth in the background. Right portion of a panoramic, completed by 709.
Link:					
20/07/16 13:50		Photograph	711	Upper and Lower Square Top Lakes	Photo taken from the south side of the USTL. The left side of the photo is the south side of Upper Square Top Lake which is where water spills into a channel that leads to Lower Square Top Lake, center right. Mt. Bierstadt and the Sawtooth in the background.
Link:					

20/07/16 13:51		Photograph	712	Lower Square Top Lake	Photo taken from the south east side of Upper Square Top Lake. Lower Square Top is in the bottom center of the photograph. Mt. Bierstadt and the Sawtooth in the background.
Link:					
20/07/16 13:52		Photograph	713	Marmot	Marmot that make the Square Top Lakes area home.
Link:					
20/07/16 13:52		Photograph	714	Marmot	Marmot family that make the Square Top Lakes area home.
Link:					
20/07/16 13:53		Photograph	715	Marmot	Marmot family that make the Square Top Lakes area home.
Link:					
20/07/16 13:54		Photograph	716	Lower Square Top Lake	Photo taken from the south east side of Upper Square Top Lake. Marshy area creates from Upper Square Top Lake bottom and Lower Square Top is in the center of the photograph. Mt. Bierstadt and the Sawtooth in the background.
Link:					
20/07/16 13:58		Photograph	717	Lower Square Top Lake	Photo taken from the south east side of Upper Square Top Lake. Lower Square Top is in the center of the photograph. Sawtooth is in the background.
Link:					
20/07/16 14:03		Video	718	Duck Creek (?)	Duck Creek (?) taken from near the trail crossing below Lower Square Top Lake.
Link:					

1	Lower Square Top Lake		16/1/A-010	7/11/2016	Duck Creek (?) and Square Top Lakes

Remarks

Date	Remark
11/07/16 10:20	Arrive at site. Drove up above Duck Lake to take overview pictures.
11/07/16 11:43	Julie Holmes 303-569-2681, angels11@wildblue.net, PO Box 819, Georgetown, CO, 80444. Cabin owner. Owns land on downstream portion of Duck Lake. Alpenboch, creek that comes into west side of Duck Lake. Flows all year. February low month. Bill Holmes memorial power plant powers the cabin. Has diversion for domestic. Famers Reservoir Irrigation Company / Burlington Ditch Reservoir and Land Company owns land above Duck Lake.
11/07/16 12:38	Duck Creek may not be the proper name for the proposed creek. Julie Holmes informed me that the creek that has been proposed as Duck Creek is actually named Glacier Creek. It enters northwest side and Evens Creek enters northeast side of Duck Lake. The notes will refer to the proposed creek as Duck Creek (?) or DC?. Julie Holmes, Square Top Lakes have hydro permit through FERC. Might be interested in 102(3)b.
11/07/16 14:07	Trail to STLs passes two unnamed unmapped lakes. Lakes are referred to in notes as 1 which is the southern and 2 the northern lake. A GPS point DC002 was take. South of the southern lake, referred to as 1. Photographs of the lakes we're taken and tracks were made around the lakes.

11/07/16 16:24	Spot discharge measurement taken, below proposed UT. DCNRLSTL.001

GPS Log

GPS Date	Device	GPSPoint Name	Latitude	Longitude	UTM Zone	UTM Easting	UTMNorthing	Horizontal Accuracy	GPSDescription
11/07/16 13:15	Phone (BJE)	DC001	39.597126	-105.713109				5.000000	Trail head to Square Top Lakes. Parked at Guanella Pass and hiked from here "South Park 600 Trail"
11/07/16 13:43	Phone (BJE)	DC002	39.591485	-105.731599				5.000000	Unnamed unmapped natural lake.
11/07/16 14:24	Phone (BJE)	DC003	39.591106	-105.735434				5.000000	Draw that feed Duck Creek (name ?) at trail crossing.
11/07/16 14:49	Phone (BJE)	DC005	39.590039	-105.738112				5.000000	Pictures of DC? Taken from this location, just below proposed UT.
11/07/16 14:57	Phone (BJE)	DC006	39.590508	-105.738651				5.000000	Actual location of proposed UT. Outflow point of Lower Square Top Lake, spilling into Duck Creek (?).
11/07/16 15:11	Phone (BJE)	DC007	39.591770	-105.740171				5.000000	Spring inflow to Lower Square Top Lake.
11/07/16 15:13	Phone (BJE)	DC008	39.591743	-105.740559				5.000000	Spring inflow to Lower Square Top Lake.
11/07/16 15:19	Phone (BJE)	DC009	39.590908	-105.741571				5.000000	Main inflow to Lower Square Top Lake.
11/07/16 15:48	Phone (BJE)	DC010	39.589892	-105.738043				5.000000	Duck Creek (?) near upper terminus spot discharge measurement location.

Photo Log

Photo Date	Camera	Media Type	Photo Video ID	Caption	Photo Comment
11/07/16 10:55		Photograph	660	Overview picture of Duck Creek	Photo taken from Guanella Pass Road looking at proposed Instream flow reach on Duck Creek, from Duck Lake to Lower Square Top Lakes.
Link:					
11/07/16 10:55		Photograph	661	Lower portion of proposed isf reach	Duck Lake is on the middle left of the photo. The section of the reach pictured is lower gradient. Duck Creek enters a steep canyon, photo middle right.
Link:					
11/07/16 10:55		Photograph	662	Close up of steep canyon middle of proposed reach	Duck Creek enters the steep tight canyon on the middle right 1/3 and exits on the lower left of the photo.
Link:					
11/07/16 10:56		Photograph	663	Upper portion of Duck Creek	Square Top Mountain towering over the headwaters of Duck Creek, photo upper right.
Link:					
11/07/16 10:56		Photograph	664	Headwaters of Duck Creek	Square Top Mountain towering over the headwaters of Duck Creek, photo upper right.
Link:					

11/07/16 12:15		Photograph		Duck Lake Bathimetry	Duck Lake bathimetry
Link: https://620638672b84d7ed4da9-bca54e529e5752f1e6d63fb4a534334b.ssl.cf2.rackcdn.com/iformbuilder.com/461577/_data461577_cwcb_general_subform_photos/field_145016004579134ba7fbff.jpg					
11/07/16 13:46		Photograph	665	Unnamed unmapped lake 1 (south)	The trail from Guanella Pass to Square Top Lakes passes this small natural lake. Photo taken looking southeast.
Link:					
11/07/16 14:03		Photograph	666	Unnamed unmapped lake 2 (north)	The trail from Guanella Pass to Square Top Lakes passes this small natural lake. Photo looking northeast.
Link:					
11/07/16 14:25		Photograph		Draw that feed Duck Creek	Standing at GPS point DC003, in creek on trail, looking upstream at headwaters.
Link: https://620638672b84d7ed4da9-bca54e529e5752f1e6d63fb4a534334b.ssl.cf2.rackcdn.com/iformbuilder.com/461577/_data461577_cwcb_general_subform_photos/field_1355395963579134be5ed05.jpg					
11/07/16 14:33		Photograph		Draw that feeds Duck Creek (?)	Another unnamed feeder to Duck Creek (?), further west than previous and flowing less.
Link: https://620638672b84d7ed4da9-bca54e529e5752f1e6d63fb4a534334b.ssl.cf2.rackcdn.com/iformbuilder.com/461577/_data461577_cwcb_general_subform_photos/field_1831619661579134bfc42cd.jpg					
11/07/16 14:40		Photograph	667	Duck Creek (?) below lower Square Top Lake near UT	Pictures 667-669 taken from same location, DC005, left ridge over DC?. Looking downstream. Creek is stable and well functioning: high gradient, plunge pool, through alpine meadow, meandering through willows, rushes, sedges and wildflowers, and with a boulder/cobble bed.
Link:					
11/07/16 14:59		Photograph		Proposed upper terminus.	Photo of GPS DC006
Link: https://620638672b84d7ed4da9-bca54e529e5752f1e6d63fb4a534334b.ssl.cf2.rackcdn.com/iformbuilder.com/461577/_data461577_cwcb_general_subform_photos/field_1641815423579134c21f638.jpg					