STATE OF COLORADO

Colorado Water Conservation Board
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TO: Colorado Water Conservation Board Members

FROM: Jeff Baessler
Stream and Lake Protection Section

DATE: January 10, 2012

SUBJECT: **Agenda Item 23, January 23-24, 2012, Board Meeting**
Stream and Lake Protection Section – New Appropriation Recommendations in Water Division 3

Introduction

This memo provides an overview of the technical analyses that were performed by both the recommending entities and CWCB staff to provide the Board with sufficient information to declare its intent to appropriate in accordance with the Rules Concerning the Colorado Instream Flow and Natural Lake Level Program ("ISF Rules"). Staff's detailed analysis of each stream, contained in the Instream Flow Recommendation Reports attached to this memo, provides the technical basis for each appropriation.

Staff Recommendation

Staff recommends that, pursuant to ISF Rule 5d., the Board declare its intent to appropriate an ISF water right on each stream segment listed on the attached Tabulation of Instream Flow and Natural Lake Level Recommendations, and direct Staff to publicly notice the Board's declaration of its intent to appropriate.

Background

Pursuant to Rule 5d. of the ISF Rules, staff is requesting the Board to declare its intent to appropriate instream flow water rights on the stream segments identified in the attached table. Staff has reviewed each proposed stream segment to ensure that for each instream flow recommendation, the data set is complete and standard methods and procedures were followed. In addition, staff has completed its water availability studies. Staff has identified four stream segments in Water Division 3 for which sufficient information has been compiled and analyses performed upon which the Board can base its intent to appropriate. These segments are located in Saguache County in the Kerber Creek Watershed.

Technical Investigations

Staff's executive summary and technical analysis of each stream are contained in the Instream Flow Recommendation Reports and form the basis for staff's recommendations. In addition to the reports, a CD containing the scientific data and technical analyses performed by the recommending entity is located in the front pocket of the Board notebook.

Natural Environment Studies

The Bureau of Land Management (BLM) has conducted field surveys of the natural environment resources on these streams and has found natural environments that can be preserved. To quantify the resources and to evaluate instream flow requirements, the BLM has collected biologic and hydraulic data that were analyzed by CWCB staff. Based on the results of these analyses, staff prepared recommendations of the amount of water necessary to preserve the natural environment to a reasonable degree for each of the streams listed on the attached Tabulation of Instream Flow and Natural Lake Level Recommendations.

Water Availability Studies

Staff has conducted an evaluation of water availability for the streams listed. To determine the amount of water physically available for the Board's appropriations, staff analyzed available USGS gage records, available streamflow models, and/or utilized appropriate standard methods to develop a hydrograph of median and/or mean daily flows for each stream flow recommendation. In addition, staff analyzed the water rights tabulation for each stream and has consulted with the Division Engineer's Office to identify any potential water availability problems. Based upon its analyses, staff has determined that water is available for appropriation on each stream to preserve the natural environment to a reasonable degree without limiting or foreclosing the exercise of valid water rights.

Instream Flow Rule 5d.

Rule 5d. provides that the Board may declare its intent to appropriate ISF water rights after reviewing Staff's recommendations for the proposed appropriations. Rule 5d. also sets forth the activities that take place after the Board declares its intent that initiate the public notice and comment procedure for the ISF appropriations. Specifically,

5d. Board's Intent to Appropriate. Notice of the Board's potential action to declare its intent to appropriate shall be given in the January Board meeting agenda and the Board will take public comment regarding its intent to appropriate at the January meeting.

(1) After reviewing Staff's ISF recommendations for proposed ISF appropriations, the Board may declare its intent to appropriate specific ISF water rights. At that time, the Board shall direct the Staff to publicly notice the Board's declaration of its intent to appropriate.

(2) After the Board declares its intent to appropriate, notice shall be published in a mailing to the ISF Subscription Mailing Lists for the relevant water divisions and shall include:

  (a) A description of the appropriation (e.g. stream reach, lake location, amounts, etc.);
  (b) Availability (time and place) for review of Summary Reports and Investigations Files for each recommendation; and,
  (c) Summary identification of any data, exhibits, testimony or other information in addition to the Summary Reports and Investigations Files supporting the appropriation.

(3) Published notice shall also contain the following information:

  (a) The Board may change flow amounts of contested ISF appropriations based on information received during the public notice and comment period.

  (b) Staff will maintain, pursuant to Rule 5e.(3), an ISF Subscription Mailing List for each water division composed of the names of all persons who have sent notice to the Board Office that they wish to be included on such list for a particular water division.

Any person desiring to be on the ISF Subscription Mailing List(s) must send notice to the Board Office.

(c) Any meetings held between Staff and members of the public will be open to the public. Staff may provide Proper Notice prior to any such meetings and may provide notice to persons on the ISF Subscription Mailing List(s).

(d) Any Notice to Contest must be received at the Board office no later than March 31st, or the first business day thereafter. All Notices of Party status and Contested Hearing Participant status must be received at the Board office no later than April 30th, or the first business day thereafter.

(e) Staff will announce its Final Staff ISF Recommendation concerning contested appropriations at the September Board meeting and will send notice of the Final Staff Recommendation to all persons on the Contested Hearing Mailing List.

(f) The Board may take final action on any uncontested ISF appropriations at the May Board meeting.

(4) After the Board declares its intent to appropriate, notice of the Board's action shall be mailed within five working days to the County Commissioners of the county(ies) in which the proposed reach or lake is located.

Attachment

Colorado Water Conservation Board

Instream Flow Tabulation - Streams

Water Division 3

Case Number	Stream	Watershed	County	Upper Terminus	Lower Terminus	Length (miles)	USGS QUADS	Amount(dates) (CFS)	Approp Date
12/3/A-003	Brewery Creek	San Luis Creek	Saguache	USFS Boundary at lat 38 17 24N long 106 10 29W	confl Kerber Creek at lat 38 16 38N long 106 08 60W	1.79	Bonanza	1.6 (11/16 - 3/31) 2.85 (4/1 - 7/31) 2.1 (8/1 - 11/15)	
12/3/A-004	Elkhorn Gulch	San Luis Creek	Saguache	USFS-BLM Boundary at lat 38 17 24N long 106 10 29W	confl Kerber Creek at lat 38 16 57N long 106 08 35W	0.32	Bonanza Whale Hill	1.05 (4/15 - 7/31) 0.55 (8/1 - 4/14)	
12/3/A-001	Kerber Creek	San Luis Creek	Saguache	confl Elkhorn Gulch at lat 38 16 57N long 106 08 35W	confl Brewery Creek at lat 38 16 38N long 106 08 60W	0.55	Bonanza	0.8 (11/1 - 3/1) 1.45 (3/2 - 4/15) 3.5 (4/16 - 7/15) 1.45 (7/16 - 10/31)	
12/3/A-002	Kerber Creek	San Luis Creek	Saguache	confl Brewery Creek at lat 38 16 38N long 106 08 60W	hdgt Wells Kerber Ditch at lat 38 13 58N long 105 59 09W	13.10	Bonanza Graveyard Gulch Klondike Mine Villa Grove	2.6 (11/16 - 3/31) 6.75 (4/1 - 7/31) 4 (8/1 - 11/15)	

Totals for Water Division 3

Total # of Stream Miles = 15.76

Total # of Appropriations = 4

(Totals do not include donated/acquired water rights)

Report Totals

Total # of Stream Miles = 15.76

Total # of Appropriations = 4

(Totals do not include donated/acquired water rights)

<u>Stream:</u> Brewery Creek

Executive Summary

Water Division: 3
Water District: 25
CDOW#: 38554
CWCB ID: 12/3/A-003

Segment: US Forest Service Boundary to Confluence with Kerber Creek
Upper Terminus: USFS BOUNDARY
(Latitude 38° 17’ 24.3”N) (Longitude 106° 10’ 29.02”W)

Lower Terminus: CONFLUENCE KERBER CREEK
(Latitude 38° 16’ 37.53”N) (Longitude 105° 08’ 59.61”W)

Watershed: San Luis (HUC#: 13010003)
Counties: Saguache
Length: 1.79 miles
USGS Quad(s): Bonanza
Flow Recommendation: 2.85 cfs (April 1 – July 31)
2.10 cfs (August 1 – November 15)
1.60 cfs (November 16 – March 31)

Staff Analysis and Recommendation

Summary

The information contained in this report and the associated supporting data and analyses (located on the enclosed CD) forms the basis for staff's instream flow recommendation to be considered by the Board. It is staff's opinion that the information contained in this report is sufficient to support the findings required in Rule 5.40.

Colorado's Instream Flow Program was created in 1973 when the Colorado State Legislature recognized "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3) C.R.S.). The statute vests the CWCB with the exclusive authority to appropriate and acquire instream flow and natural lake level water rights. In order to encourage other entities to participate in Colorado's Instream Flow Program, the statute directs the CWCB to request instream flow recommendations from other state and federal agencies. The Bureau of Land Management (BLM) recommended this segment of Brewery Creek to the CWCB for inclusion into the Instream Flow Program. Brewery Creek is being considered for inclusion into the Instream Flow Program because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

Brewery Creek is approximately 3.6 miles long. Brewery Creek originates on the east flank of Sheep Mountain at an elevation of 11,850 feet and flows generally southeasterly through the Rio Grande National Forest as it drops to an elevation of 9,400 feet at its confluence with Kerber Creek. Approximately 91.5 percent of the land on the 1.79 mile segment addressed by this report is privately owned. Brewery Creek is located within Saguache County and the total drainage area of the creek is approximately 10.64 square miles.

The subject of this report is a segment of Brewery Creek beginning at the USFS Boundary and extending downstream to the confluence with Kerber Creek. The proposed segment is located approximately 14.5 miles west of Villa Grove. Staff has received one recommendation for this segment, from the BLM. The recommendation for this segment is discussed below.

Instream Flow Recommendation

The BLM recommended 2.85 cfs (April 1 – July 31), 2.10 cfs (August 1 – November 15) and 1.60 cfs (November 16 – March 31) based on its October 7, 2010 data collection efforts and staff's water availability analyses.

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
USFS Boundary	Confluence with Kerber Creek	1.79	91.5%	8.5%

100% of the public lands are managed by the BLM.

Biological Data

Brewery Creek is considered to be a cold-water stream in an alpine environment, a moderate gradient stream (1.2 % average slope), and has well-developed and functional floodplains and several active beaver dams. Brewery Creek is one of the few perennial streams in the Bonanza Mining District that has not been impacted by mining activities.

Fish surveys show that Brewery Creek supports a naturally reproducing brook trout population. Macroinvertebrate surveys have revealed various species of mayfly, stonefly, and caddisfly.

The riparian community is comprised primarily of willow, alder, aspen, and sedge species, with coyote willow and alder being the most dominant shrubs. The healthy riparian community has resulted in normal width-to-depth ratios, sinuosity, and bank stability.

Field Survey Data

BLM staff used the R2Cross methodology to quantify the amount of water required to preserve the natural environment to a reasonable degree. The R2Cross method requires that stream discharge and channel profile data be collected in a riffle stream habitat type. Riffles are most easily visualized, as the stream habitat types that would dry up first should streamflow cease. This type of hydraulic data collection consists of setting up a transect, surveying the stream channel geometry, and measuring the stream discharge.

Biological Flow Recommendation

The CWCB staff relied upon the biological expertise of the BLM to interpret output from the R2Cross data collected to develop the initial, biologic instream flow recommendation. This initial recommendation is designed to address the unique biologic requirements of each stream without regard to water availability. Three instream flow hydraulic parameters, average depth, percent wetted perimeter, and average velocity are used to develop biologic instream flow recommendations. Colorado Parks and Wildlife has determined that maintaining these three hydraulic parameters at adequate levels across riffle habitat types, aquatic habitat in pools and runs will also be maintained for most life stages of fish and aquatic invertebrates (Nehring 1979; Espegren 1996).

For this segment of stream, two data sets were collected with the results shown in Table 1 below. Table 1 shows who collected the data (Party), the date the data was collected (Date), the measured discharge at the time of the survey (Q), the accuracy range of the predicted flows based on Manning's Equation (240% and 40% of Q), the summer flow recommendation based on meeting 3 of 3 hydraulic criteria and the winter flow recommendation based upon meeting 2 of 3 hydraulic criteria. Recommendations that fall outside of the accuracy range of the model (over 250% of the measured discharge or under 40% of the measured discharge) may not give an accurate estimate of the necessary instream flow required.

Table 1: Data

Party	Date	Q	250%-40%	Summer (3/3)	Winter (2/3)
BLM	10/7/2010	1.44	3.6 – 0.6	1.34	2.10
BLM	10/7/2010	1.59	4.0 – 0.6	1.89	3.59
			Averages	1.62	2.85

The summer flow recommendation, which meets 3 of 3 criteria and is within the accuracy range of the R2CROSS model, is 2.85 cfs. The winter flow recommendation which meets 2 of 3 criteria and is within the accuracy range of the R2CROSS model is 1.6 cfs.

Hydrologic Data and Analysis

After receiving the BLM biological evaluation and recommended flow regime, the CWCB staff conducted an evaluation of the stream hydrology to determine if water was physically available for an instream flow appropriation in the amounts recommended. This evaluation was done through a computation that is, in essence, an accounting exercise referred to as a water balance. In its most rigorous form, the water balance parses precipitation into all the avenues water pursues after it is deposited as rain, snow, or ice. In other words, given a specified amount of water deposition (input), water depletions (losses) are accounted until inputs and losses balance one with the other. The water losses that can be tracked include depletions due to evaporation and transpiration, deliveries into ground water storage, temporary surface storage, incorporations into plant and animal tissue and so forth. When these losses are individually or collectively subtracted from the input, any of the original input not balanced by loss is anticipated to be found in stream runoff as represented by the discharge measured at intercepting stream gages.

In its analysis, CWCB staff has used this approach of balancing inputs and losses to determine if water is available for the recommended instream flow appropriation. Of course, this analysis must be a practical exercise rather than a lengthy and costly scientific investigation. As a result, staff has simplified the process by lumping together some variables and employing certain rational and scientifically supportable assumptions. The following describes the steps used to complete the evaluation for this particular stream.

The first step required to determine water availability is a determination of the hydrologic regime at the Lower Terminus (LT) of the recommended ISF reach. In the best case, this means looking at the data from a gage at the LT. Further, this data, again in the best case, has been collected for a long period of time (the longer the better) including wet and dry periods. In the case of Brewery Creek**,** there is no gage on the stream. However**,** there is a USGS & DWR gage record of discharge on Kerber Creek whose data encompasses Brewery Creek. Discharge measured at the Kerber Creek gage includes the discharge emanating from Brewery Creek. The gage is KERBER CR ABV LITTLE KERBER CR NR VILLA GROVE, CO (USGS 08224500/DWR KERVILCO); it has a 61 year period of record (POR) collected between 1923 and 2010. The gage is at an elevation of 8,640 ft above mean sea level (amsl) and has a drainage area of 45.4 mi^2. The hydrograph (plot of discharge over time) produced from this

gage includes the consumptive uses of several diversions in the basin above the gage. However, the existence of these diversions is not a major limitation upon the use of the data from the gage. To make the measured data transferable to Brewery Creek above the LT, the consumptive portions of these diversions were added back to the measured hydrograph. The resulting "adjusted" hydrograph could then be used on Brewery Creek above the LT by multiplying the "adjusted" hydrograph by an area ratio; specifically, the area of Brewery Creek above the LT (10.64 mi^2 above the LT) to Kerber Creek above the gage (41.21 mi^2 above the gage). Next, the resulting proportioned "adjusted" hydrograph would itself be "adjusted" (decreased) to reflect the existing depletions on Brewery Creek above the LT resulting from upstream consumptive irrigation uses. The final hydrograph would thus represent a distribution of flow over time that has been reduced to reflect existing human uses.

{The following discussion is based upon the US Geological Survey's *Techniques of Water-Resources Investigations* Series, *Book 4: Hydrologic Analysis and Interpretation, Chapter A3: Statistical Methods in Water Resources* (Chapter 3: Describing Uncertainty) by D.R. Helsel and R. M. Hirsch. This technical reference provides the scientific background and guidance important to the systematic interpretation of hydrologic data. The document is available online and is a valuable aid to understanding and interpreting the analyses described here.}

The next step in producing a representation of the discharge at Brewery Creek above the LT is to compute the Geometric Mean of the area-prorated "adjusted" data values from the Kerber Cr above Little Kerber Cr nr Villa Grove, CO hydrograph. This step is of value because of the inherent statistical weaknesses found in any collection of data intended to measure natural stream discharge. Without getting into the details of statistical theory, it is worth noting that a set of discharge measurements is inherently inaccurate, no matter how well collected, due to the difficulties attendant to data collection, especially hydrologic data. In this particular case, the short period of record lends even greater merit to the use of this statistical tool. To give deference to this fact and to increase the value of the hydrograph product of this analysis, the Geometric Means of the data were computed and plotted along with the 95% Confidence Intervals about the data. The resultant hydrograph, including recommended instream flow values, is displayed in Figure 1.

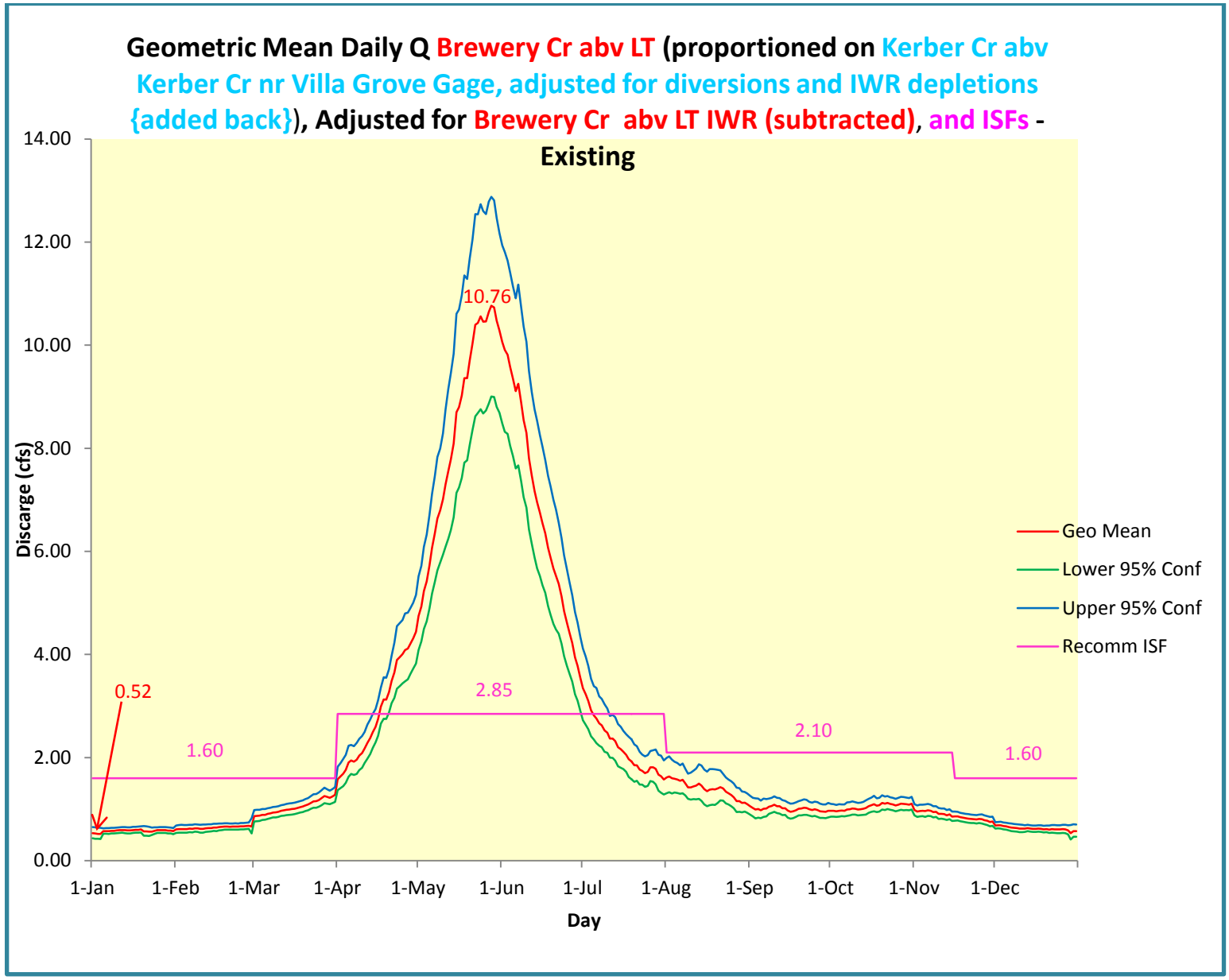
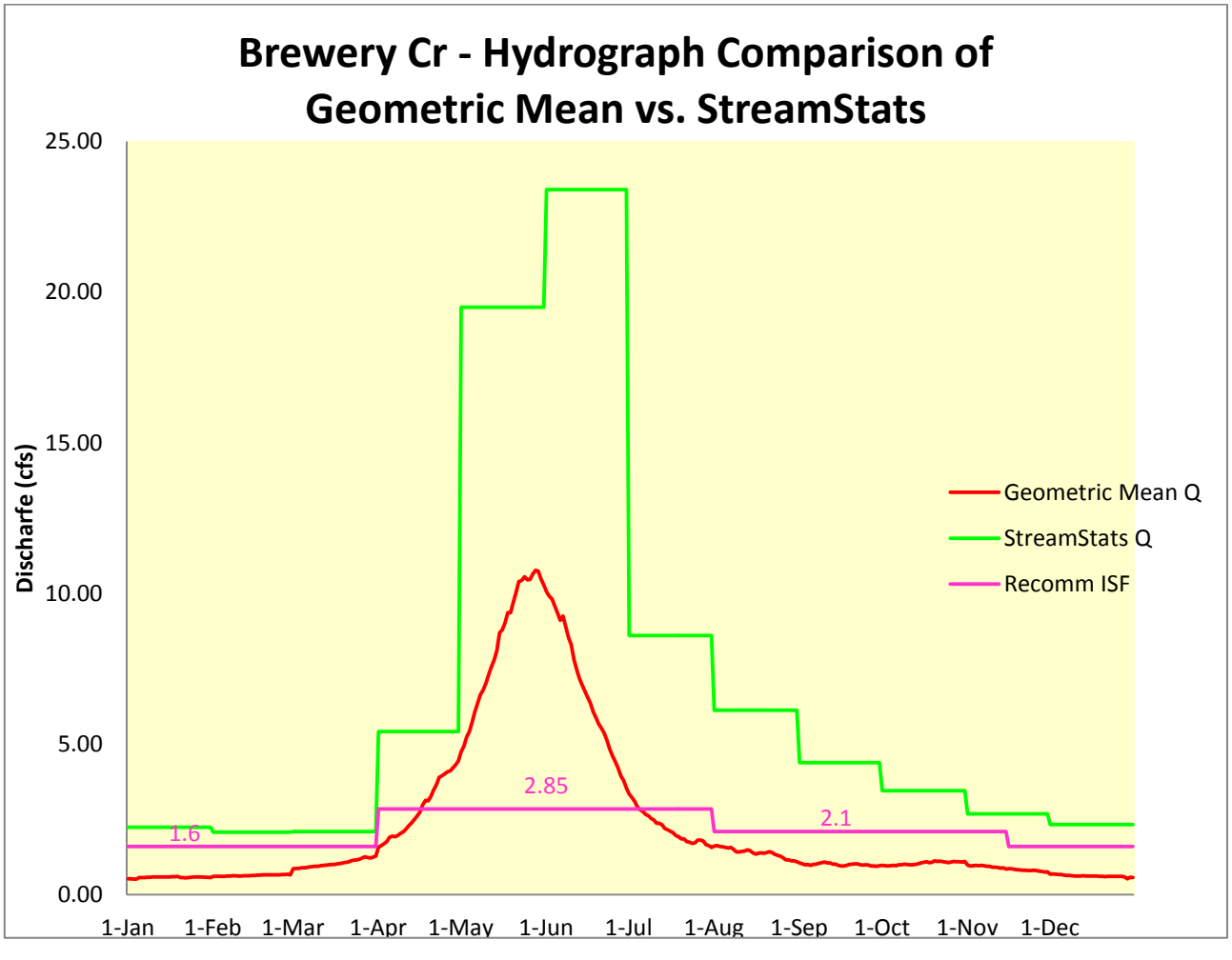

Geometric Mean Daily Q Brewery Cr abv LT (proportioned on Kerber Cr abv Kerber Cr nr Villa Grove Gage, adjusted for diversions and IWR depletions {added back}), Adjusted for Brewery Cr abv LT IWR (subtracted), and ISFs - Existing
Discarge (cfs)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
10.76
0.52
1.60
2.85
2.10
1.60
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Day
Geo Mean
Lower 95% Conf
Upper 95% Conf
Recomm ISF

Figure 1

The result of the foregoing analysis displays a significant difference between the projected discharge data using the geometric mean analysis and the estimated flow values (and recommendation) generated by the R2-Cross analysis. This and on-the-ground observations have led the BLM and CWCB Staff to question the validity of the results of analysis in this specific case. It appears that unmeasured factors that have the effect of under-predicting the discharge in Brewery Creek are at work in this geometric mean analysis. The fact that this drainage is located at elevations higher than much of the Kerber Creek basin has led Staff to conclude that the per-acre water yield of Brewery Creek basin is more than that of the basin overall. Staff concluded in this instance that the USGS StreamStats methodology would be appropriate for this basin because the StreamStats regression equations give greater recognition to the role of basin elevation in water yield. The results of the StreamStats analysis are displayed in the hydrograph below.



Geometric Mean Existing Cond (IWR or div subtracted) Elkhorn Gulch abv LT Prop on Kerber Cr abv Gage Baseline Cond (with Kerber Cr abv Gage IWR consumption added back)				
	GM (abv LT) Prorated by 23.44%	Lower 95% Conf Prorated by 23.44%	Upper 95% Conf Prorated by 23.44%	Recommended ISFs
1-Jan	0.53	0.43	0.65	1.60
2-Jan	0.53	0.43	0.65	1.60
3-Jan	0.52	0.42	0.64	1.60
4-Jan	0.52	0.42	0.64	1.60
5-Jan	0.57	0.52	0.63	1.60
6-Jan	0.57	0.52	0.63	1.60
7-Jan	0.57	0.52	0.63	1.60
8-Jan	0.58	0.53	0.64	1.60
9-Jan	0.58	0.53	0.64	1.60
10-Jan	0.59	0.54	0.64	1.60
11-Jan	0.59	0.54	0.65	1.60
12-Jan	0.59	0.54	0.65	1.60
13-Jan	0.59	0.53	0.65	1.60
14-Jan	0.59	0.53	0.65	1.60
15-Jan	0.59	0.53	0.65	1.60
16-Jan	0.59	0.54	0.66	1.60
17-Jan	0.60	0.54	0.66	1.60
18-Jan	0.60	0.54	0.66	1.60
19-Jan	0.61	0.55	0.67	1.60
20-Jan	0.57	0.48	0.67	1.60
21-Jan	0.57	0.48	0.66	1.60
22-Jan	0.56	0.48	0.66	1.60
23-Jan	0.56	0.50	0.64	1.60
24-Jan	0.58	0.52	0.65	1.60
25-Jan	0.59	0.54	0.65	1.60
26-Jan	0.59	0.54	0.65	1.60
27-Jan	0.59	0.54	0.65	1.60
28-Jan	0.59	0.54	0.65	1.60
29-Jan	0.58	0.53	0.65	1.60
30-Jan	0.58	0.53	0.64	1.60
31-Jan	0.57	0.52	0.63	1.60
1-Feb	0.61	0.54	0.68	1.60
2-Feb	0.61	0.55	0.69	1.60
3-Feb	0.61	0.54	0.69	1.60
4-Feb	0.61	0.54	0.69	1.60
5-Feb	0.61	0.54	0.69	1.60
6-Feb	0.62	0.56	0.70	1.60
7-Feb	0.62	0.55	0.70	1.60
8-Feb	0.63	0.56	0.71	1.60
9-Feb	0.63	0.56	0.70	1.60
10-Feb	0.62	0.55	0.70	1.60
11-Feb	0.62	0.54	0.70	1.60
12-Feb	0.63	0.56	0.70	1.60
13-Feb	0.63	0.56	0.71	1.60
14-Feb	0.63	0.57	0.71	1.60
15-Feb	0.64	0.58	0.72	1.60
16-Feb	0.64	0.57	0.71	1.60
17-Feb	0.65	0.59	0.72	1.60
18-Feb	0.65	0.59	0.72	1.60
19-Feb	0.66	0.60	0.72	1.60

20-Feb	0.66	0.60	0.73	1.60
21-Feb	0.66	0.60	0.72	1.60
22-Feb	0.66	0.60	0.72	1.60
23-Feb	0.66	0.60	0.72	1.60
24-Feb	0.66	0.60	0.72	1.60
25-Feb	0.67	0.61	0.73	1.60
26-Feb	0.67	0.61	0.73	1.60
27-Feb	0.67	0.61	0.74	1.60
28-Feb	0.68	0.62	0.74	1.60
29-Feb	0.66	0.53	0.82	1.60
1-Mar	0.86	0.76	0.98	1.60
2-Mar	0.87	0.76	0.99	1.60
3-Mar	0.87	0.77	0.99	1.60
4-Mar	0.89	0.79	1.00	1.60
5-Mar	0.89	0.79	1.00	1.60
6-Mar	0.91	0.81	1.01	1.60
7-Mar	0.92	0.82	1.02	1.60
8-Mar	0.93	0.84	1.04	1.60
9-Mar	0.94	0.84	1.05	1.60
10-Mar	0.95	0.85	1.06	1.60
11-Mar	0.97	0.87	1.08	1.60
12-Mar	0.98	0.88	1.09	1.60
13-Mar	0.99	0.89	1.10	1.60
14-Mar	0.99	0.89	1.11	1.60
15-Mar	1.00	0.90	1.12	1.60
16-Mar	1.01	0.90	1.13	1.60
17-Mar	1.02	0.92	1.14	1.60
18-Mar	1.04	0.93	1.15	1.60
19-Mar	1.05	0.94	1.17	1.60
20-Mar	1.07	0.97	1.19	1.60
21-Mar	1.09	0.98	1.21	1.60
22-Mar	1.12	1.01	1.25	1.60
23-Mar	1.15	1.03	1.29	1.60
24-Mar	1.15	1.03	1.29	1.60
25-Mar	1.18	1.05	1.32	1.60
26-Mar	1.21	1.08	1.37	1.60
27-Mar	1.26	1.11	1.41	1.60
28-Mar	1.24	1.11	1.38	1.60
29-Mar	1.22	1.09	1.36	1.60
30-Mar	1.24	1.11	1.39	1.60
31-Mar	1.28	1.14	1.43	1.60
1-Apr	1.58	1.37	1.82	2.85
2-Apr	1.63	1.41	1.89	2.85
3-Apr	1.69	1.45	1.97	2.85
4-Apr	1.76	1.51	2.05	2.85
5-Apr	1.91	1.63	2.23	2.85
6-Apr	1.94	1.68	2.24	2.85
7-Apr	1.92	1.66	2.22	2.85
8-Apr	1.96	1.68	2.29	2.85
9-Apr	2.04	1.76	2.37	2.85
10-Apr	2.09	1.80	2.42	2.85
11-Apr	2.18	1.89	2.50	2.85
12-Apr	2.29	1.98	2.64	2.85
13-Apr	2.38	2.07	2.74	2.85
14-Apr	2.49	2.19	2.85	2.85

15-Apr	2.60	2.30	2.94	2.85
16-Apr	2.75	2.42	3.12	2.85
17-Apr	2.99	2.66	3.36	2.85
18-Apr	3.13	2.75	3.56	2.85
19-Apr	3.12	2.75	3.55	2.85
20-Apr	3.27	2.88	3.72	2.85
21-Apr	3.48	3.06	3.97	2.85
22-Apr	3.65	3.16	4.23	2.85
23-Apr	3.89	3.34	4.55	2.85
24-Apr	3.95	3.38	4.61	2.85
25-Apr	4.01	3.44	4.67	2.85
26-Apr	4.08	3.48	4.79	2.85
27-Apr	4.11	3.52	4.81	2.85
28-Apr	4.21	3.62	4.90	2.85
29-Apr	4.31	3.72	5.00	2.85
30-Apr	4.44	3.83	5.15	2.85
1-May	4.75	4.09	5.52	2.85
2-May	4.93	4.26	5.72	2.85
3-May	5.23	4.50	6.09	2.85
4-May	5.42	4.64	6.32	2.85
5-May	5.73	4.90	6.71	2.85
6-May	6.07	5.18	7.11	2.85
7-May	6.35	5.41	7.46	2.85
8-May	6.64	5.63	7.83	2.85
9-May	6.80	5.78	7.99	2.85
10-May	7.01	5.94	8.29	2.85
11-May	7.30	6.09	8.75	2.85
12-May	7.56	6.25	9.15	2.85
13-May	7.79	6.41	9.46	2.85
14-May	8.09	6.66	9.84	2.85
15-May	8.70	7.14	10.61	2.85
16-May	8.80	7.24	10.69	2.85
17-May	9.02	7.43	10.97	2.85
18-May	9.36	7.72	11.35	2.85
19-May	9.36	7.77	11.28	2.85
20-May	9.70	8.06	11.68	2.85
21-May	10.03	8.35	12.05	2.85
22-May	10.39	8.62	12.54	2.85
23-May	10.43	8.68	12.54	2.85
24-May	10.56	8.76	12.73	2.85
25-May	10.45	8.67	12.60	2.85
26-May	10.46	8.73	12.54	2.85
27-May	10.64	8.87	12.79	2.85
28-May	10.76	9.00	12.88	2.85
29-May	10.73	9.00	12.81	2.85
30-May	10.47	8.80	12.47	2.85
31-May	10.28	8.69	12.17	2.85
1-Jun	10.06	8.48	11.94	2.85
2-Jun	9.91	8.32	11.81	2.85
3-Jun	9.81	8.28	11.64	2.85
4-Jun	9.58	8.05	11.41	2.85
5-Jun	9.35	7.85	11.14	2.85
6-Jun	9.11	7.61	10.91	2.85
7-Jun	9.25	7.67	11.17	2.85
8-Jun	8.90	7.37	10.75	2.85

9-Jun	8.54	7.05	10.36	2.85
10-Jun	8.30	6.85	10.06	2.85
11-Jun	7.81	6.42	9.50	2.85
12-Jun	7.47	6.15	9.09	2.85
13-Jun	7.17	5.88	8.75	2.85
14-Jun	6.95	5.67	8.53	2.85
15-Jun	6.75	5.52	8.25	2.85
16-Jun	6.55	5.35	8.03	2.85
17-Jun	6.35	5.20	7.77	2.85
18-Jun	6.07	4.94	7.47	2.85
19-Jun	5.88	4.77	7.26	2.85
20-Jun	5.67	4.60	7.00	2.85
21-Jun	5.52	4.49	6.81	2.85
22-Jun	5.37	4.40	6.56	2.85
23-Jun	5.13	4.21	6.26	2.85
24-Jun	4.84	3.97	5.92	2.85
25-Jun	4.62	3.78	5.65	2.85
26-Jun	4.43	3.63	5.41	2.85
27-Jun	4.23	3.47	5.15	2.85
28-Jun	3.94	3.23	4.82	2.85
29-Jun	3.78	3.10	4.62	2.85
30-Jun	3.54	2.90	4.34	2.85
1-Jul	3.34	2.73	4.11	2.85
2-Jul	3.23	2.63	3.96	2.85
3-Jul	3.10	2.55	3.78	2.85
4-Jul	2.91	2.41	3.53	2.85
5-Jul	2.82	2.35	3.39	2.85
6-Jul	2.76	2.28	3.35	2.85
7-Jul	2.66	2.23	3.19	2.85
8-Jul	2.63	2.20	3.14	2.85
9-Jul	2.53	2.11	3.04	2.85
10-Jul	2.48	2.09	2.95	2.85
11-Jul	2.37	2.00	2.81	2.85
12-Jul	2.37	1.99	2.83	2.85
13-Jul	2.32	1.94	2.78	2.85
14-Jul	2.20	1.83	2.65	2.85
15-Jul	2.16	1.80	2.60	2.85
16-Jul	2.11	1.77	2.52	2.85
17-Jul	2.05	1.72	2.45	2.85
18-Jul	1.97	1.62	2.40	2.85
19-Jul	1.93	1.58	2.36	2.85
20-Jul	1.85	1.53	2.25	2.85
21-Jul	1.85	1.55	2.22	2.85
22-Jul	1.76	1.48	2.11	2.85
23-Jul	1.74	1.48	2.06	2.85
24-Jul	1.70	1.43	2.02	2.85
25-Jul	1.72	1.45	2.05	2.85
26-Jul	1.81	1.55	2.13	2.85
27-Jul	1.81	1.53	2.14	2.85
28-Jul	1.78	1.48	2.15	2.85
29-Jul	1.67	1.36	2.05	2.85
30-Jul	1.64	1.32	2.04	2.85
31-Jul	1.58	1.28	1.95	2.85
1-Aug	1.61	1.31	1.99	2.10
2-Aug	1.63	1.33	2.02	2.10

3-Aug	1.60	1.31	1.96	2.10
4-Aug	1.59	1.32	1.92	2.10
5-Aug	1.57	1.31	1.90	2.10
6-Aug	1.55	1.30	1.85	2.10
7-Aug	1.57	1.31	1.89	2.10
8-Aug	1.50	1.27	1.78	2.10
9-Aug	1.42	1.20	1.69	2.10
10-Aug	1.42	1.19	1.71	2.10
11-Aug	1.44	1.19	1.75	2.10
12-Aug	1.45	1.19	1.79	2.10
13-Aug	1.49	1.20	1.87	2.10
14-Aug	1.46	1.16	1.85	2.10
15-Aug	1.38	1.09	1.77	2.10
16-Aug	1.35	1.06	1.73	2.10
17-Aug	1.38	1.07	1.78	2.10
18-Aug	1.39	1.09	1.78	2.10
19-Aug	1.38	1.08	1.77	2.10
20-Aug	1.40	1.12	1.76	2.10
21-Aug	1.43	1.17	1.75	2.10
22-Aug	1.40	1.17	1.68	2.10
23-Aug	1.34	1.11	1.62	2.10
24-Aug	1.31	1.09	1.57	2.10
25-Aug	1.27	1.06	1.54	2.10
26-Aug	1.23	1.01	1.49	2.10
27-Aug	1.15	0.94	1.42	2.10
28-Aug	1.15	0.95	1.41	2.10
29-Aug	1.12	0.94	1.34	2.10
30-Aug	1.13	0.95	1.33	2.10
31-Aug	1.10	0.93	1.30	2.10
1-Sep	1.06	0.90	1.26	2.10
2-Sep	1.02	0.86	1.22	2.10
3-Sep	0.99	0.82	1.21	2.10
4-Sep	1.00	0.84	1.20	2.10
5-Sep	0.98	0.82	1.17	2.10
6-Sep	1.01	0.85	1.21	2.10
7-Sep	1.01	0.86	1.20	2.10
8-Sep	1.05	0.91	1.21	2.10
9-Sep	1.06	0.93	1.22	2.10
10-Sep	1.09	0.95	1.25	2.10
11-Sep	1.06	0.92	1.22	2.10
12-Sep	1.05	0.92	1.22	2.10
13-Sep	1.02	0.88	1.18	2.10
14-Sep	1.02	0.89	1.16	2.10
15-Sep	0.97	0.84	1.13	2.10
16-Sep	0.95	0.82	1.11	2.10
17-Sep	0.96	0.83	1.11	2.10
18-Sep	0.98	0.85	1.13	2.10
19-Sep	1.01	0.88	1.16	2.10
20-Sep	1.01	0.88	1.17	2.10
21-Sep	1.03	0.89	1.19	2.10
22-Sep	1.02	0.89	1.18	2.10
23-Sep	1.00	0.88	1.14	2.10
24-Sep	0.98	0.86	1.13	2.10
25-Sep	1.00	0.87	1.14	2.10
26-Sep	0.98	0.85	1.14	2.10

27-Sep	0.96	0.83	1.10	2.10
28-Sep	0.95	0.83	1.09	2.10
29-Sep	0.95	0.82	1.09	2.10
30-Sep	0.97	0.84	1.12	2.10
1-Oct	0.97	0.85	1.10	2.10
2-Oct	0.97	0.85	1.10	2.10
3-Oct	0.96	0.85	1.08	2.10
4-Oct	0.97	0.86	1.09	2.10
5-Oct	0.97	0.87	1.09	2.10
6-Oct	0.97	0.86	1.09	2.10
7-Oct	0.99	0.87	1.13	2.10
8-Oct	1.00	0.88	1.14	2.10
9-Oct	1.01	0.89	1.15	2.10
10-Oct	1.01	0.89	1.14	2.10
11-Oct	0.99	0.88	1.12	2.10
12-Oct	1.00	0.88	1.13	2.10
13-Oct	1.00	0.89	1.14	2.10
14-Oct	1.02	0.90	1.17	2.10
15-Oct	1.05	0.93	1.20	2.10
16-Oct	1.08	0.95	1.22	2.10
17-Oct	1.10	0.96	1.26	2.10
18-Oct	1.07	0.94	1.21	2.10
19-Oct	1.08	0.95	1.22	2.10
20-Oct	1.12	0.99	1.27	2.10
21-Oct	1.11	0.98	1.24	2.10
22-Oct	1.12	1.00	1.25	2.10
23-Oct	1.10	0.99	1.23	2.10
24-Oct	1.09	0.98	1.22	2.10
25-Oct	1.07	0.96	1.20	2.10
26-Oct	1.09	0.97	1.22	2.10
27-Oct	1.10	0.99	1.24	2.10
28-Oct	1.10	0.98	1.23	2.10
29-Oct	1.10	0.98	1.22	2.10
30-Oct	1.09	0.98	1.21	2.10
31-Oct	1.11	0.99	1.24	2.10
1-Nov	0.98	0.88	1.10	2.10
2-Nov	0.95	0.85	1.07	2.10
3-Nov	0.96	0.86	1.08	2.10
4-Nov	0.97	0.86	1.09	2.10
5-Nov	0.96	0.85	1.09	2.10
6-Nov	0.98	0.87	1.10	2.10
7-Nov	0.97	0.86	1.09	2.10
8-Nov	0.94	0.84	1.06	2.10
9-Nov	0.95	0.85	1.06	2.10
10-Nov	0.91	0.81	1.02	2.10
11-Nov	0.91	0.82	1.01	2.10
12-Nov	0.90	0.80	1.01	2.10
13-Nov	0.88	0.79	0.98	2.10
14-Nov	0.90	0.81	1.00	2.10
15-Nov	0.86	0.77	0.95	2.10
16-Nov	0.86	0.77	0.95	1.60
17-Nov	0.86	0.78	0.95	1.60
18-Nov	0.84	0.77	0.93	1.60
19-Nov	0.83	0.76	0.92	1.60
20-Nov	0.83	0.75	0.91	1.60

21-Nov	0.82	0.74	0.90	1.60
22-Nov	0.81	0.73	0.89	1.60
23-Nov	0.81	0.73	0.89	1.60
24-Nov	0.80	0.72	0.88	1.60
25-Nov	0.81	0.73	0.90	1.60
26-Nov	0.80	0.72	0.90	1.60
27-Nov	0.79	0.70	0.88	1.60
28-Nov	0.77	0.69	0.86	1.60
29-Nov	0.75	0.67	0.85	1.60
30-Nov	0.76	0.68	0.85	1.60
1-Dec	0.68	0.62	0.75	1.60
2-Dec	0.69	0.63	0.75	1.60
3-Dec	0.69	0.62	0.75	1.60
4-Dec	0.67	0.61	0.74	1.60
5-Dec	0.67	0.60	0.74	1.60
6-Dec	0.65	0.59	0.73	1.60
7-Dec	0.64	0.57	0.72	1.60
8-Dec	0.64	0.57	0.71	1.60
9-Dec	0.63	0.56	0.71	1.60
10-Dec	0.62	0.55	0.70	1.60
11-Dec	0.62	0.56	0.70	1.60
12-Dec	0.62	0.56	0.69	1.60
13-Dec	0.63	0.57	0.70	1.60
14-Dec	0.62	0.56	0.69	1.60
15-Dec	0.62	0.56	0.68	1.60
16-Dec	0.62	0.56	0.68	1.60
17-Dec	0.62	0.56	0.69	1.60
18-Dec	0.62	0.56	0.69	1.60
19-Dec	0.61	0.55	0.68	1.60
20-Dec	0.61	0.55	0.68	1.60
21-Dec	0.60	0.54	0.68	1.60
22-Dec	0.61	0.54	0.69	1.60
23-Dec	0.61	0.54	0.69	1.60
24-Dec	0.61	0.53	0.69	1.60
25-Dec	0.61	0.53	0.69	1.60
26-Dec	0.61	0.54	0.69	1.60
27-Dec	0.61	0.53	0.70	1.60
28-Dec	0.59	0.51	0.69	1.60
29-Dec	0.53	0.41	0.69	1.60
30-Dec	0.57	0.47	0.71	1.60
31-Dec	0.57	0.46	0.70	1.60

Existing Water Right Information

Staff has analyzed the water rights tabulation and contacted the Division Engineer Office (DEO) to identify any potential water availability problems. There are no decreed surface diversions within this reach of stream. Staff has determined that water is available for appropriation on Brewery Creek between the USFS Boundary and the confluence with Kerber Creek, to preserve the natural environment to a reasonable degree without limiting or foreclosing the exercise of valid existing water rights.

CWCB Staff's Instream Flow Recommendation

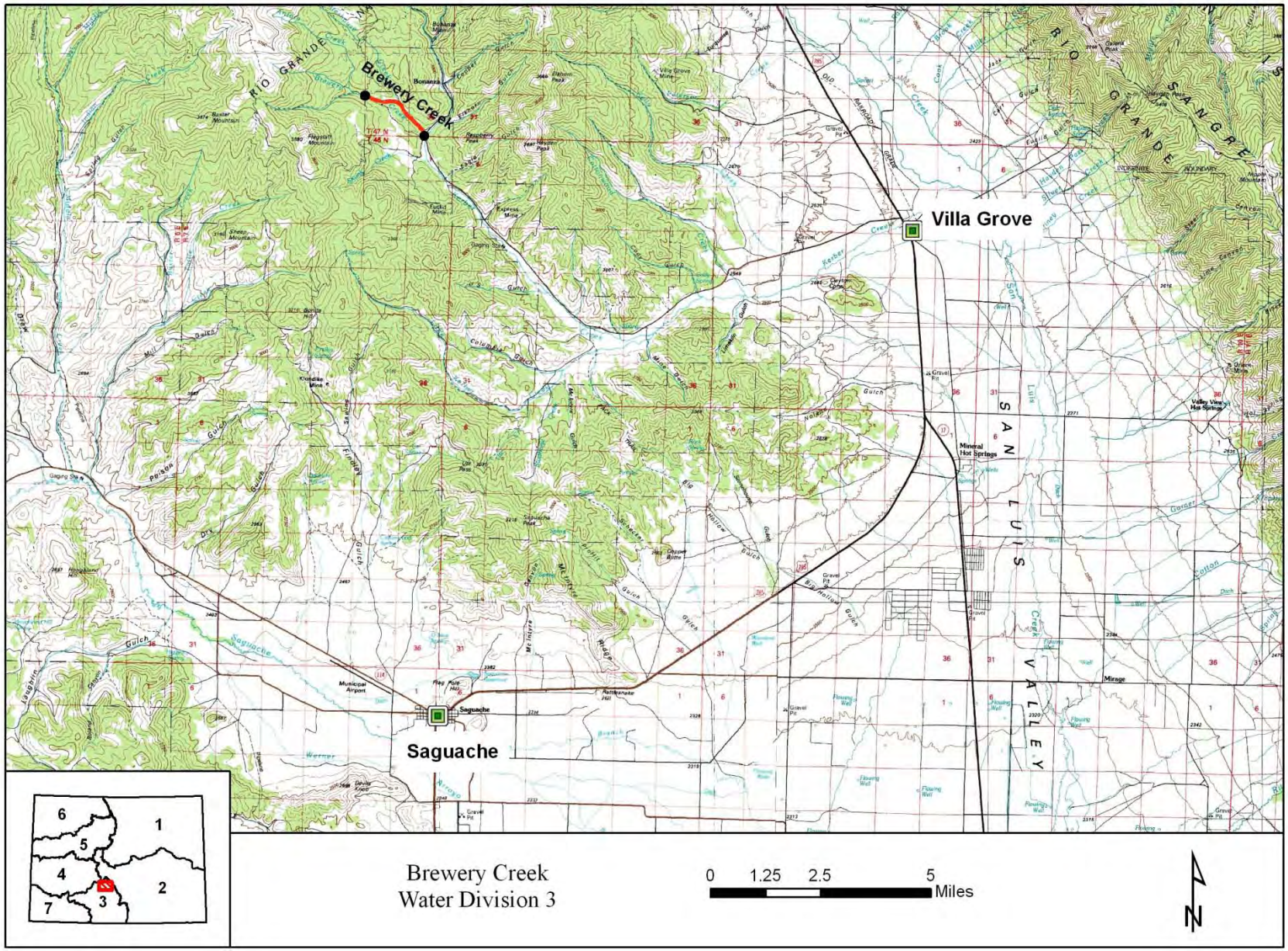
Staff recommends the Board form its intent to appropriate on the following stream reach:

Segment: US Forest Service Boundary to Confluence with Kerber Creek
Upper Terminus: USFS BOUNDARY
(Latitude 38° 17' 24.3"N) (Longitude 106° 10' 29.02"W)
UTM North: 4238653.95 UTM East: 397267.96
NW NW Section 35, Township 47 North, Range 7 East NMPM
9' East of the West Section Line; 533' South of the North Section Line

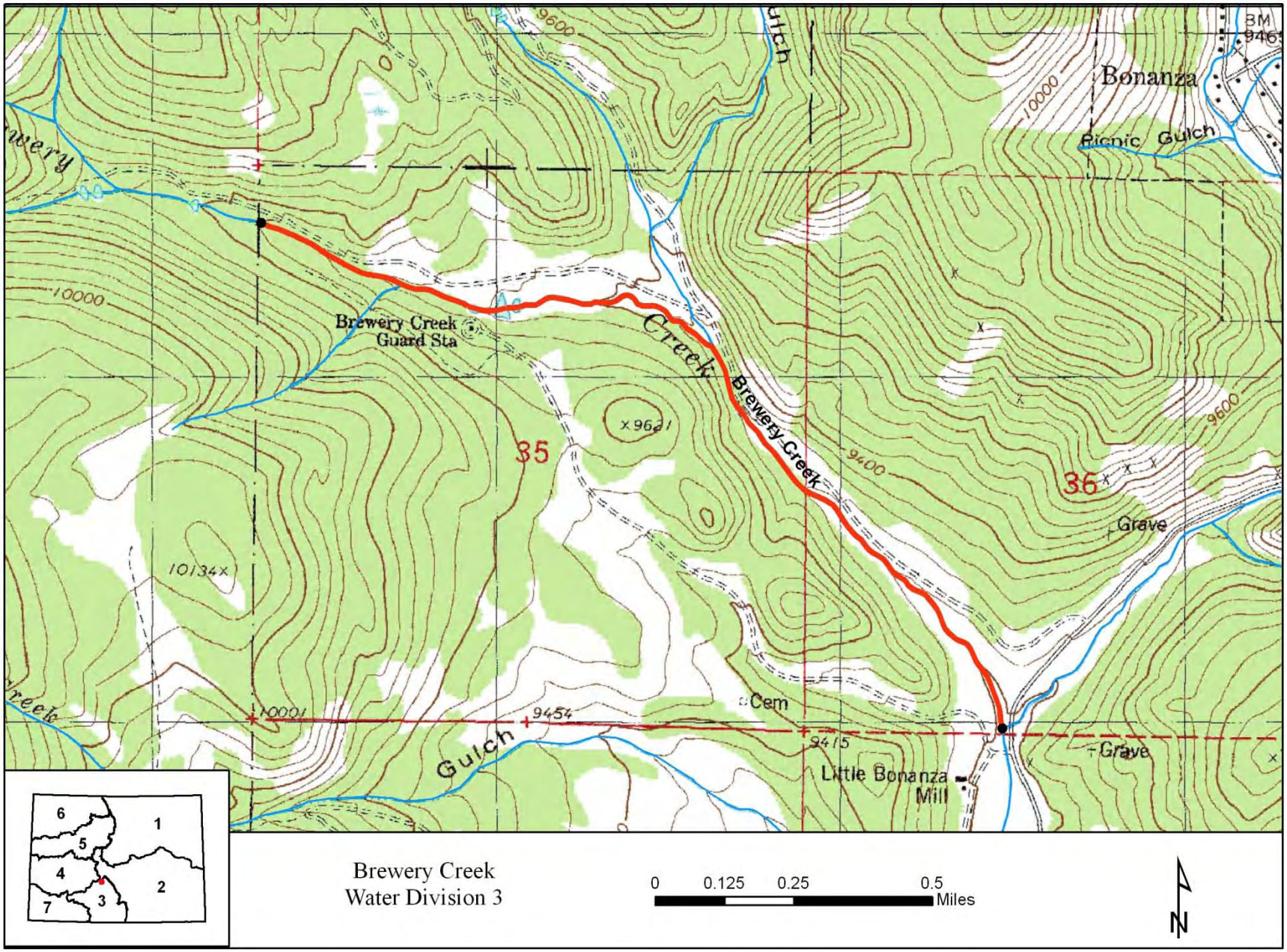
Lower Terminus: CONFLUENCE KERBER CREEK
(Latitude 38° 16' 37.53"N) (Longitude 105° 08' 59.61"W)
UTM North: 4237184.91 UTM East: 399422.13
SE SW Section 36, Township 47 North, Range 7 East NMPM
1851' East of the West Section Line; 85' North of the South Section Line

Watershed: San Luis (HUC#: 13010003)
Counties: Saguache
Length: 1.79 miles
USGS Quad(s): Bonanza
Flow Recommendation: 2.85 cfs (April 1 – July 31)
2.10 cfs (August 1 – November 15)
1.60 cfs (November 16 – March 31)

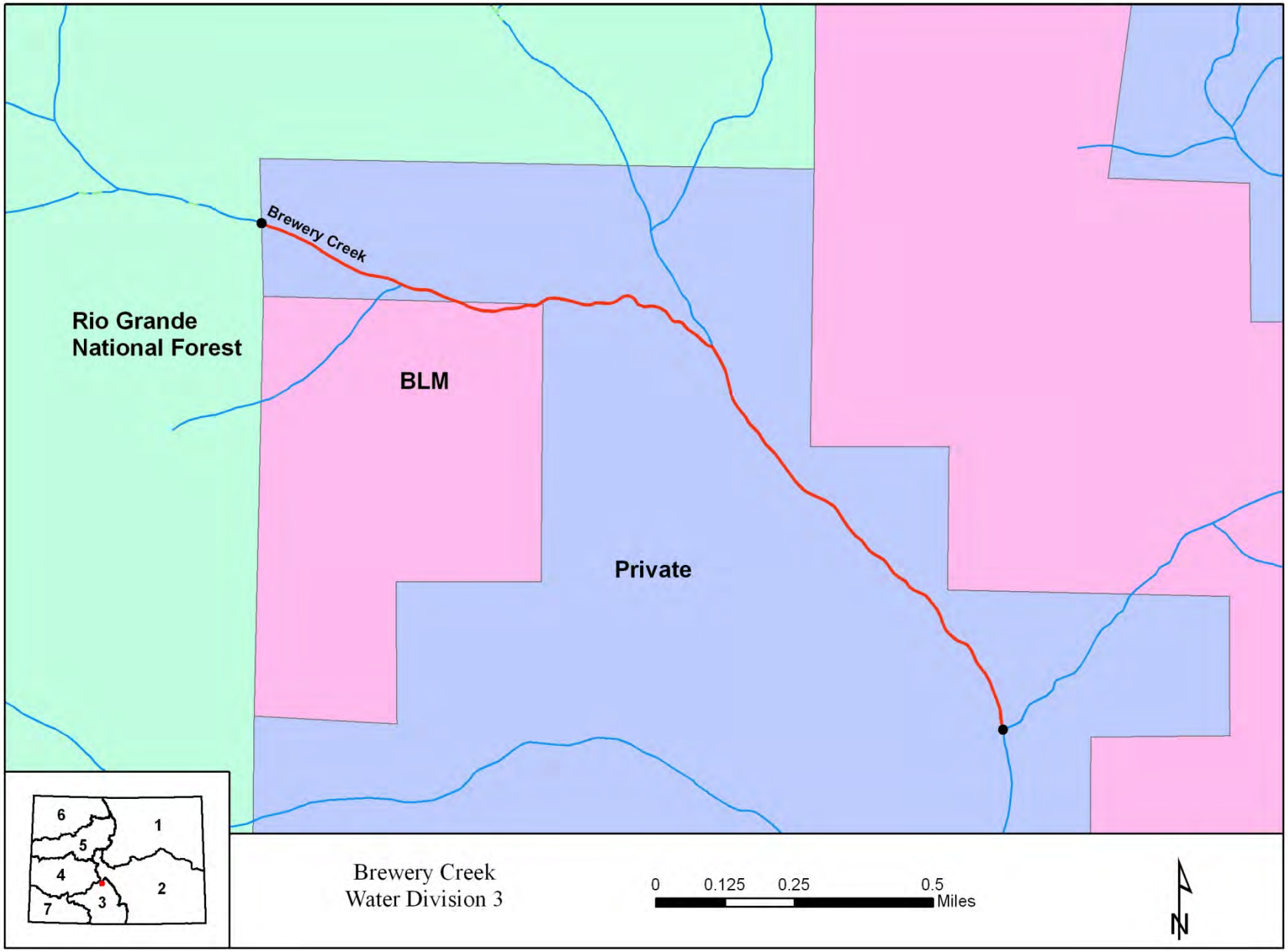
Vicinity Map



Water Rights Map



Land Use Map


Brewery Creek
Rio Grande
National Forest
BLM
Private
6
1
5
4
2
3
7
Brewery Creek
Water Division 3
0
0.125
0.25
0.5
Miles
N

<u>Stream:</u> Elkhorn Gulch

Executive Summary

Water Division: 3
Water District: 25
CDOW#: 40844
CWCB ID: 12/3/A-004

Segment: USFS/BLM Boundary to Confluence with Kerber Creek
Upper Terminus: USFS/BLM BOUNDARY
(Latitude 38° 17’ 24.3”N) (Longitude 106° 10’ 29.02”W)

Lower Terminus: CONFLUENCE WITH KERBER CREEK
(Latitude 38° 16’ 57.2”N) (Longitude 106° 08’ 34.96”W)

Watershed: San Luis (HUC#: 13010003)
Counties: Saguache
Length: 0.32 miles
USGS Quad(s): Bonanza, Whale Hill
Flow Recommendation: 1.05 cfs (April 15 – July 31)
0.55 cfs (August 1 – April 14)

Staff Analysis and Recommendation

Summary

The information contained in this report and the associated supporting data and analyses (located on the enclosed CD) forms the basis for staff's instream flow recommendation to be considered by the Board. It is staff's opinion that the information contained in this report is sufficient to support the findings required in Rule 5.40.

Colorado's Instream Flow Program was created in 1973 when the Colorado State Legislature recognized "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3) C.R.S.). The statute vests the CWCB with the exclusive authority to appropriate and acquire instream flow and natural lake level water rights. In order to encourage other entities to participate in Colorado's Instream Flow Program, the statute directs the CWCB to request instream flow recommendations from other state and federal agencies. The Bureau of Land Management (BLM) recommended this segment of Elkhorn Gulch to the CWCB for inclusion into the Instream Flow Program. Elkhorn Gulch is being considered for inclusion into the Instream Flow Program because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

Elkhorn Gulch is approximately 2.62 miles long. Elkhorn Gulch originates on the west flank of Elkhorn Peak at an elevation of 10,800 feet and flows generally southwesterly through the Rio Grande National Forest as it drops to an elevation of 9,280 feet at its confluence with Kerber Creek. One hundred percent of the land on the 0.32 mile segment addressed by this report is publicly owned. Elkhorn Gulch is located within Saguache County and the total drainage area of the creek is approximately 2.83 square miles.

The subject of this report is a segment of Elkhorn Gulch beginning at the USFS/BLM Boundary and extending downstream to the confluence with Kerber Creek. The proposed segment is located approximately 12 miles west of Villa Grove. Staff has received one recommendation for this segment, from the BLM. The recommendation for this segment is discussed below.

Instream Flow Recommendation

The BLM recommended 1.05 cfs (April 1 – July 31) and 0.55 cfs (August 1 – March 31) based on its June 16, 2010, data collection efforts and staff's water availability analyses.

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
USFS/BLM Boundary	Confluence with Kerber Creek	0.32	0%	100%

100% of the lands are managed by the BLM.

Biological Data

Elkhorn Gulch is considered to be a cold-water stream in an alpine environment. It is a moderate gradient stream (1.1 % average slope), and has well-developed and functional floodplains, and several active beaver dams. Elkhorn Gulch is one of the few perennial streams in the Bonanza Mining District that has not been impacted by mining activities.

Fish surveys show that Elkhorn Gulch supports a naturally reproducing brook trout population. Intensive macoinvertebrate surveys have not been conducted, but spot samples have revealed various species of mayfly, stonefly, and caddisfly.

The riparian community is comprised primarily of willow, alder, aspen, and sedge species, with coyote willow and alder being the most dominant shrubs. The healthy riparian community has resulted in normal width-to-depth ratios, sinuousity, and bank stability.

Field Survey Data

BLM staff used the R2Cross methodology to quantify the amount of water required to preserve the natural environment to a reasonable degree. The R2Cross method requires that stream discharge and channel profile data be collected in a riffle stream habitat type. Riffles are most easily visualized, as the stream habitat types that would dry up first should streamflow cease. This type of hydraulic data collection consists of setting up a transect, surveying the stream channel geometry, and measuring the stream discharge.

Biological Flow Recommendation

The CWCB staff relied upon the biological expertise of the BLM to interpret output from the R2Cross data collected to develop the initial, biologic instream flow recommendation. This initial recommendation is designed to address the unique biologic requirements of each stream without regard to water availability. Three instream flow hydraulic parameters, average depth, percent wetted perimeter, and average velocity are used to develop biologic instream flow recommendations. Colorado Parks and Wildlife has determined that maintaining these three hydraulic parameters at adequate levels across riffle habitat types, aquatic habitat in pools and runs will also be maintained for most life stages of fish and aquatic invertebrates (Nehring 1979; Espegren 1996).

For this segment of stream, two data sets were collected, with the results shown in Table 1 below. Table 1 shows who collected the data (Party), the date the data was collected (Date), the measured discharge at the time of the survey (Q), the accuracy range of the predicted flows based on Manning's Equation (240% and 40% of Q), the summer flow recommendation based on meeting 3 of 3 hydraulic criteria and the winter flow recommendation based upon 2 of 3 hydraulic criteria. Recommendations that fall outside of the accuracy range of the model, over 250% of the measured discharge or under 40% of the measured discharge may not give an accurate estimate of the necessary instream flow required.

Table 1: Data

Party	Date	Q	250%-40%	Summer (3/3)	Winter (2/3)
BLM	6/16/2010	0.90	2.2 – 0.4	Out of Range	1.24
BLM	6/16/2010	0.93	2.3 – 0.4	0.57	0.86
			Averages	0.57	1.05

The summer flow recommendation, which meets 3 of 3 criteria and is within the accuracy range of the R2CROSS model, is 1.05 cfs. The winter flow recommendation was lowered to 0.55 cfs due to water availability constraints. This lowered flow rate should provide sufficient velocity and depth to prevent icing of all physical habitat within the recommended stream segment.

Hydrologic Data and Analysis

After receiving the BLM biological evaluation and recommended flow regime, the CWCB staff conducted an evaluation of the stream hydrology to determine if water was physically available for an instream flow appropriation in the amounts recommended. This evaluation was done through a computation that is, in essence, an accounting exercise referred to as a water balance. In its most rigorous form, the water balance parses precipitation into all the avenues water pursues after it is deposited as rain, snow, or ice. In other words, given a specified amount of water deposition (input), water depletions (losses) are accounted until inputs and losses balance one with the other. The water losses that can be tracked include depletions due to evaporation and transpiration, deliveries into ground water storage, temporary surface storage, incorporations into plant and animal tissue and so forth. When these losses are individually or collectively subtracted from the input any of the original input not balanced by loss is anticipated to be found in stream runoff as represented by the discharge measured at intercepting stream gages.

In its analysis, CWCB staff has used this approach of balancing inputs and losses to determine if water is available for the recommended instream flow appropriation. Of course, this analysis must be a practical exercise rather than a lengthy and costly scientific investigation. As a result, staff has simplified the process by lumping together some variables and employing certain rational and scientifically supportable assumptions. The process may be described through the following description of the steps used to complete the evaluation for this particular stream.

The first step required to determine water availability is a determination of the hydrologic regime at the Lower Terminus (LT) of the recommended ISF reach. In the best case, this means looking at the data from a gage at the LT. Further, this data, again in the best case, has been collected for a long period of time (the longer the better), including wet and dry periods. In the case of Elkhorn Gulch there is no gage on the stream. However**,** there is a USGS & DWR gage record of discharge on Kerber Creek whose data encompasses Elklhorn Gulch. Discharge measured at the Kerber Creek gage includes the discharge emanating from Elkhorn Gulch. The gage is KERBER CR ABV LITTLE KERBER CR NR VILLA GROVE, CO (USGS 08224500/DWR KERVILCO); it has a 61-year period of record (POR) collected between 1923 and 2010. The gage is at an elevation of 8,640 ft above mean sea level (amsl) and has a drainage area of 45.4 mi^2. The hydrograph (plot of discharge over time) produced from this

gage includes the consumptive uses of several diversions in the basin above the gage. However, the existence of these diversions is not a major limitation upon the use of the data from the gage. To make the measured data transferable to Elkhorn Gulch above the LT, the consumptive portions of these diversions were added back to the measured hydrograph. The resulting "adjusted" hydrograph could then be used on Elkhorn Gulch above the LT by multiplying the "adjusted" hydrograph by an area ratio; specifically, the area of Elkhorn Gulch above the LT (2.83 mi^2 above the LT) to Kerber Creek above the gage (41.21 mi^2 above the gage). Next, the resulting proportioned "adjusted" hydrograph would itself be "adjusted" (decreased) to reflect the existing depletions on Elkhorn Gulch above the LT resulting from upstream consumptive irrigation uses. The final hydrograph would thus represent a distribution of flow over time that has been reduced to reflect existing human uses.

{The following discussion is based upon the US Geological Survey's *Techniques of Water-Resources Investigations* Series, *Book 4: Hydrologic Analysis and Interpretation, Chapter A3: Statistical Methods in Water Resources* (Chapter 3: Describing Uncertainty) by D.R. Helsel and R. M. Hirsch. This technical reference provides the scientific background and guidance important to the systematic interpretation of hydrologic data. The document is available online and is a valuable aid to understanding and interpreting the analyses described here.}

The next step in producing a representation of the discharge at Elkhorn Gulch above the LT is to compute the Geometric Mean of the area-prorated "adjusted" data values from the Kerber Creek above Little Kerber Creek near Villa Grove, CO hydrograph. This step is of value because of the inherent statistical weaknesses found in any collection of data intended to measure natural stream discharge. Without getting into the details of statistical theory, it is worth noting that a set of discharge measurements is inherently inaccurate, no matter how well collected, due to the difficulties attendant to data collection, especially hydrologic data. In this particular case, the short period of record lends even greater merit to the use of this statistical tool. To give deference to this fact and to increase the value of the hydrograph product of this analysis, the Geometric Means of the data were computed and plotted along with the 95% Confidence Intervals about the data. The resultant hydrograph, including recommended Instream Flow values, is displayed in Figure 1.

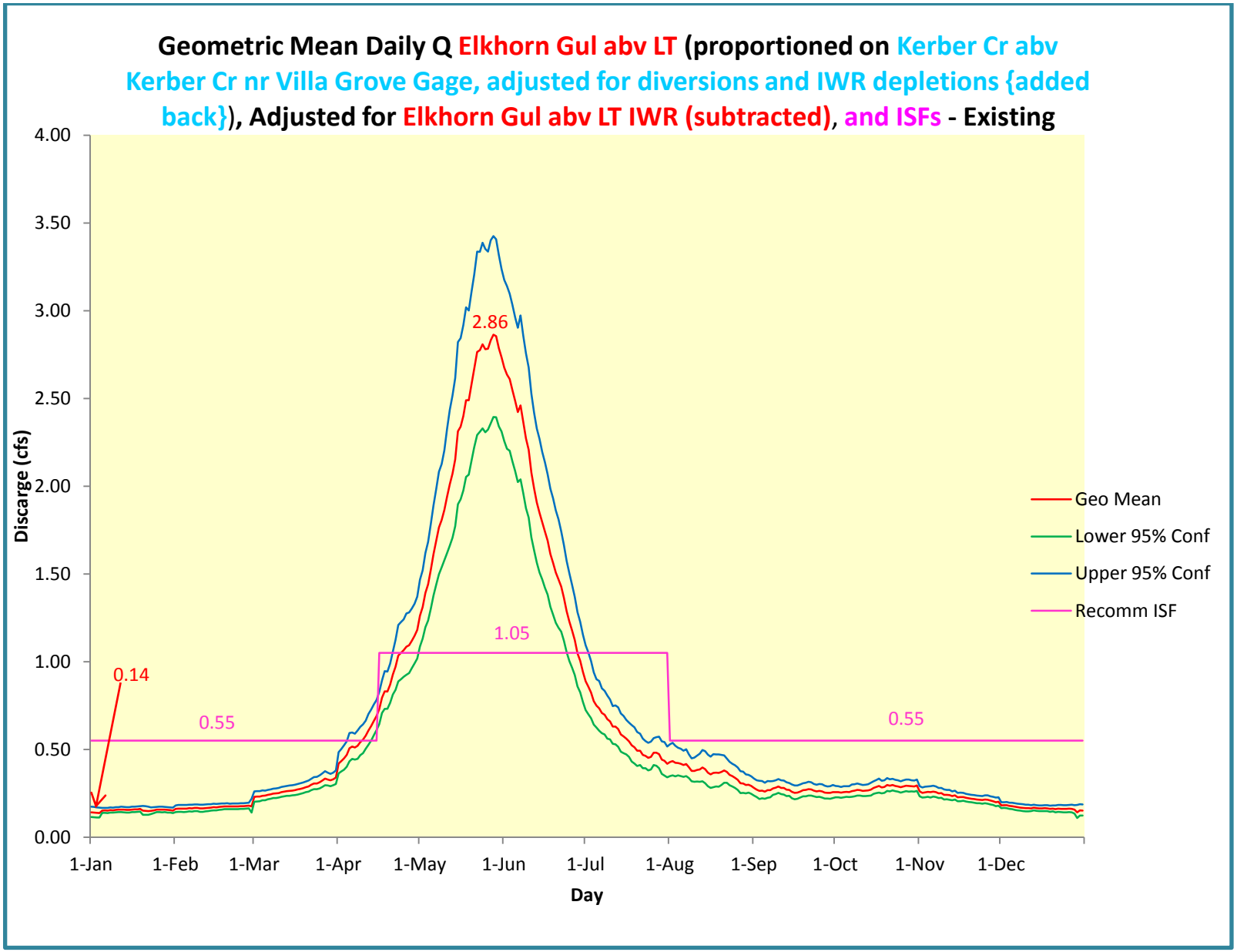
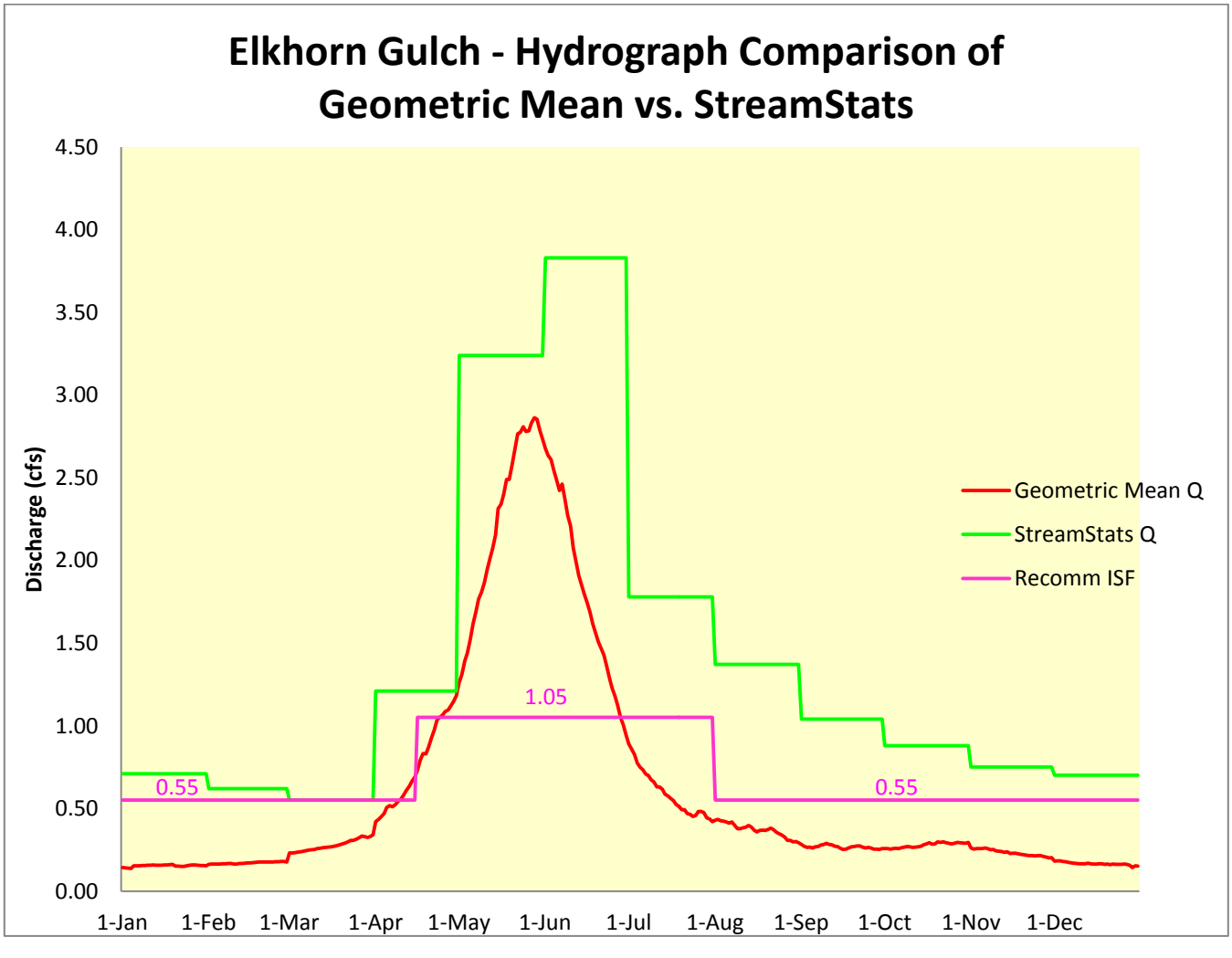

Geometric Mean Daily Q Elkhorn Gul abv LT (proportioned on Kerber Cr abv Kerber Cr nr Villa Grove Gage, adjusted for diversions and IWR depletions {added back}), Adjusted for Elkhorn Gul abv LT IWR (subtracted), and ISFs - Existing
Discarge (cfs)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
2.86
1.05
0.14
0.55
0.55
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Day
Geo Mean
Lower 95% Conf
Upper 95% Conf
Recomm ISF

Figure 1

The result of the foregoing analysis displays a significant difference between the projected discharge data using the Geometric mean analysis and the estimated flow values (and recommendation) generated by the R2-Cross analysis. This and on-the-ground observations have led the BLM and CWCB Staff to question the validity of the results of analysis in this specific case. It appears that unmeasured factors that have the effect of under-predicting the discharge in Elkhorn Gulch are at work in this Geometric mean analysis. The fact that this long and narrow drainage is located at elevations higher than much of the Kerber Creek basin has led Staff to conclude that the per-acre water yield of Elkhorn Gulch basin is more than that of the basin overall. Staff concluded in this instance that the USGS StreamStats methodology would be appropriate for this basin because the StreamStats regression equations give greater recognition to the role of basin elevation in water yield. The results of the StreamStats analysis are displayed in the hydrograph below.



Geometric Mean Existing Cond (IWR or div subtracted) Elkhorn Gulch abv LT Prop on Kerber Cr abv Gage Baseline Cond (with Kerber Cr abv Gage IWR consumption added back)				
	Geometric Mean Prorated by 6.23%	Lower 95% Conf Prorated by 6.23%	Upper 95% Conf Prorated by 6.23%	Recommended ISFs
1-Jan	0.14	0.12	0.17	0.55
2-Jan	0.14	0.11	0.17	0.55
3-Jan	0.14	0.11	0.17	0.55
4-Jan	0.14	0.11	0.17	0.55
5-Jan	0.15	0.14	0.17	0.55
6-Jan	0.15	0.14	0.17	0.55
7-Jan	0.15	0.14	0.17	0.55
8-Jan	0.15	0.14	0.17	0.55
9-Jan	0.15	0.14	0.17	0.55
10-Jan	0.16	0.14	0.17	0.55
11-Jan	0.16	0.14	0.17	0.55
12-Jan	0.16	0.14	0.17	0.55
13-Jan	0.16	0.14	0.17	0.55
14-Jan	0.16	0.14	0.17	0.55
15-Jan	0.16	0.14	0.17	0.55
16-Jan	0.16	0.14	0.17	0.55
17-Jan	0.16	0.14	0.17	0.55
18-Jan	0.16	0.14	0.18	0.55
19-Jan	0.16	0.15	0.18	0.55
20-Jan	0.15	0.13	0.18	0.55
21-Jan	0.15	0.13	0.18	0.55
22-Jan	0.15	0.13	0.17	0.55
23-Jan	0.15	0.13	0.17	0.55
24-Jan	0.15	0.14	0.17	0.55
25-Jan	0.16	0.14	0.17	0.55
26-Jan	0.16	0.14	0.17	0.55
27-Jan	0.16	0.14	0.17	0.55
28-Jan	0.16	0.14	0.17	0.55
29-Jan	0.16	0.14	0.17	0.55
30-Jan	0.15	0.14	0.17	0.55
31-Jan	0.15	0.14	0.17	0.55
1-Feb	0.16	0.14	0.18	0.55
2-Feb	0.16	0.15	0.18	0.55
3-Feb	0.16	0.14	0.18	0.55
4-Feb	0.16	0.14	0.18	0.55
5-Feb	0.16	0.14	0.18	0.55
6-Feb	0.17	0.15	0.19	0.55
7-Feb	0.16	0.15	0.19	0.55
8-Feb	0.17	0.15	0.19	0.55
9-Feb	0.17	0.15	0.19	0.55
10-Feb	0.16	0.15	0.19	0.55
11-Feb	0.16	0.14	0.19	0.55
12-Feb	0.17	0.15	0.19	0.55
13-Feb	0.17	0.15	0.19	0.55
14-Feb	0.17	0.15	0.19	0.55
15-Feb	0.17	0.15	0.19	0.55
16-Feb	0.17	0.15	0.19	0.55
17-Feb	0.17	0.16	0.19	0.55
18-Feb	0.17	0.16	0.19	0.55

19-Feb	0.18	0.16	0.19	0.55
20-Feb	0.18	0.16	0.19	0.55
21-Feb	0.18	0.16	0.19	0.55
22-Feb	0.18	0.16	0.19	0.55
23-Feb	0.18	0.16	0.19	0.55
24-Feb	0.18	0.16	0.19	0.55
25-Feb	0.18	0.16	0.19	0.55
26-Feb	0.18	0.16	0.19	0.55
27-Feb	0.18	0.16	0.20	0.55
28-Feb	0.18	0.16	0.20	0.55
29-Feb	0.18	0.14	0.22	0.55
1-Mar	0.23	0.20	0.26	0.55
2-Mar	0.23	0.20	0.26	0.55
3-Mar	0.23	0.20	0.26	0.55
4-Mar	0.24	0.21	0.27	0.55
5-Mar	0.24	0.21	0.27	0.55
6-Mar	0.24	0.22	0.27	0.55
7-Mar	0.24	0.22	0.27	0.55
8-Mar	0.25	0.22	0.28	0.55
9-Mar	0.25	0.22	0.28	0.55
10-Mar	0.25	0.23	0.28	0.55
11-Mar	0.26	0.23	0.29	0.55
12-Mar	0.26	0.23	0.29	0.55
13-Mar	0.26	0.24	0.29	0.55
14-Mar	0.26	0.24	0.29	0.55
15-Mar	0.27	0.24	0.30	0.55
16-Mar	0.27	0.24	0.30	0.55
17-Mar	0.27	0.24	0.30	0.55
18-Mar	0.28	0.25	0.31	0.55
19-Mar	0.28	0.25	0.31	0.55
20-Mar	0.29	0.26	0.32	0.55
21-Mar	0.29	0.26	0.32	0.55
22-Mar	0.30	0.27	0.33	0.55
23-Mar	0.31	0.27	0.34	0.55
24-Mar	0.31	0.27	0.34	0.55
25-Mar	0.31	0.28	0.35	0.55
26-Mar	0.32	0.29	0.36	0.55
27-Mar	0.33	0.30	0.38	0.55
28-Mar	0.33	0.29	0.37	0.55
29-Mar	0.32	0.29	0.36	0.55
30-Mar	0.33	0.30	0.37	0.55
31-Mar	0.34	0.30	0.38	0.55
1-Apr	0.42	0.36	0.48	0.55
2-Apr	0.43	0.37	0.50	0.55
3-Apr	0.45	0.38	0.52	0.55
4-Apr	0.47	0.40	0.55	0.55
5-Apr	0.51	0.43	0.59	0.55
6-Apr	0.52	0.45	0.60	0.55
7-Apr	0.51	0.44	0.59	0.55
8-Apr	0.52	0.45	0.61	0.55
9-Apr	0.54	0.47	0.63	0.55
10-Apr	0.56	0.48	0.64	0.55
11-Apr	0.58	0.50	0.66	0.55
12-Apr	0.61	0.53	0.70	0.55
13-Apr	0.63	0.55	0.73	0.55

14-Apr	0.66	0.58	0.76	0.55
15-Apr	0.69	0.61	0.78	1.05
16-Apr	0.73	0.64	0.83	1.05
17-Apr	0.80	0.71	0.89	1.05
18-Apr	0.83	0.73	0.95	1.05
19-Apr	0.83	0.73	0.94	1.05
20-Apr	0.87	0.77	0.99	1.05
21-Apr	0.93	0.81	1.06	1.05
22-Apr	0.97	0.84	1.13	1.05
23-Apr	1.04	0.89	1.21	1.05
24-Apr	1.05	0.90	1.23	1.05
25-Apr	1.07	0.91	1.24	1.05
26-Apr	1.09	0.93	1.28	1.05
27-Apr	1.09	0.94	1.28	1.05
28-Apr	1.12	0.96	1.30	1.05
29-Apr	1.15	0.99	1.33	1.05
30-Apr	1.18	1.02	1.37	1.05
1-May	1.26	1.09	1.47	1.05
2-May	1.31	1.13	1.52	1.05
3-May	1.39	1.20	1.62	1.05
4-May	1.44	1.24	1.68	1.05
5-May	1.52	1.30	1.79	1.05
6-May	1.61	1.38	1.89	1.05
7-May	1.69	1.44	1.98	1.05
8-May	1.77	1.50	2.08	1.05
9-May	1.81	1.54	2.13	1.05
10-May	1.87	1.58	2.20	1.05
11-May	1.94	1.62	2.33	1.05
12-May	2.01	1.66	2.43	1.05
13-May	2.07	1.71	2.52	1.05
14-May	2.15	1.77	2.62	1.05
15-May	2.31	1.90	2.82	1.05
16-May	2.34	1.93	2.84	1.05
17-May	2.40	1.98	2.92	1.05
18-May	2.49	2.05	3.02	1.05
19-May	2.49	2.07	3.00	1.05
20-May	2.58	2.14	3.11	1.05
21-May	2.67	2.22	3.21	1.05
22-May	2.76	2.29	3.34	1.05
23-May	2.77	2.31	3.34	1.05
24-May	2.81	2.33	3.39	1.05
25-May	2.78	2.31	3.35	1.05
26-May	2.78	2.32	3.34	1.05
27-May	2.83	2.36	3.40	1.05
28-May	2.86	2.39	3.43	1.05
29-May	2.85	2.39	3.41	1.05
30-May	2.79	2.34	3.32	1.05
31-May	2.73	2.31	3.24	1.05
1-Jun	2.68	2.26	3.17	1.05
2-Jun	2.64	2.21	3.14	1.05
3-Jun	2.61	2.20	3.10	1.05
4-Jun	2.55	2.14	3.03	1.05
5-Jun	2.49	2.09	2.96	1.05
6-Jun	2.42	2.02	2.90	1.05
7-Jun	2.46	2.04	2.97	1.05

8-Jun	2.37	1.96	2.86	1.05
9-Jun	2.27	1.88	2.76	1.05
10-Jun	2.21	1.82	2.68	1.05
11-Jun	2.08	1.71	2.53	1.05
12-Jun	1.99	1.64	2.42	1.05
13-Jun	1.91	1.56	2.33	1.05
14-Jun	1.85	1.51	2.27	1.05
15-Jun	1.79	1.47	2.20	1.05
16-Jun	1.74	1.42	2.14	1.05
17-Jun	1.69	1.38	2.07	1.05
18-Jun	1.61	1.31	1.99	1.05
19-Jun	1.56	1.27	1.93	1.05
20-Jun	1.51	1.22	1.86	1.05
21-Jun	1.47	1.19	1.81	1.05
22-Jun	1.43	1.17	1.74	1.05
23-Jun	1.36	1.12	1.66	1.05
24-Jun	1.29	1.05	1.57	1.05
25-Jun	1.23	1.00	1.50	1.05
26-Jun	1.18	0.97	1.44	1.05
27-Jun	1.12	0.92	1.37	1.05
28-Jun	1.05	0.86	1.28	1.05
29-Jun	1.01	0.83	1.23	1.05
30-Jun	0.94	0.77	1.15	1.05
1-Jul	0.89	0.72	1.09	1.05
2-Jul	0.86	0.70	1.05	1.05
3-Jul	0.82	0.68	1.00	1.05
4-Jul	0.78	0.64	0.94	1.05
5-Jul	0.75	0.62	0.90	1.05
6-Jul	0.73	0.61	0.89	1.05
7-Jul	0.71	0.59	0.85	1.05
8-Jul	0.70	0.59	0.83	1.05
9-Jul	0.67	0.56	0.81	1.05
10-Jul	0.66	0.56	0.78	1.05
11-Jul	0.63	0.53	0.75	1.05
12-Jul	0.63	0.53	0.75	1.05
13-Jul	0.62	0.52	0.74	1.05
14-Jul	0.59	0.49	0.70	1.05
15-Jul	0.57	0.48	0.69	1.05
16-Jul	0.56	0.47	0.67	1.05
17-Jul	0.55	0.46	0.65	1.05
18-Jul	0.52	0.43	0.64	1.05
19-Jul	0.51	0.42	0.63	1.05
20-Jul	0.49	0.41	0.60	1.05
21-Jul	0.49	0.41	0.59	1.05
22-Jul	0.47	0.39	0.56	1.05
23-Jul	0.46	0.39	0.55	1.05
24-Jul	0.45	0.38	0.54	1.05
25-Jul	0.46	0.39	0.54	1.05
26-Jul	0.48	0.41	0.57	1.05
27-Jul	0.48	0.41	0.57	1.05
28-Jul	0.47	0.39	0.57	1.05
29-Jul	0.44	0.36	0.55	1.05
30-Jul	0.44	0.35	0.54	1.05
31-Jul	0.42	0.34	0.52	1.05
1-Aug	0.43	0.35	0.53	0.55

2-Aug	0.43	0.35	0.54	0.55
3-Aug	0.42	0.35	0.52	0.55
4-Aug	0.42	0.35	0.51	0.55
5-Aug	0.42	0.35	0.50	0.55
6-Aug	0.41	0.34	0.49	0.55
7-Aug	0.42	0.35	0.50	0.55
8-Aug	0.40	0.34	0.47	0.55
9-Aug	0.38	0.32	0.45	0.55
10-Aug	0.38	0.32	0.45	0.55
11-Aug	0.38	0.32	0.46	0.55
12-Aug	0.39	0.32	0.48	0.55
13-Aug	0.40	0.32	0.50	0.55
14-Aug	0.39	0.31	0.49	0.55
15-Aug	0.37	0.29	0.47	0.55
16-Aug	0.36	0.28	0.46	0.55
17-Aug	0.37	0.29	0.47	0.55
18-Aug	0.37	0.29	0.47	0.55
19-Aug	0.37	0.29	0.47	0.55
20-Aug	0.37	0.30	0.47	0.55
21-Aug	0.38	0.31	0.47	0.55
22-Aug	0.37	0.31	0.45	0.55
23-Aug	0.36	0.30	0.43	0.55
24-Aug	0.35	0.29	0.42	0.55
25-Aug	0.34	0.28	0.41	0.55
26-Aug	0.33	0.27	0.40	0.55
27-Aug	0.31	0.25	0.38	0.55
28-Aug	0.31	0.25	0.37	0.55
29-Aug	0.30	0.25	0.36	0.55
30-Aug	0.30	0.25	0.35	0.55
31-Aug	0.29	0.25	0.35	0.55
1-Sep	0.28	0.24	0.33	0.55
2-Sep	0.27	0.23	0.32	0.55
3-Sep	0.26	0.22	0.32	0.55
4-Sep	0.27	0.22	0.32	0.55
5-Sep	0.26	0.22	0.31	0.55
6-Sep	0.27	0.23	0.32	0.55
7-Sep	0.27	0.23	0.32	0.55
8-Sep	0.28	0.24	0.32	0.55
9-Sep	0.28	0.25	0.32	0.55
10-Sep	0.29	0.25	0.33	0.55
11-Sep	0.28	0.25	0.32	0.55
12-Sep	0.28	0.24	0.32	0.55
13-Sep	0.27	0.23	0.31	0.55
14-Sep	0.27	0.24	0.31	0.55
15-Sep	0.26	0.22	0.30	0.55
16-Sep	0.25	0.22	0.29	0.55
17-Sep	0.25	0.22	0.30	0.55
18-Sep	0.26	0.23	0.30	0.55
19-Sep	0.27	0.23	0.31	0.55
20-Sep	0.27	0.23	0.31	0.55
21-Sep	0.27	0.24	0.32	0.55
22-Sep	0.27	0.24	0.31	0.55
23-Sep	0.27	0.23	0.30	0.55
24-Sep	0.26	0.23	0.30	0.55
25-Sep	0.26	0.23	0.30	0.55

26-Sep	0.26	0.23	0.30	0.55
27-Sep	0.25	0.22	0.29	0.55
28-Sep	0.25	0.22	0.29	0.55
29-Sep	0.25	0.22	0.29	0.55
30-Sep	0.26	0.22	0.30	0.55
1-Oct	0.26	0.23	0.29	0.55
2-Oct	0.26	0.23	0.29	0.55
3-Oct	0.25	0.23	0.29	0.55
4-Oct	0.26	0.23	0.29	0.55
5-Oct	0.26	0.23	0.29	0.55
6-Oct	0.26	0.23	0.29	0.55
7-Oct	0.26	0.23	0.30	0.55
8-Oct	0.27	0.23	0.30	0.55
9-Oct	0.27	0.24	0.31	0.55
10-Oct	0.27	0.24	0.30	0.55
11-Oct	0.26	0.23	0.30	0.55
12-Oct	0.27	0.24	0.30	0.55
13-Oct	0.27	0.24	0.30	0.55
14-Oct	0.27	0.24	0.31	0.55
15-Oct	0.28	0.25	0.32	0.55
16-Oct	0.29	0.25	0.33	0.55
17-Oct	0.29	0.26	0.33	0.55
18-Oct	0.28	0.25	0.32	0.55
19-Oct	0.29	0.25	0.32	0.55
20-Oct	0.30	0.26	0.34	0.55
21-Oct	0.29	0.26	0.33	0.55
22-Oct	0.30	0.27	0.33	0.55
23-Oct	0.29	0.26	0.33	0.55
24-Oct	0.29	0.26	0.32	0.55
25-Oct	0.28	0.25	0.32	0.55
26-Oct	0.29	0.26	0.32	0.55
27-Oct	0.29	0.26	0.33	0.55
28-Oct	0.29	0.26	0.33	0.55
29-Oct	0.29	0.26	0.33	0.55
30-Oct	0.29	0.26	0.32	0.55
31-Oct	0.29	0.26	0.33	0.55
1-Nov	0.26	0.23	0.29	0.55
2-Nov	0.25	0.23	0.28	0.55
3-Nov	0.26	0.23	0.29	0.55
4-Nov	0.26	0.23	0.29	0.55
5-Nov	0.26	0.23	0.29	0.55
6-Nov	0.26	0.23	0.29	0.55
7-Nov	0.26	0.23	0.29	0.55
8-Nov	0.25	0.22	0.28	0.55
9-Nov	0.25	0.23	0.28	0.55
10-Nov	0.24	0.22	0.27	0.55
11-Nov	0.24	0.22	0.27	0.55
12-Nov	0.24	0.21	0.27	0.55
13-Nov	0.23	0.21	0.26	0.55
14-Nov	0.24	0.21	0.27	0.55
15-Nov	0.23	0.20	0.25	0.55
16-Nov	0.23	0.21	0.25	0.55
17-Nov	0.23	0.21	0.25	0.55
18-Nov	0.22	0.20	0.25	0.55
19-Nov	0.22	0.20	0.24	0.55

20-Nov	0.22	0.20	0.24	0.55
21-Nov	0.22	0.20	0.24	0.55
22-Nov	0.22	0.19	0.24	0.55
23-Nov	0.21	0.19	0.24	0.55
24-Nov	0.21	0.19	0.24	0.55
25-Nov	0.22	0.19	0.24	0.55
26-Nov	0.21	0.19	0.24	0.55
27-Nov	0.21	0.19	0.23	0.55
28-Nov	0.21	0.18	0.23	0.55
29-Nov	0.20	0.18	0.23	0.55
30-Nov	0.20	0.18	0.23	0.55
1-Dec	0.18	0.17	0.20	0.55
2-Dec	0.18	0.17	0.20	0.55
3-Dec	0.18	0.17	0.20	0.55
4-Dec	0.18	0.16	0.20	0.55
5-Dec	0.18	0.16	0.20	0.55
6-Dec	0.17	0.16	0.19	0.55
7-Dec	0.17	0.15	0.19	0.55
8-Dec	0.17	0.15	0.19	0.55
9-Dec	0.17	0.15	0.19	0.55
10-Dec	0.17	0.15	0.19	0.55
11-Dec	0.17	0.15	0.19	0.55
12-Dec	0.17	0.15	0.18	0.55
13-Dec	0.17	0.15	0.19	0.55
14-Dec	0.17	0.15	0.18	0.55
15-Dec	0.16	0.15	0.18	0.55
16-Dec	0.16	0.15	0.18	0.55
17-Dec	0.17	0.15	0.18	0.55
18-Dec	0.16	0.15	0.18	0.55
19-Dec	0.16	0.15	0.18	0.55
20-Dec	0.16	0.15	0.18	0.55
21-Dec	0.16	0.14	0.18	0.55
22-Dec	0.16	0.14	0.18	0.55
23-Dec	0.16	0.14	0.18	0.55
24-Dec	0.16	0.14	0.18	0.55
25-Dec	0.16	0.14	0.18	0.55
26-Dec	0.16	0.14	0.18	0.55
27-Dec	0.16	0.14	0.19	0.55
28-Dec	0.16	0.13	0.18	0.55
29-Dec	0.14	0.11	0.18	0.55
30-Dec	0.15	0.12	0.19	0.55
31-Dec	0.15	0.12	0.19	0.55

Existing Water Right Information

Staff has analyzed the water rights tabulation and contacted the Division Engineer Office (DEO) to identify any potential water availability problems. There are no decreed surface diversions within this reach of stream. Staff has determined that water is available for appropriation on Elkhorn Gulch, between the USFS/BLM Boundary down to its confluence with Kerber Creek, to preserve the natural environment to a reasonable degree without limiting or foreclosing the exercise of valid existing water rights.

CWCB Staff's Instream Flow Recommendation

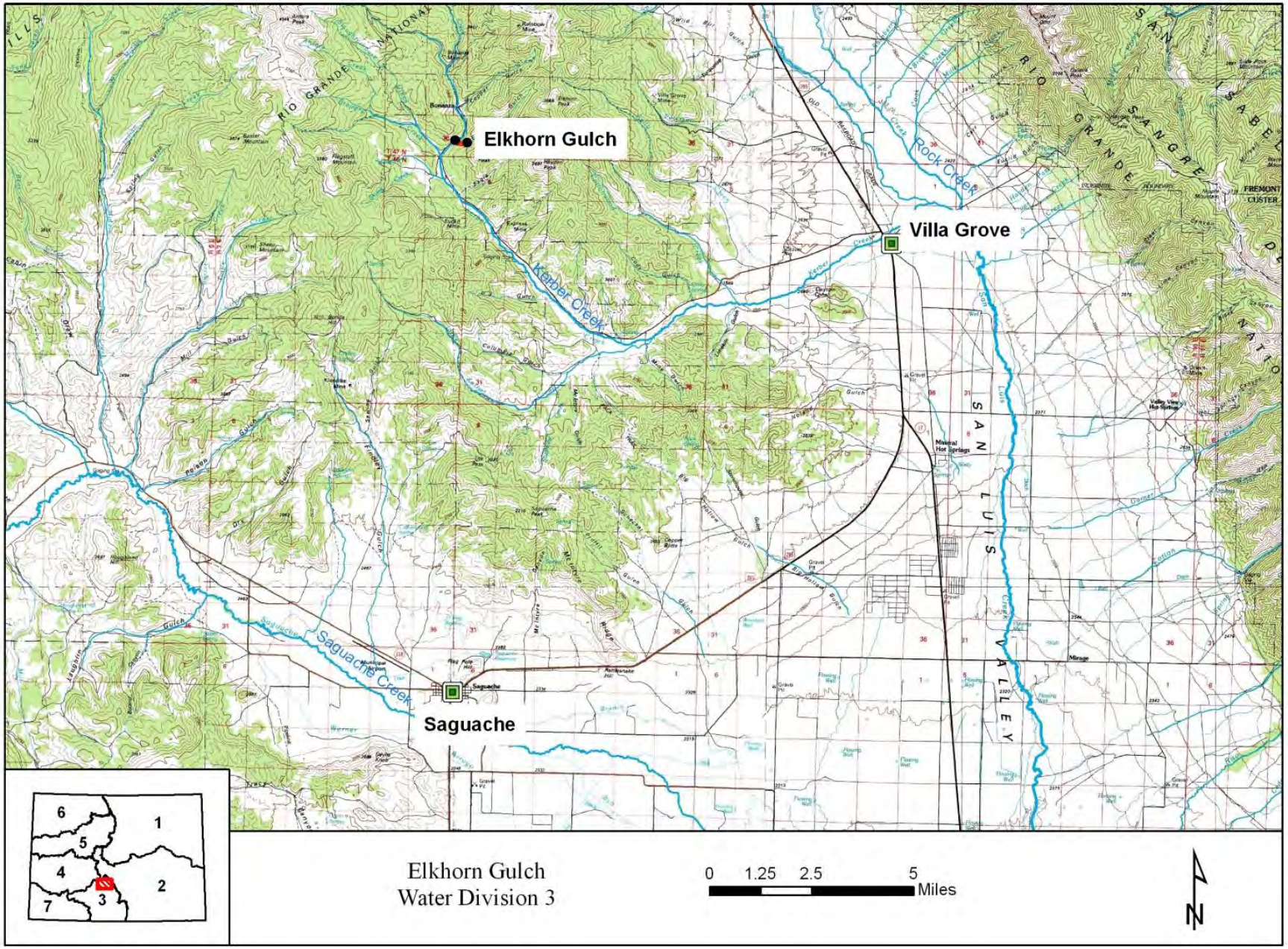
Staff recommends the Board form its intent to appropriate on the following stream reach:

Segment: USFS/BLM Boundary to Confluence with Kerber Creek
Upper Terminus: USFS/BLM BOUNDARY
(Latitude 38° 17' 24.3"N) (Longitude 106° 10' 29.02"W)
UTM North: 4238653.95 UTM East: 397267.96
NW NW Section 35, Township 47 North, Range 8 East NMPM
9' East of the West Section Line; 533' North of the South Section Line

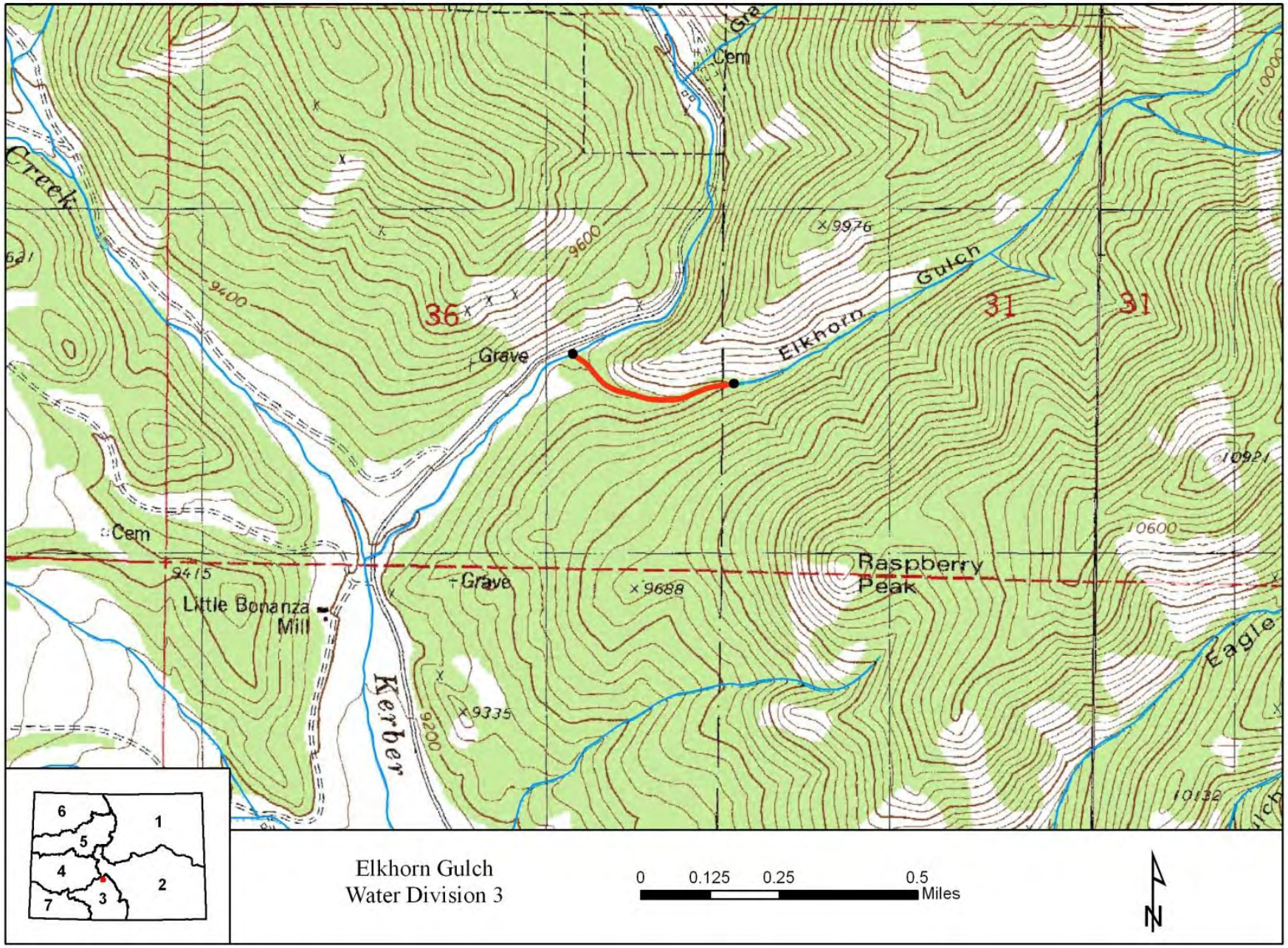
Lower Terminus: CONFLUENCE WITH KERBER CREEK
(Latitude 38° 16' 57.2"N) (Longitude 106° 08' 34.96"W)
UTM North: 4237783.91 UTM East: 400028.36
NW SE Section 36, Township 47 North, Range 7 East NMPM
1472' West of the East Section Line; 2085' North of the South Section Line

Watershed: San Luis (HUC#: 13010003)
Counties: Saguache
Length: 0.32 miles
USGS Quad(s): Bonanza, Whale Hill
Flow Recommendation: 1.05 cfs (April 15 – July 31)
0.55 cfs (August 1 – April 14)

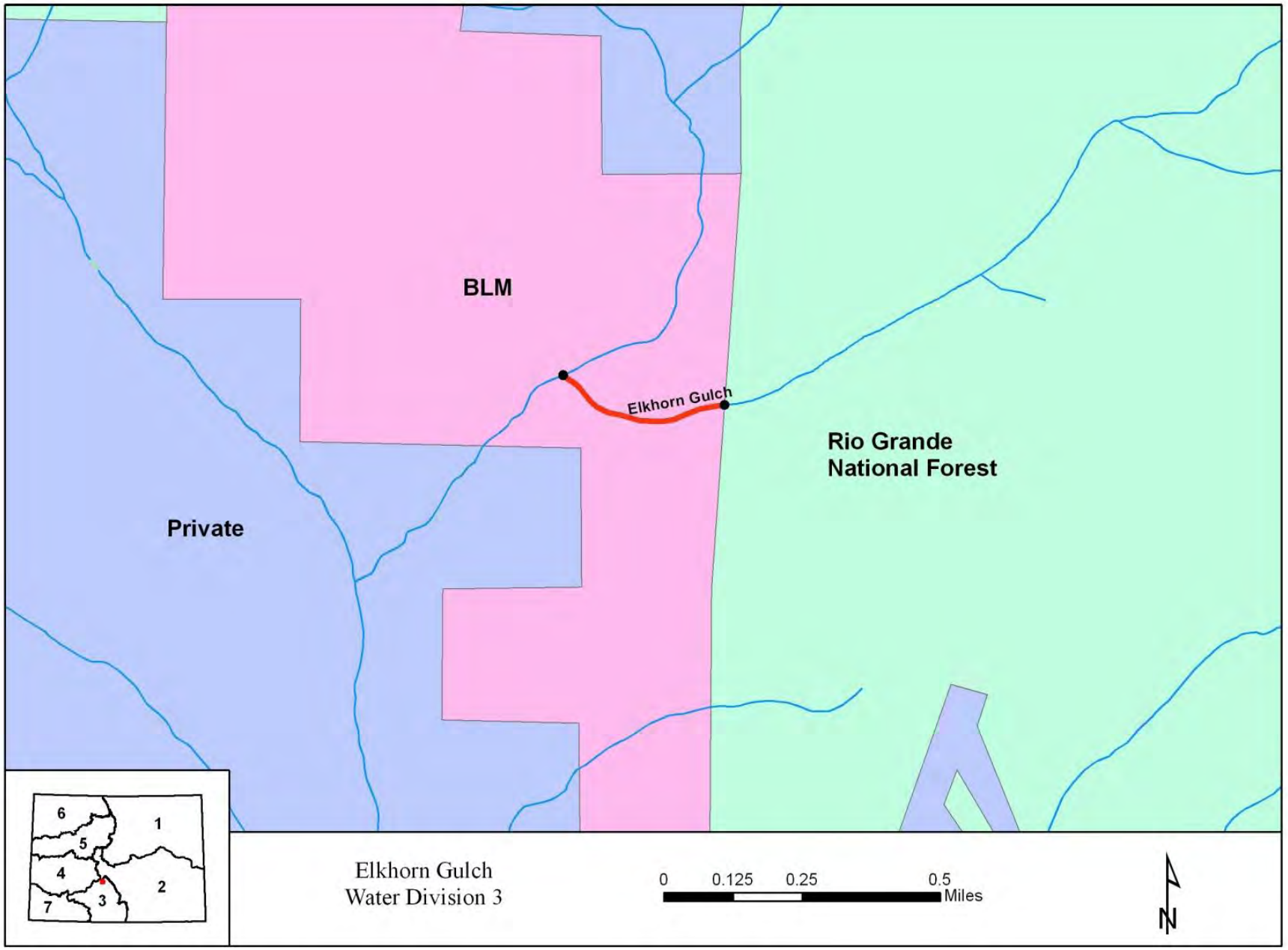
Vicinity Map



Water Rights Map



Land Use Map


BLM
Elkhorn Gulch
Rio Grande
National Forest
Private
6
1
5
4
2
7
3
Elkhorn Gulch
Water Division 3
0
0.125
0.25
0.5
Miles
N

<u>Stream:</u> Kerber Creek (Upper Segment)

Executive Summary

Water Division: 3
Water District: 25
CDOW#: 40903
CWCB ID: 12/3/A-001

Segment: Confluence with Elkhorn Gulch to Confluence with Brewery Creek
Upper Terminus: CONFLUENCE WITH ELKHORN GULCH
(Latitude 38° 16’ 57.2”N) (Longitude 106° 08’ 34.96”W)

Lower Terminus: CONFLUENCE WITH BREWERY CREEK
(Latitude 38° 16’ 37.53”N) (Longitude 106° 08’ 59.61”W)

Watershed: San Luis (HUC#: 13010003)
Counties: Saguache
Length: 0.55 miles
USGS Quad(s): Bonanza
Flow Recommendation: 3.5 cfs (April 16 – July 15)
1.45 cfs (July 16 – October 31)
0.8 cfs (November 1 – March 1)
1.45 cfs (March 2 – April 15)

Staff Analysis and Recommendation

Summary

The information contained in this report and the associated supporting data and analyses (located on the enclosed CD) forms the basis for staff's instream flow recommendation to be considered by the Board. It is staff's opinion that the information contained in this report is sufficient to support the findings required in Rule 5.40.

Colorado's Instream Flow Program was created in 1973 when the Colorado State Legislature recognized "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3) C.R.S.). The statute vests the CWCB with the exclusive authority to appropriate and acquire instream flow and natural lake level water rights. In order to encourage other entities to participate in Colorado's Instream Flow Program, the statute directs the CWCB to request instream flow recommendations from other state and federal agencies. The Bureau of Land Management (BLM) recommended this segment of Kerber Creek to the CWCB for inclusion into the Instream Flow Program. Kerber Creek is being considered for inclusion into the Instream Flow Program because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

Kerber Creek is approximately 22.0 miles long. Kerber Creek originates on the east flank of Sheep Mountain at an elevation of 11,650 feet and flows generally southeasterly through the Rio Grande National Forest as it drops to an elevation of 7,913 feet at its confluence with San Luis Creek. Approximately 35 percent of the land on the 0.55 mile segment addressed by this report is publicly owned. Kerber Creek is located within Saguache County and the total drainage area of the creek is approximately 97.36 square miles.

The subject of this report is a segment of Kerber Creek beginning at the confluence with Elkhorn Gulch and extending downstream to the confluence with Brewery Creek. The proposed segment is located approximately 14.5 miles west of Villa Grove. Staff has received one recommendation for this segment, from the BLM. The recommendation for this segment is discussed below.

Instream Flow Recommendation

The BLM recommended 3.5 cfs (April 16 – July 15), 1.45 cfs (July 16 – October 31), 0.8 cfs (November 1 – March 1), and 1.45 cfs (March 2 – April 15) based on its June 16, 2010 and October 7, 2010, data collection efforts and staff's water availability analyses.

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Confluence with Elkhorn Gulch	Confluence with Brewery Creek	0.55	65%	35%

100% of the public lands are managed by the BLM.

Biological Data

Kerber Creek is a moderate gradient stream, and historically had extensive functional floodplains and an abundance of point bars. The natural environment in Kerber Creek has been and continues to be affected by acid mine drainage from historical mining activities within the Kerber Creek watershed. The acid mine drainage significantly altered the vegetation regime along the creek, resulting in extensive changes in channel morphology.

Kerber Creek supports a naturally reproducing brook trout population, which is the trout species typically most tolerant of reduced Ph levels and some presence of heavy metals. Fish surveys have noted a full range of fish weights and ages. Macroinvertebrate surveys indicate that the creek has achieved a diversity of species that is typical of streams in the southern Rocky Mountains ecoregion. However, abundance and biomass of macroinvertebrates remains below average for streams in the southern Rocky Mountain ecoregion, which is to be expected in a stream with some continuing influence from acid mine drainage.

The riparian community is comprised primarily of willow and sedge species, with coyote willow as the most dominant shrub in the riparian community. The treatment of historic tailing deposition areas has resulted in a higher percentage of vegetation cover in the riparian zone, resulting in improved width-to-depth ratios, sinuosity, and bank stability. The brook trout population now has access to a wide range of physical habitats, including overhanging banks, pools, and velocity cover behind larger rocks in the stream channel.

Field Survey Data

BLM staff used the R2Cross methodology to quantify the amount of water required to preserve the natural environment to a reasonable degree. The R2Cross method requires that stream discharge and channel profile data be collected in a riffle stream habitat type. Riffles are most easily visualized, as the stream habitat types that would dry up first should streamflow cease. This type of hydraulic data collection consists of setting up a transect, surveying the stream channel geometry, and measuring the stream discharge.

Biological Flow Recommendation

The CWCB staff relied upon the biological expertise of the BLM to interpret output from the R2Cross data collected to develop the initial, biologic instream flow recommendation. This initial recommendation is designed to address the unique biologic requirements of each stream without regard to water availability. Three instream flow hydraulic parameters, average depth, percent wetted perimeter, and average velocity are used to develop biologic instream flow recommendations. Colorado Parks and Wildlife has determined that maintaining these three hydraulic parameters at adequate levels across riffle habitat types, aquatic habitat in pools and runs will also be maintained for most life stages of fish and aquatic invertebrates (Nehring 1979; Espegren 1996).

For this segment of stream, two data sets were collected, with the results shown in Table 1 below. Table 1 shows who collected the data (Party), the date the data was collected (Date), the measured discharge at the time of the survey (Q), the accuracy range of the predicted flows based on Manning's Equation (240% and 40% of Q), the summer flow recommendation based on meeting 3 of 3 hydraulic criteria and the winter flow recommendation based upon meeting 2 of 3 hydraulic criteria. Recommendations that fall outside of the accuracy range of the model (over 250% of the measured discharge or under 40% of the measured discharge) may not give an accurate estimate of the necessary instream flow required.

Table 1: Data

Party	Date	Q	250%-40%	Summer (3/3)	Winter (2/3)
BLM	6/16/2010	9.90	24.8 – 4.0	Out of Range	Out of Range
BLM	10/7/2010	1.58	3.9 – 0.6	3.53	1.45

The summer flow recommendation, which meets 3 of 3 criteria and is within the accuracy range of the R2CROSS model, is 3.5 cfs. The winter flow recommendation was lowered from 1.45 cfs to 0.8 cfs because of water availability constraints. This lower flow rate should provide sufficient velocity and depth to prevent icing of all physical habitat within the stream.

Hydrologic Data and Analysis

After receiving the BLM's biological evaluation and recommended flow regime, the CWCB staff conducted an evaluation of the stream hydrology to determine if water was physically available for an instream flow appropriation in the amounts recommended. This evaluation was done through a computation that is, in essence, an accounting exercise referred to as a water balance. In its most rigorous form, the water balance parses precipitation into all the avenues water pursues after it is deposited as rain, snow, or ice. In other words, given a specified amount of water deposition (input), water depletions (losses) are accounted until inputs and losses balance one with the other. The water losses that can be tracked include depletions due to evaporation and transpiration, deliveries into ground water storage, temporary surface storage, incorporations into plant and animal tissue and so forth. When these losses are individually or collectively subtracted from the input, any of the original input not balanced by loss is anticipated to be found in stream runoff as represented by the discharge measured at intercepting stream gages. In its analysis, CWCB staff has used this approach of balancing inputs and losses to determine if water is available for the recommended instream flow appropriation. Of course, this analysis must be a practical exercise rather than a lengthy and costly scientific investigation. As a result, staff has simplified the process by lumping together some variables and employing certain rational and scientifically supportable assumptions. The following describes the steps used to complete the evaluation for this particular stream.

The first step required to determine water availability is a determination of the hydrologic regime at the Lower Terminus (LT) of the recommended ISF reach. In the best case, this means looking at the data from a gage at the LT. Further, this data, again in the best case, has been collected for a long period of

time (the longer the better), including wet and dry periods. For the subject reach of Kerber Creek, there is a USGS and DWR gage record of discharge on the creek. The gage is KERBER CR ABV LITTLE KERBER CR NR VILLA GROVE, CO (USGS 08224500/DWR KERVILCO); it has a 61-year period of record (POR) collected between 1923 and 2010. The gage is at an elevation of 8,640 ft above mean sea level (amsl) and has a drainage area of 45.4 mi^2. The hydrograph (plot of discharge over time) produced from this gage includes the consumptive uses of several diversions in the basin above the gage. However, the existence of these diversions is not a major limitation upon the use of the data from the gage. To make the measured data transferable to Kerber Creek above the LT, the consumptive portions of these diversions were added back to the measured hydrograph. The resulting "adjusted" hydrograph could then be used on Kerber Creek above the LT by multiplying the "adjusted" hydrograph by an area ratio; specifically, the area of Kerber Creek above the LT (16.52 mi^2 above the LT) to Kerber Creek above the gage (41.21 mi^2 above the gage). Next, the resulting proportioned "adjusted" hydrograph would itself be "adjusted" (decreased) to reflect the existing depletions on Kerber Creek above the LT resulting from upstream consumptive irrigation uses. The final hydrograph would thus represent a distribution of flow over time that has been reduced to reflect existing human uses.

{The following discussion is based upon the US Geological Survey's *Techniques of Water-Resources Investigations* Series, *Book 4: Hydrologic Analysis and Interpretation, Chapter A3: Statistical Methods in Water Resources* (Chapter 3: Describing Uncertainty) by D.R. Helsel and R. M. Hirsch. This technical reference provides the scientific background and guidance important to the systematic interpretation of hydrologic data. The document is available online and is a valuable aid to understanding and interpreting the analyses described here.}

The next step in producing a representation of the discharge at Kerber Creek above the LT is to compute the Geometric Mean of the area-prorated "adjusted" data values from the Kerber Cr above Little Kerber Cr nr Villa Grove, CO hydrograph. This step is of value because of the inherent statistical weaknesses found in any collection of data intended to measure natural stream discharge. Without getting into the details of statistical theory, it is worth noting that a set of discharge measurements is inherently inaccurate, no matter how well collected, due to the difficulties attendant to data collection, especially hydrologic data. In this particular case, the relatively short period of record lends even greater merit to the use of this statistical tool. To give deference to this fact and to increase the value of the hydrograph product of this analysis, the Geometric Means of the data were computed and plotted along with the 95% Confidence Intervals about the data. The resultant hydrograph, including recommended instream flow values, is displayed in Figure 1.

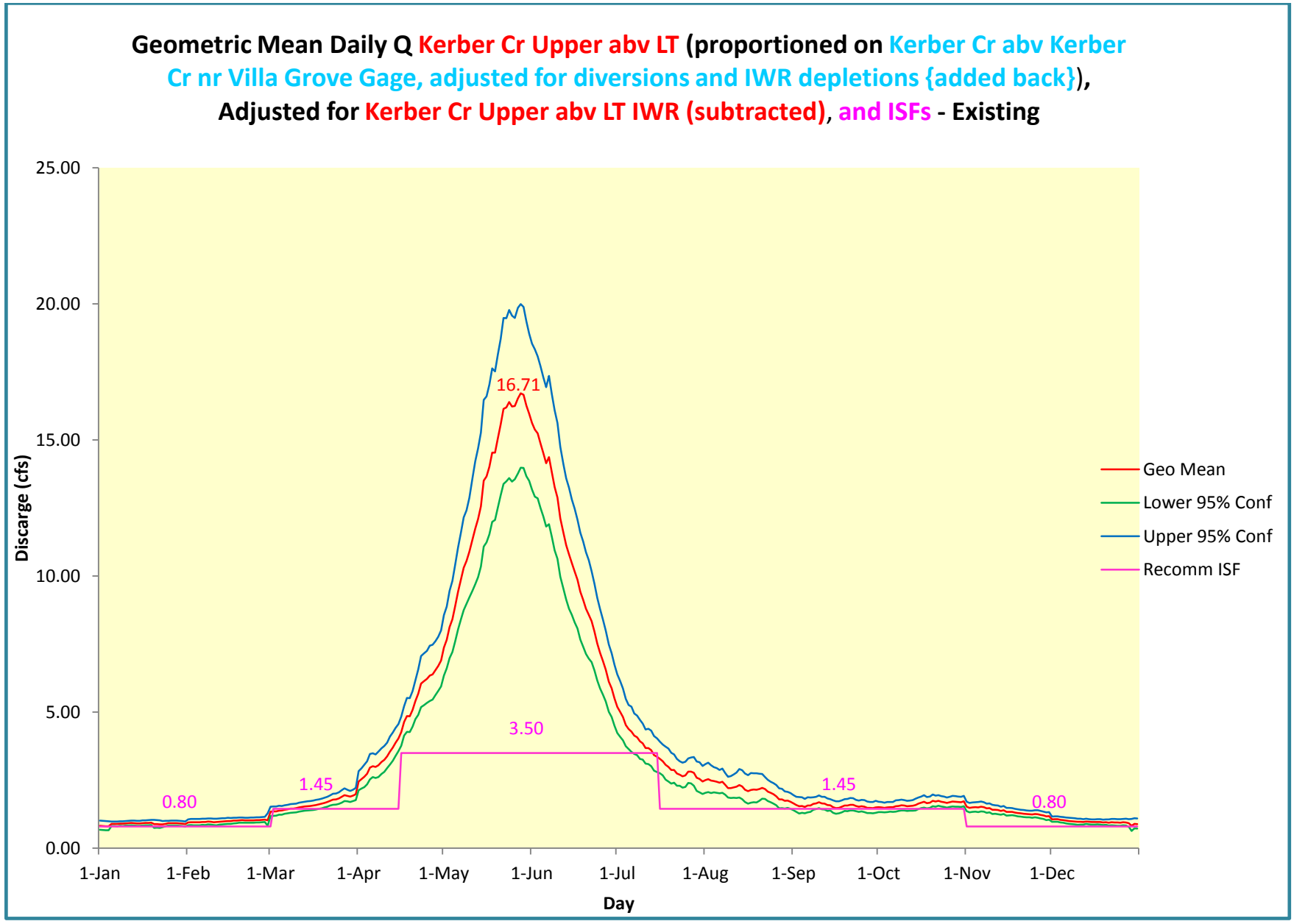

Geometric Mean Daily Q Kerber Cr Upper abv LT (proportioned on Kerber Cr abv Kerber Cr nr Villa Grove Gage, adjusted for diversions and IWR depletions {added back}), Adjusted for Kerber Cr Upper abv LT IWR (subtracted), and ISFs - Existing
Discarge (cfs)
25.00
20.00
15.00
10.00
5.00
0.00
16.71
3.50
1.45
1.45
0.80
0.80
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Day
Geo Mean
Lower 95% Conf
Upper 95% Conf
Recomm ISF

Figure 1

Geometric Mean Existing Cond (IWR or div subtracted) Kerber Cr Upper abv LT Prop on Kerber Cr abv Gage Baseline Cond (with Kerber Cr abv Gage IWR consumption added back)				
	GM (abv LT) Prorated by 36.39%	**Lower 95% Conf Prorated by 36.39%**	**Upper 95% Conf Prorated by 36.39%**	**Recommended ISFs**
1-Jan	0.83	0.67	1.02	0.80
2-Jan	0.82	0.66	1.01	0.80
3-Jan	0.81	0.66	0.99	0.80
4-Jan	0.80	0.66	0.99	0.80
5-Jan	0.89	0.81	0.97	0.80
6-Jan	0.89	0.81	0.98	0.80
7-Jan	0.89	0.81	0.98	0.80
8-Jan	0.90	0.82	0.99	0.80
9-Jan	0.90	0.82	0.99	0.80
10-Jan	0.91	0.83	1.00	0.80
11-Jan	0.92	0.84	1.01	0.80
12-Jan	0.92	0.84	1.01	0.80
13-Jan	0.92	0.83	1.01	0.80
14-Jan	0.91	0.82	1.00	0.80
15-Jan	0.91	0.82	1.00	0.80
16-Jan	0.92	0.83	1.02	0.80
17-Jan	0.93	0.84	1.02	0.80
18-Jan	0.93	0.84	1.03	0.80
19-Jan	0.94	0.85	1.04	0.80
20-Jan	0.88	0.75	1.04	0.80
21-Jan	0.88	0.75	1.03	0.80
22-Jan	0.87	0.75	1.02	0.80
23-Jan	0.88	0.77	1.00	0.80
24-Jan	0.90	0.80	1.00	0.80
25-Jan	0.92	0.84	1.01	0.80
26-Jan	0.92	0.84	1.02	0.80
27-Jan	0.92	0.83	1.01	0.80
28-Jan	0.92	0.83	1.01	0.80
29-Jan	0.91	0.82	1.00	0.80
30-Jan	0.90	0.82	1.00	0.80
31-Jan	0.89	0.80	0.98	0.80
1-Feb	0.94	0.84	1.06	0.80
2-Feb	0.95	0.85	1.07	0.80
3-Feb	0.95	0.84	1.08	0.80
4-Feb	0.95	0.84	1.07	0.80
5-Feb	0.95	0.84	1.08	0.80
6-Feb	0.97	0.86	1.08	0.80
7-Feb	0.96	0.85	1.08	0.80
8-Feb	0.98	0.87	1.10	0.80
9-Feb	0.97	0.87	1.09	0.80
10-Feb	0.96	0.85	1.08	0.80
11-Feb	0.96	0.84	1.09	0.80
12-Feb	0.97	0.87	1.09	0.80
13-Feb	0.98	0.87	1.10	0.80
14-Feb	0.98	0.88	1.10	0.80
15-Feb	1.00	0.89	1.11	0.80
16-Feb	1.00	0.89	1.11	0.80
17-Feb	1.01	0.91	1.12	0.80
18-Feb	1.02	0.92	1.12	0.80
19-Feb	1.02	0.93	1.12	0.80
20-Feb	1.03	0.93	1.13	0.80

21-Feb	1.02	0.93	1.12	0.80
22-Feb	1.02	0.94	1.12	0.80
23-Feb	1.03	0.94	1.12	0.80
24-Feb	1.03	0.94	1.12	0.80
25-Feb	1.03	0.94	1.13	0.80
26-Feb	1.03	0.94	1.13	0.80
27-Feb	1.04	0.95	1.14	0.80
28-Feb	1.05	0.96	1.15	0.80
29-Feb	1.02	0.82	1.28	0.80
1-Mar	1.34	1.18	1.53	0.80
2-Mar	1.35	1.19	1.54	1.45
3-Mar	1.36	1.20	1.54	1.45
4-Mar	1.38	1.23	1.55	1.45
5-Mar	1.38	1.23	1.55	1.45
6-Mar	1.41	1.26	1.58	1.45
7-Mar	1.43	1.28	1.59	1.45
8-Mar	1.45	1.30	1.62	1.45
9-Mar	1.46	1.31	1.63	1.45
10-Mar	1.47	1.32	1.64	1.45
11-Mar	1.50	1.35	1.67	1.45
12-Mar	1.51	1.36	1.69	1.45
13-Mar	1.53	1.37	1.71	1.45
14-Mar	1.54	1.38	1.72	1.45
15-Mar	1.55	1.39	1.73	1.45
16-Mar	1.57	1.40	1.75	1.45
17-Mar	1.59	1.42	1.77	1.45
18-Mar	1.61	1.45	1.79	1.45
19-Mar	1.63	1.47	1.82	1.45
20-Mar	1.67	1.50	1.85	1.45
21-Mar	1.69	1.52	1.88	1.45
22-Mar	1.74	1.56	1.94	1.45
23-Mar	1.79	1.60	2.00	1.45
24-Mar	1.79	1.60	2.01	1.45
25-Mar	1.83	1.62	2.06	1.45
26-Mar	1.88	1.67	2.13	1.45
27-Mar	1.95	1.73	2.20	1.45
28-Mar	1.92	1.72	2.15	1.45
29-Mar	1.89	1.70	2.11	1.45
30-Mar	1.93	1.73	2.15	1.45
31-Mar	1.98	1.77	2.22	1.45
1-Apr	2.45	2.13	2.83	1.45
2-Apr	2.53	2.19	2.94	1.45
3-Apr	2.62	2.25	3.06	1.45
4-Apr	2.74	2.35	3.19	1.45
5-Apr	2.96	2.53	3.46	1.45
6-Apr	3.02	2.61	3.48	1.45
7-Apr	2.98	2.58	3.44	1.45
8-Apr	3.04	2.61	3.55	1.45
9-Apr	3.17	2.73	3.67	1.45
10-Apr	3.24	2.80	3.76	1.45
11-Apr	3.38	2.94	3.88	1.45
12-Apr	3.55	3.07	4.10	1.45
13-Apr	3.70	3.21	4.25	1.45
14-Apr	3.87	3.39	4.42	1.45
15-Apr	4.03	3.57	4.56	1.45

16-Apr	4.26	3.76	4.84	3.50
17-Apr	4.64	4.13	5.22	3.50
18-Apr	4.86	4.27	5.52	3.50
19-Apr	4.85	4.27	5.51	3.50
20-Apr	5.08	4.47	5.77	3.50
21-Apr	5.41	4.74	6.17	3.50
22-Apr	5.67	4.90	6.57	3.50
23-Apr	6.04	5.18	7.06	3.50
24-Apr	6.13	5.25	7.16	3.50
25-Apr	6.22	5.34	7.25	3.50
26-Apr	6.34	5.40	7.44	3.50
27-Apr	6.39	5.46	7.47	3.50
28-Apr	6.54	5.62	7.61	3.50
29-Apr	6.70	5.78	7.77	3.50
30-Apr	6.89	5.94	8.00	3.50
1-May	7.37	6.34	8.56	3.50
2-May	7.66	6.61	8.88	3.50
3-May	8.12	6.98	9.45	3.50
4-May	8.41	7.21	9.82	3.50
5-May	8.90	7.60	10.42	3.50
6-May	9.42	8.04	11.05	3.50
7-May	9.86	8.40	11.58	3.50
8-May	10.31	8.74	12.15	3.50
9-May	10.55	8.98	12.41	3.50
10-May	10.89	9.22	12.87	3.50
11-May	11.33	9.45	13.58	3.50
12-May	11.74	9.70	14.21	3.50
13-May	12.09	9.96	14.69	3.50
14-May	12.56	10.35	15.27	3.50
15-May	13.51	11.08	16.47	3.50
16-May	13.66	11.24	16.60	3.50
17-May	14.01	11.53	17.03	3.50
18-May	14.53	11.99	17.63	3.50
19-May	14.53	12.06	17.52	3.50
20-May	15.06	12.52	18.14	3.50
21-May	15.57	12.97	18.71	3.50
22-May	16.14	13.38	19.48	3.50
23-May	16.20	13.48	19.47	3.50
24-May	16.39	13.60	19.77	3.50
25-May	16.23	13.47	19.57	3.50
26-May	16.24	13.56	19.48	3.50
27-May	16.53	13.77	19.85	3.50
28-May	16.71	13.98	19.99	3.50
29-May	16.66	13.97	19.89	3.50
30-May	16.26	13.66	19.36	3.50
31-May	15.96	13.49	18.90	3.50
1-Jun	15.62	13.17	18.53	3.50
2-Jun	15.38	12.92	18.33	3.50
3-Jun	15.24	12.86	18.07	3.50
4-Jun	14.87	12.50	17.71	3.50
5-Jun	14.51	12.19	17.30	3.50
6-Jun	14.14	11.81	16.94	3.50
7-Jun	14.37	11.91	17.35	3.50
8-Jun	13.81	11.44	16.69	3.50
9-Jun	13.27	10.95	16.09	3.50

10-Jun	12.88	10.63	15.62	3.50
11-Jun	12.12	9.97	14.75	3.50
12-Jun	11.60	9.54	14.11	3.50
13-Jun	11.14	9.13	13.59	3.50
14-Jun	10.79	8.80	13.25	3.50
15-Jun	10.48	8.58	12.82	3.50
16-Jun	10.17	8.30	12.47	3.50
17-Jun	9.86	8.07	12.07	3.50
18-Jun	9.42	7.67	11.59	3.50
19-Jun	9.13	7.40	11.27	3.50
20-Jun	8.80	7.14	10.87	3.50
21-Jun	8.58	6.97	10.58	3.50
22-Jun	8.34	6.84	10.18	3.50
23-Jun	7.96	6.53	9.72	3.50
24-Jun	7.52	6.16	9.19	3.50
25-Jun	7.17	5.87	8.78	3.50
26-Jun	6.88	5.64	8.40	3.50
27-Jun	6.56	5.39	8.00	3.50
28-Jun	6.12	5.01	7.48	3.50
29-Jun	5.87	4.82	7.17	3.50
30-Jun	5.50	4.50	6.74	3.50
1-Jul	5.19	4.23	6.39	3.50
2-Jul	5.01	4.09	6.15	3.50
3-Jul	4.82	3.96	5.87	3.50
4-Jul	4.53	3.74	5.48	3.50
5-Jul	4.37	3.65	5.26	3.50
6-Jul	4.29	3.54	5.20	3.50
7-Jul	4.13	3.46	4.95	3.50
8-Jul	4.08	3.42	4.87	3.50
9-Jul	3.93	3.28	4.71	3.50
10-Jul	3.85	3.25	4.58	3.50
11-Jul	3.68	3.11	4.36	3.50
12-Jul	3.68	3.09	4.39	3.50
13-Jul	3.60	3.01	4.32	3.50
14-Jul	3.42	2.85	4.11	3.50
15-Jul	3.35	2.80	4.03	3.50
16-Jul	3.28	2.76	3.91	1.45
17-Jul	3.19	2.68	3.81	1.45
18-Jul	3.06	2.52	3.73	1.45
19-Jul	2.99	2.45	3.66	1.45
20-Jul	2.88	2.37	3.50	1.45
21-Jul	2.87	2.40	3.45	1.45
22-Jul	2.74	2.29	3.28	1.45
23-Jul	2.70	2.29	3.19	1.45
24-Jul	2.64	2.22	3.14	1.45
25-Jul	2.67	2.25	3.18	1.45
26-Jul	2.81	2.40	3.30	1.45
27-Jul	2.81	2.38	3.33	1.45
28-Jul	2.77	2.30	3.35	1.45
29-Jul	2.59	2.11	3.19	1.45
30-Jul	2.54	2.05	3.16	1.45
31-Jul	2.45	1.99	3.02	1.45
1-Aug	2.50	2.03	3.09	1.45
2-Aug	2.54	2.06	3.14	1.45
3-Aug	2.48	2.03	3.05	1.45

4-Aug	2.47	2.06	2.98	1.45
5-Aug	2.45	2.04	2.95	1.45
6-Aug	2.40	2.01	2.88	1.45
7-Aug	2.44	2.03	2.93	1.45
8-Aug	2.33	1.96	2.76	1.45
9-Aug	2.21	1.86	2.62	1.45
10-Aug	2.21	1.84	2.65	1.45
11-Aug	2.24	1.85	2.71	1.45
12-Aug	2.26	1.84	2.78	1.45
13-Aug	2.32	1.86	2.90	1.45
14-Aug	2.26	1.80	2.87	1.45
15-Aug	2.15	1.69	2.74	1.45
16-Aug	2.09	1.64	2.69	1.45
17-Aug	2.14	1.67	2.76	1.45
18-Aug	2.15	1.69	2.76	1.45
19-Aug	2.14	1.68	2.75	1.45
20-Aug	2.18	1.74	2.74	1.45
21-Aug	2.22	1.82	2.72	1.45
22-Aug	2.17	1.81	2.61	1.45
23-Aug	2.08	1.73	2.51	1.45
24-Aug	2.03	1.69	2.44	1.45
25-Aug	1.98	1.64	2.39	1.45
26-Aug	1.91	1.58	2.32	1.45
27-Aug	1.79	1.47	2.20	1.45
28-Aug	1.79	1.47	2.19	1.45
29-Aug	1.74	1.46	2.09	1.45
30-Aug	1.75	1.48	2.07	1.45
31-Aug	1.71	1.44	2.02	1.45
1-Sep	1.64	1.39	1.95	1.45
2-Sep	1.59	1.34	1.89	1.45
3-Sep	1.54	1.27	1.87	1.45
4-Sep	1.55	1.30	1.87	1.45
5-Sep	1.52	1.28	1.81	1.45
6-Sep	1.57	1.32	1.87	1.45
7-Sep	1.57	1.33	1.86	1.45
8-Sep	1.63	1.41	1.87	1.45
9-Sep	1.65	1.44	1.89	1.45
10-Sep	1.69	1.47	1.94	1.45
11-Sep	1.64	1.43	1.89	1.45
12-Sep	1.64	1.42	1.89	1.45
13-Sep	1.58	1.37	1.83	1.45
14-Sep	1.58	1.38	1.80	1.45
15-Sep	1.51	1.30	1.76	1.45
16-Sep	1.47	1.27	1.72	1.45
17-Sep	1.48	1.28	1.72	1.45
18-Sep	1.52	1.32	1.76	1.45
19-Sep	1.56	1.36	1.80	1.45
20-Sep	1.57	1.36	1.81	1.45
21-Sep	1.60	1.38	1.85	1.45
22-Sep	1.59	1.38	1.83	1.45
23-Sep	1.55	1.36	1.77	1.45
24-Sep	1.53	1.33	1.75	1.45
25-Sep	1.55	1.35	1.78	1.45
26-Sep	1.53	1.32	1.77	1.45
27-Sep	1.48	1.29	1.71	1.45

28-Sep	1.48	1.29	1.69	1.45
29-Sep	1.47	1.28	1.70	1.45
30-Sep	1.50	1.30	1.74	1.45
1-Oct	1.51	1.33	1.71	1.45
2-Oct	1.50	1.33	1.70	1.45
3-Oct	1.48	1.32	1.68	1.45
4-Oct	1.50	1.33	1.70	1.45
5-Oct	1.51	1.35	1.70	1.45
6-Oct	1.50	1.33	1.70	1.45
7-Oct	1.54	1.35	1.76	1.45
8-Oct	1.55	1.36	1.76	1.45
9-Oct	1.57	1.39	1.79	1.45
10-Oct	1.56	1.39	1.77	1.45
11-Oct	1.54	1.37	1.74	1.45
12-Oct	1.55	1.37	1.75	1.45
13-Oct	1.56	1.38	1.77	1.45
14-Oct	1.59	1.39	1.81	1.45
15-Oct	1.64	1.44	1.86	1.45
16-Oct	1.67	1.47	1.90	1.45
17-Oct	1.70	1.49	1.95	1.45
18-Oct	1.66	1.46	1.88	1.45
19-Oct	1.67	1.48	1.89	1.45
20-Oct	1.74	1.54	1.97	1.45
21-Oct	1.72	1.53	1.93	1.45
22-Oct	1.74	1.56	1.95	1.45
23-Oct	1.71	1.53	1.91	1.45
24-Oct	1.69	1.51	1.89	1.45
25-Oct	1.66	1.49	1.86	1.45
26-Oct	1.69	1.51	1.89	1.45
27-Oct	1.71	1.53	1.92	1.45
28-Oct	1.71	1.52	1.92	1.45
29-Oct	1.70	1.52	1.90	1.45
30-Oct	1.69	1.52	1.88	1.45
31-Oct	1.72	1.54	1.92	1.45
1-Nov	1.52	1.36	1.70	1.45
2-Nov	1.48	1.32	1.66	0.80
3-Nov	1.50	1.33	1.68	0.80
4-Nov	1.51	1.34	1.69	0.80
5-Nov	1.50	1.32	1.70	0.80
6-Nov	1.52	1.35	1.71	0.80
7-Nov	1.50	1.34	1.69	0.80
8-Nov	1.46	1.30	1.64	0.80
9-Nov	1.47	1.32	1.64	0.80
10-Nov	1.41	1.26	1.59	0.80
11-Nov	1.41	1.27	1.57	0.80
12-Nov	1.40	1.25	1.57	0.80
13-Nov	1.37	1.23	1.52	0.80
14-Nov	1.39	1.25	1.55	0.80
15-Nov	1.33	1.19	1.48	0.80
16-Nov	1.33	1.20	1.48	0.80
17-Nov	1.34	1.21	1.47	0.80
18-Nov	1.31	1.19	1.44	0.80
19-Nov	1.29	1.17	1.43	0.80
20-Nov	1.28	1.16	1.41	0.80
21-Nov	1.27	1.15	1.40	0.80

22-Nov	1.26	1.14	1.39	0.80
23-Nov	1.25	1.13	1.38	0.80
24-Nov	1.24	1.12	1.37	0.80
25-Nov	1.26	1.13	1.39	0.80
26-Nov	1.25	1.12	1.39	0.80
27-Nov	1.22	1.09	1.36	0.80
28-Nov	1.20	1.07	1.34	0.80
29-Nov	1.17	1.03	1.32	0.80
30-Nov	1.18	1.05	1.33	0.80
1-Dec	1.06	0.97	1.16	0.80
2-Dec	1.07	0.97	1.17	0.80
3-Dec	1.06	0.97	1.17	0.80
4-Dec	1.04	0.95	1.15	0.80
5-Dec	1.03	0.93	1.15	0.80
6-Dec	1.01	0.91	1.13	0.80
7-Dec	1.00	0.89	1.12	0.80
8-Dec	0.99	0.88	1.11	0.80
9-Dec	0.98	0.87	1.10	0.80
10-Dec	0.97	0.86	1.09	0.80
11-Dec	0.97	0.86	1.08	0.80
12-Dec	0.96	0.87	1.07	0.80
13-Dec	0.98	0.89	1.08	0.80
14-Dec	0.97	0.88	1.07	0.80
15-Dec	0.96	0.87	1.06	0.80
16-Dec	0.96	0.87	1.06	0.80
17-Dec	0.97	0.87	1.07	0.80
18-Dec	0.96	0.87	1.06	0.80
19-Dec	0.94	0.85	1.05	0.80
20-Dec	0.95	0.86	1.06	0.80
21-Dec	0.94	0.83	1.06	0.80
22-Dec	0.95	0.84	1.08	0.80
23-Dec	0.95	0.83	1.07	0.80
24-Dec	0.94	0.83	1.07	0.80
25-Dec	0.94	0.83	1.07	0.80
26-Dec	0.95	0.84	1.08	0.80
27-Dec	0.95	0.83	1.08	0.80
28-Dec	0.92	0.79	1.07	0.80
29-Dec	0.83	0.64	1.07	0.80
30-Dec	0.89	0.72	1.10	0.80
31-Dec	0.89	0.72	1.09	0.80

Existing Water Right Information

Staff has analyzed the water rights tabulation and contacted the Division Engineer Office (DEO) to identify any potential water availability problems. There are no decreed surface diversions within this reach of stream. Staff has determined that water is available for appropriation on Kerber Creek, between the confluence with Elkhorn Gulch down to the confluence with Brewery Creek, to preserve the natural environment to a reasonable degree without limiting or foreclosing the exercise of valid existing water rights.

CWCB Staff's Instream Flow Recommendation

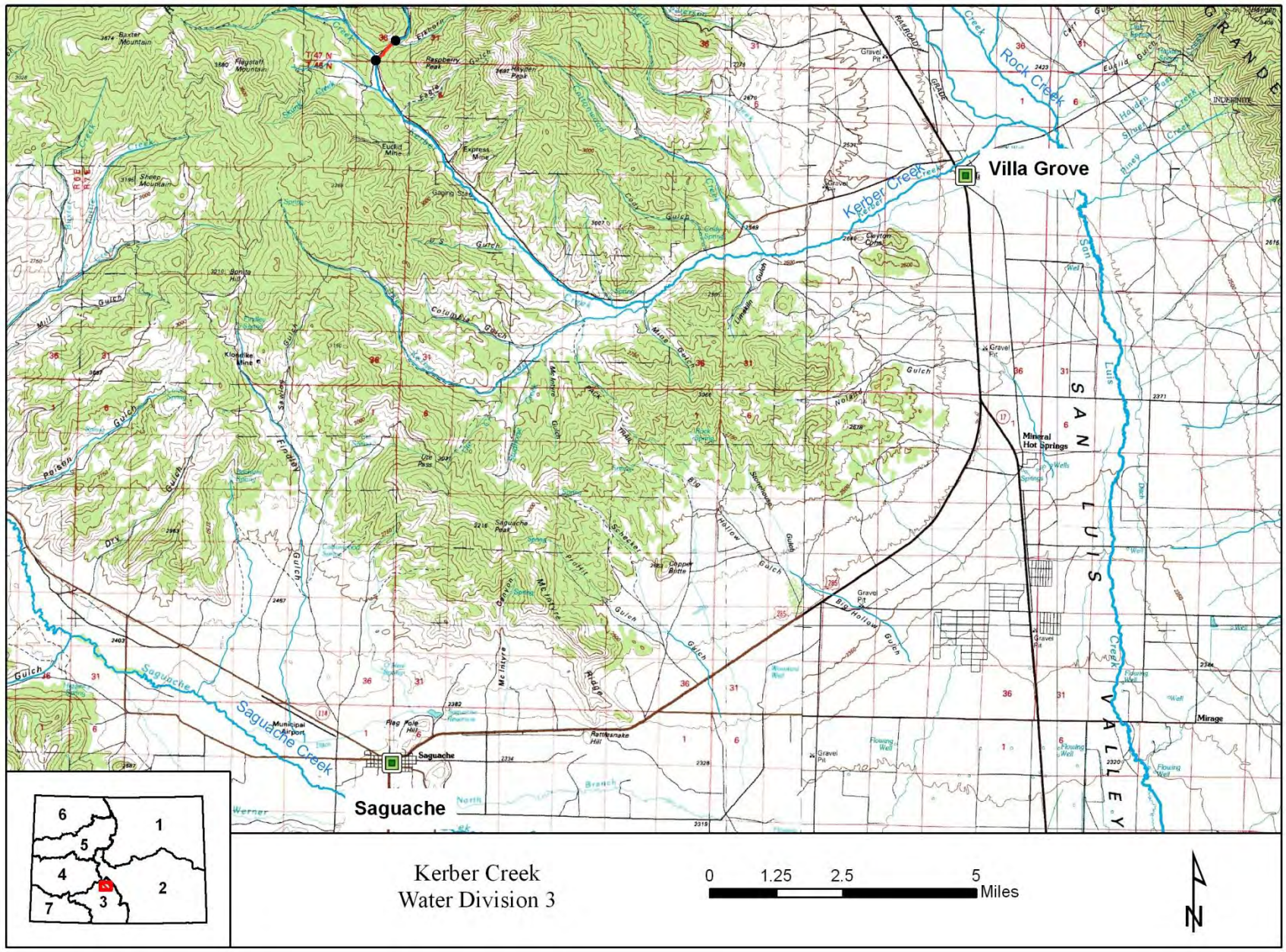
Staff recommends the Board form its intent to appropriate on the following stream reach:

Segment: Confluence with Elkhorn Gulch to Confluence with Brewery Creek
Upper Terminus: CONFLUENCE WITH ELKHORN GULCH
(Latitude 38° 16' 57.2"N) (Longitude 106° 08' 34.96"W)
UTM North: 4237783.91 UTM East: 400028.36
NW SE Section 36, Township 47 North, Range 7 East NMPM
1472' West of the East Section Line; 2085' North of the South Section Line

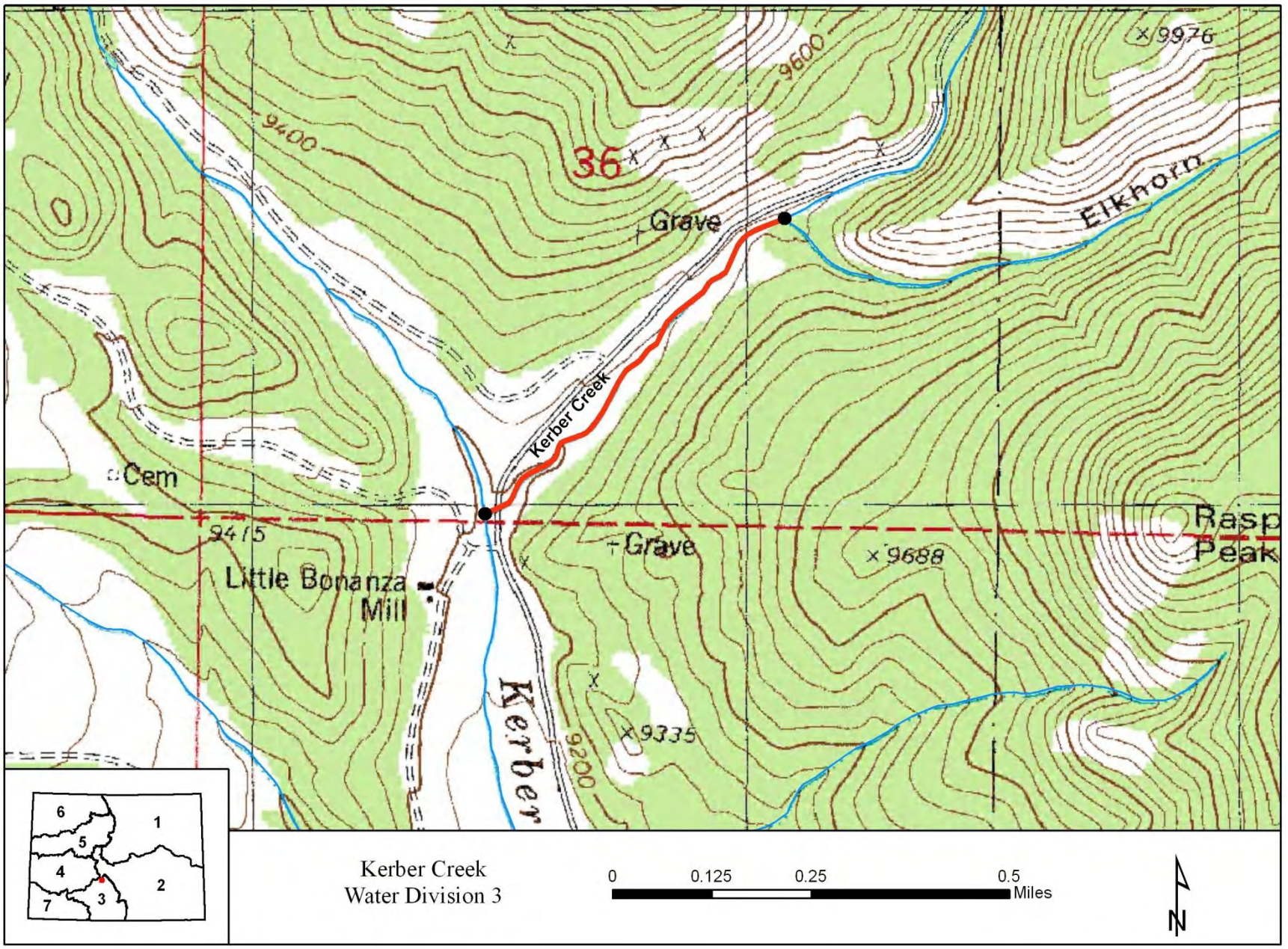
Lower Terminus: CONFLUENCE WITH BREWERY CREEK
(Latitude 38° 16' 37.53"N) (Longitude 106° 08' 59.61"W)
UTM North: 4237184.91 UTM East: 399422.13
SE SW Section 36, Township 47North, Range 7 East NMPM
1851' East of the West Section Line; 85' North of the South Section Line

Watershed: San Luis (HUC#: 13010003)
Counties: Saguache
Length: 0.55 miles
USGS Quad(s): Bonanza
Flow Recommendation: 3.5 cfs (April 16 – July 15)
1.45 cfs (July 16 – October 31)
0.8 cfs (November 1 – March 1)
1.45 cfs (March 2 – April 15)

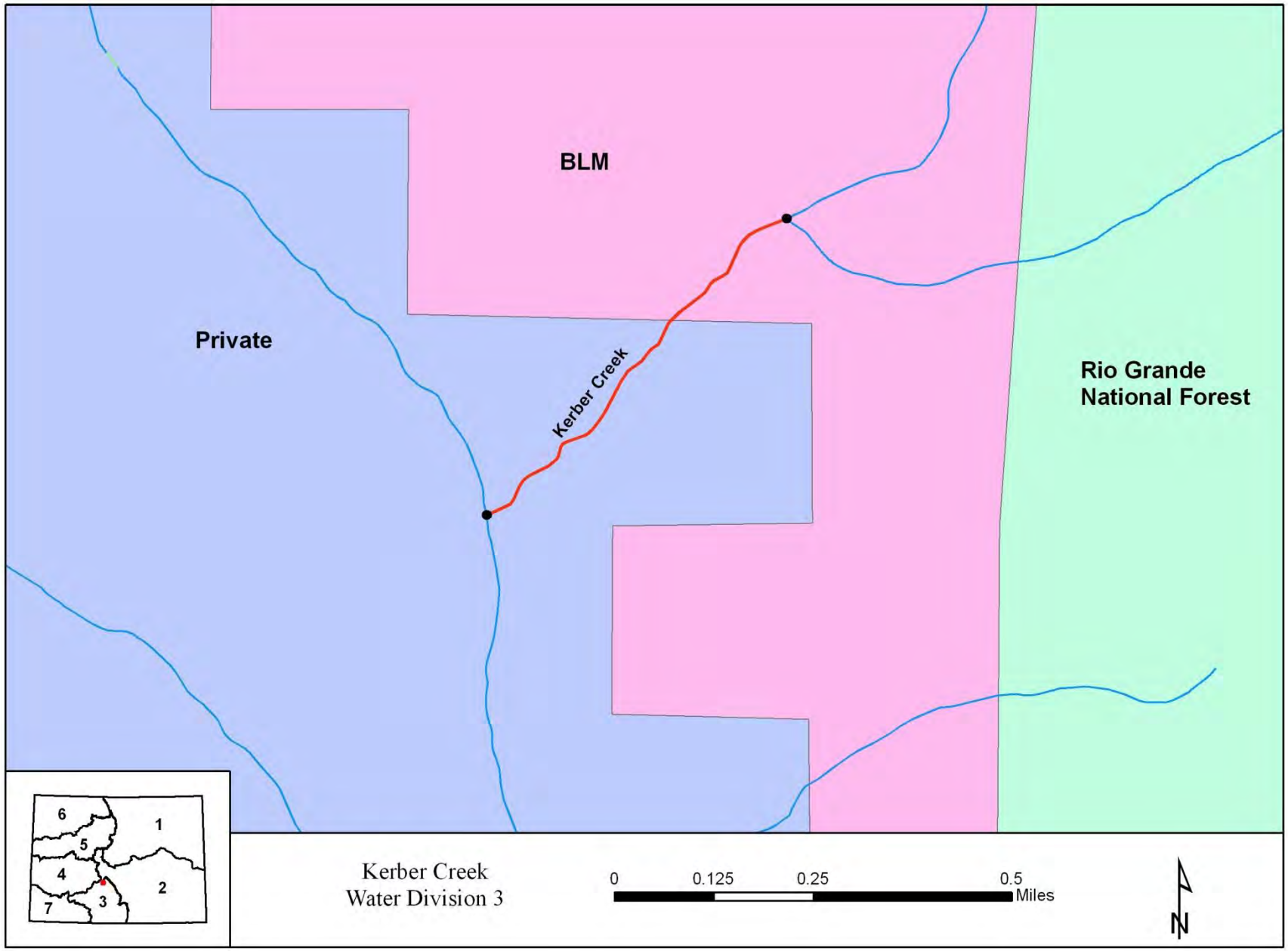
Vicinity Map



Water Rights Map



Land Use Map


BLM
Private
Kerber Creek
Rio Grande
National Forest
6
1
5
4
2
3
7
Kerber Creek
Water Division 3
0
0.125
0.25
0.5
Miles
N

<u>Stream:</u> Kerber Creek (Lower Segment)

Executive Summary

Water Division: 3
Water District: 25
CDOW#: 40903
CWCB ID: 12/3/A-002

Segment: Confluence with Brewery Creek to Wells Kerber Ditch Headgate
Upper Terminus: CONFLUENCE WITH BREWERY CREEK
(Latitude 38° 16’ 37.53”N) (Longitude 106° 08’ 59.61”W)

Lower Terminus: WELLS KERBER DITCH HEADGATE
(Latitude 38° 13’ 57.8”N) (Longitude 105° 59’ 8.71”W)

Watershed: San Luis (HUC#: 13010003)
Counties: Saguache
Length: 13.1 miles
USGS Quad(s): Villa Grove, Graveyard Gulch, Klondike Mine, Bonanza
Flow Recommendation: 6.75 cfs (April 1 – July 31)
4.0 cfs (August 1 – November 15)
2.6 cfs (November 16 – March 31)

Staff Analysis and Recommendation

Summary

The information contained in this report and the associated supporting data and analyses (located on the included CD) forms the basis for staff's instream flow recommendation to be considered by the Board. It is staff's opinion that the information contained in this report is sufficient to support the findings required in Rule 5.40.

Colorado's Instream Flow Program was created in 1973 when the Colorado State Legislature recognized "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3) C.R.S.). The statute vests the CWCB with the exclusive authority to appropriate and acquire instream flow and natural lake level water rights. In order to encourage other entities to participate in Colorado's Instream Flow Program, the statute directs the CWCB to request instream flow recommendations from other state and federal agencies. The Bureau of Land Management (BLM) recommended this segment of Kerber Creek to the CWCB for inclusion into the Instream Flow Program. Kerber Creek is being considered for inclusion into the Instream Flow Program because it has a natural environment that can be preserved to a reasonable degree with an instream flow water right.

Kerber Creek is approximately 22.0 miles long. Kerber Creek originates on the east flank of Sheep Mountain at an elevation of 11,650 feet and flows generally southeasterly through the Rio Grande National Forest as it drops to an elevation of 7,913 feet at its confluence with San Luis Creek. Approximately 97.5 percent of the land on the 13.1 mile segment addressed by this report is privately owned. Kerber Creek is located within Saguache County and the total drainage area of the creek is approximately 97.36 square miles.

The subject of this report is a segment of Kerber Creek beginning at the confluence with Brewery Creek and extending downstream to the Wells Kerber Ditch Headgate. The proposed segment is located approximately 1.5 miles west of Villa Grove. Staff has received one recommendation for this segment, from the BLM. The recommendation for this segment is discussed below.

Instream Flow Recommendation

The BLM recommended 6.75 cfs (April 1 – July 31), 4.0 cfs (August 1 – November 15) and 2.6 cfs (November 16 – March 31) based on its June 16, 2010 and October 7, 2010, data collection efforts and staff's water availability analyses.

Land Status Review

Upper Terminus	Lower Terminus	Total Length (miles)	Land Ownership	
			% Private	% Public
Confluence with Brewery Creek	Wells Kerber Ditch Headgate	13.1	97.5%	2.5%

100% of the public lands are managed by the BLM.

Biological Data

Kerber Creek is a moderate gradient stream, and historically had extensive functional floodplains and an abundance of point bars. The natural environment in Kerber Creek has been and continues to be affected by acid mine drainage from historical mining activities within the Kerber Creek watershed. The acid mine drainage significantly altered the vegetation regime along the creek, resulting in extensive changes in channel morphology.

Kerber Creek supports a naturally reproducing brook trout population, which is the trout species typically most tolerant of reduced Ph levels and some presence of heavy metals. Fish surveys have noted a full range of fish weights and ages. Macroinvertebrate surveys indicate that the creek has achieved a diversity of species that is typical of streams in the southern Rocky Mountains ecoregion. However, abundance and biomass of macroinvertebrates remains below average for streams in the southern Rocky Mountain ecoregion, which is to be expected in a stream with some continuing influence from acid mine drainage.

The riparian community is comprised primarily of willow and sedge species, with coyote willow as the most dominant shrub in the riparian community. The treatment of historic tailing deposition areas has resulted in a higher percentage of vegetation cover in the riparian zone, resulting in improved width-to-depth ratios, sinuosity, and bank stability. The brook trout population now has access to a wide range of physical habitats, including overhanging banks, pools, and velocity cover behind larger rocks in the stream channel.

Field Survey Data

BLM staff used the R2Cross methodology to quantify the amount of water required to preserve the natural environment to a reasonable degree. The R2Cross method requires that stream discharge and channel profile data be collected in a riffle stream habitat type. Riffles are most easily visualized, as the stream habitat types that would dry up first should streamflow cease. This type of hydraulic data collection consists of setting up a transect, surveying the stream channel geometry, and measuring the stream discharge.

Biological Flow Recommendation

The CWCB staff relied upon the biological expertise of the BLM to interpret output from the R2Cross data collected to develop the initial, biologic instream flow recommendation. This initial recommendation is designed to address the unique biologic requirements of each stream without regard to water availability. Three instream flow hydraulic parameters, average depth, percent wetted perimeter, and average velocity are used to develop biologic instream flow recommendations. Colorado Parks and Wildlife has determined that maintaining these three hydraulic parameters at adequate levels across riffle habitat types, aquatic habitat in pools and runs will also be maintained for most life stages of fish and aquatic invertebrates (Nehring 1979; Espegren 1996).

For this segment of stream, four data sets were collected, with the results shown in Table 1 below. Table 1 shows who collected the data (Party), the date the data was collected (Date), the measured discharge at the time of the survey (Q), the accuracy range of the predicted flows based on Manning's

Equation (240% and 40% of Q), the summer flow recommendation based on meeting 3 of 3 hydraulic criteria and the winter flow recommendation based upon meeting 2 of 3 hydraulic criteria. Recommendations that fall outside of the accuracy range of the model (over 250% of the measured discharge or under 40% of the measured discharge) may not give an accurate estimate of the necessary instream flow required.

Table 1: Data

Party	Date	Q	250%-40%	Summer (3/3)	Winter (2/3)
BLM	6/16/2010	28.75	71.9 – 11.5	Out of Range	Out of Range
BLM	10/7/2010	3.18	8.0 – 1.3	3.67	Out of Range
BLM	6/16/2010	17.40	43.5 – 7.0	Out of Range	8.7
BLM	10/7/2010	2.26	5.6 – 0.9	2.84	4.77
			Averages	3.25	6.74

The summer flow recommendation, which meets 3 of 3 criteria and is within the accuracy range of the R2CROSS model, is 6.75 cfs. Due to water availability constraints the winter flow recommendation was lowered from 3.25 cfs to 2.6 cfs. This reduced flow rate should provide sufficient velocity and depth to prevent icing of critical pool habitats along the creek.

Hydrologic Data and Analysis

After receiving the BLM's biologic evaluation and recommended flow regime, the CWCB staff conducted an evaluation of the stream hydrology to determine if water was physically available for an instream flow appropriation in the amounts recommended. This evaluation was done through a computation that is, in essence, an accounting exercise referred to as a water balance. In its most rigorous form, the water balance parses precipitation into all the avenues water pursues after it is deposited as rain, snow, or ice. In other words, given a specified amount of water deposition (input), water depletions (losses) are accounted until inputs and losses balance one with the other. The water losses that can be tracked include depletions due to evaporation and transpiration, deliveries into ground water storage, temporary surface storage, incorporations into plant and animal tissue and so forth. When these losses are individually or collectively subtracted from the input any of the original input not balanced by loss is anticipated to be found in stream runoff as represented by the discharge measured at intercepting stream gages.

In its analysis, CWCB staff has used this approach of balancing inputs and losses to determine if water is available for the recommended Instream Flow Appropriation. Of course, this analysis must be a practical exercise rather than a lengthy and costly scientific investigation. As a result, staff has simplified the process by lumping together some variables and employing certain rational and scientifically supportable assumptions. The following describes the steps used to complete the evaluation for this particular stream.

The first step required to determine water availability is a determination of the hydrologic regime at the Lower Terminus (LT) of the recommended ISF reach. In the best case, this means looking at the data from a gage at the LT. Further, this data, again in the best case, has been collected for a long period of time (the longer the better), including wet and dry periods. For the subject reach of Kerber Creek, there

is a USGS and DWR gage record of discharge on the creek. However, the gaging station is upstream of the LT. The gage is KERBER CR ABV LITTLE KERBER CR NR VILLA GROVE, CO (USGS 08224500/DWR KERVILCO); it has a period of record (POR) of 61 year period of record (POR) collected between 1923 and 2010. The gage is at an elevation of 8,640 ft above mean sea level (amsl) and has a drainage area of 45.4 mi^2. The hydrograph (plot of discharge over time) produced from this gage includes the consumptive uses of several diversions in the basin above the gage. However, the existence of these diversions is not a major limitation upon the use of the data from the gage. To make the measured data transferable to Kerber Creek above the LT, the consumptive portions of these diversions were added back to the measured hydrograph. The resulting "adjusted" hydrograph could then be used on Kerber Creek above the LT by multiplying the "adjusted" hydrograph by an area ratio; specifically, the area of Kerber Creek above the LT (97.36 mi^2 above the LT) to Kerber Creek above the gage (41.21 mi^2 above the gage). Next, the resulting proportioned "adjusted" hydrograph would itself be "adjusted" (decreased) to reflect the existing depletions on Kerber Creek above the LT resulting from upstream consumptive irrigation uses. The final hydrograph would thus represent a distribution of flow over time that has been reduced to reflect existing human uses.

{The following discussion is based upon the US Geological Survey's *Techniques of Water-Resources Investigations* Series, *Book 4: Hydrologic Analysis and Interpretation, Chapter A3: Statistical Methods in Water Resources* (Chapter 3: Describing Uncertainty) by D.R. Helsel and R. M. Hirsch. This technical reference provides the scientific background and guidance important to the systematic interpretation of hydrologic data. The document is available online and is a valuable aid to understanding and interpreting the analyses described here.}

The next step in producing a representation of the discharge at Kerber Cr above the LT is to compute the Geometric Mean of the area-prorated "adjusted" data values from the Kerber Cr above Little Kerber Cr nr Villa Grove, CO hydrograph. This step is of value because of the inherent statistical weaknesses found in any collection of data intended to measure natural stream discharge. Without getting into the details of statistical theory, it is worth noting that a set of discharge measurements is inherently inaccurate, no matter how well collected, due to the difficulties attendant to data collection, especially hydrologic data. In this particular case, the short period of record lends even greater merit to the use of this statistical tool. To give deference to this fact and to increase the value of the hydrograph product of this analysis, the Geometric Means of the data were computed and plotted along with the 95% Confidence Intervals about the data. The resultant hydrograph, including recommended instream flow values, is displayed in Figure 1.

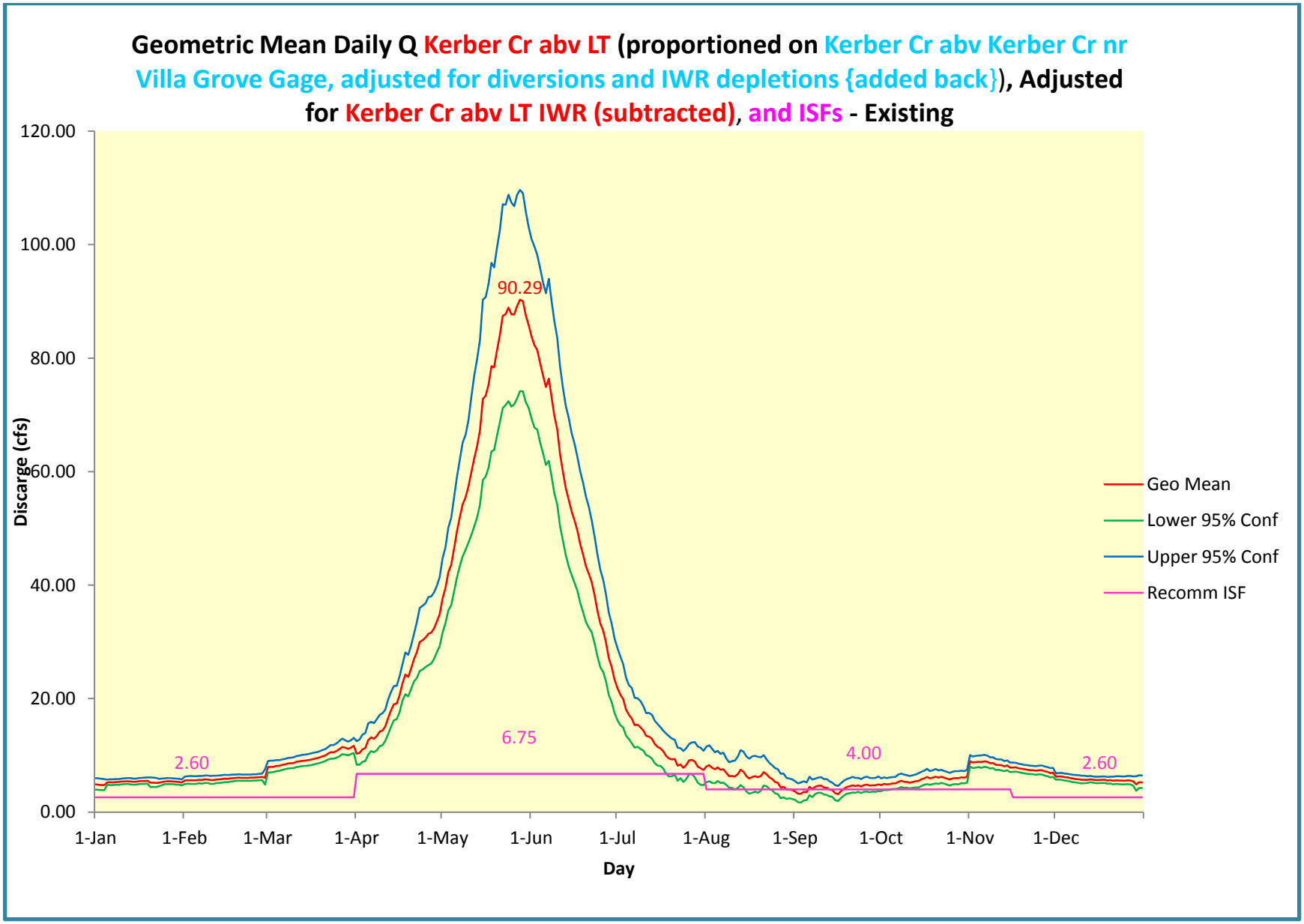

Geometric Mean Daily Q Kerber Cr abv LT (proportioned on Kerber Cr abv Kerber Cr nr Villa Grove Gage, adjusted for diversions and IWR depletions {added back}), Adjusted for Kerber Cr abv LT IWR (subtracted), and ISFs - Existing
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Discarge (cfs)
90.29
6.75
2.60
4.00
2.60
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Day
Geo Mean
Lower 95% Conf
Upper 95% Conf
Recomm ISF

Figure 1

Geometric Mean Existing Cond (IWR or div subtracted) Kerber Cr abv LT Prop on Kerber Cr abv Gage Baseline Cond (with Beaver Cr IWR abv Gage consumption added back)				
	GM (abv LT) Prorated by 214.45%	**Lower 95% Conf Prorated by 214.45%**	**Upper 95% Conf Prorated by 214.45%**	**Recommended ISFs**
1-Jan	4.87	3.97	5.99	2.60
2-Jan	4.82	3.91	5.93	2.60
3-Jan	4.77	3.88	5.86	2.60
4-Jan	4.74	3.86	5.82	2.60
5-Jan	5.24	4.79	5.75	2.60
6-Jan	5.25	4.78	5.77	2.60
7-Jan	5.24	4.76	5.76	2.60
8-Jan	5.31	4.83	5.83	2.60
9-Jan	5.29	4.82	5.82	2.60
10-Jan	5.37	4.90	5.89	2.60
11-Jan	5.40	4.93	5.92	2.60
12-Jan	5.44	4.95	5.97	2.60
13-Jan	5.40	4.90	5.96	2.60
14-Jan	5.36	4.86	5.92	2.60
15-Jan	5.36	4.86	5.92	2.60
16-Jan	5.43	4.91	6.00	2.60
17-Jan	5.46	4.95	6.02	2.60
18-Jan	5.48	4.97	6.05	2.60
19-Jan	5.54	5.03	6.11	2.60
20-Jan	5.20	4.41	6.13	2.60
21-Jan	5.18	4.42	6.08	2.60
22-Jan	5.14	4.41	6.01	2.60
23-Jan	5.17	4.55	5.87	2.60
24-Jan	5.29	4.73	5.90	2.60
25-Jan	5.40	4.92	5.93	2.60
26-Jan	5.43	4.93	5.99	2.60
27-Jan	5.42	4.91	5.98	2.60
28-Jan	5.41	4.91	5.96	2.60
29-Jan	5.35	4.85	5.90	2.60
30-Jan	5.32	4.82	5.87	2.60
31-Jan	5.23	4.72	5.79	2.60
1-Feb	5.55	4.93	6.25	2.60
2-Feb	5.62	4.99	6.32	2.60
3-Feb	5.62	4.96	6.35	2.60
4-Feb	5.60	4.96	6.32	2.60
5-Feb	5.62	4.98	6.34	2.60
6-Feb	5.69	5.08	6.37	2.60
7-Feb	5.66	5.03	6.38	2.60
8-Feb	5.76	5.14	6.45	2.60
9-Feb	5.74	5.13	6.43	2.60
10-Feb	5.64	4.99	6.37	2.60
11-Feb	5.65	4.98	6.40	2.60
12-Feb	5.72	5.10	6.42	2.60
13-Feb	5.76	5.15	6.46	2.60
14-Feb	5.80	5.20	6.47	2.60
15-Feb	5.88	5.27	6.57	2.60
16-Feb	5.87	5.26	6.54	2.60
17-Feb	5.95	5.37	6.59	2.60
18-Feb	5.99	5.43	6.61	2.60
19-Feb	6.04	5.50	6.63	2.60

20-Feb	6.06	5.51	6.66	2.60
21-Feb	6.03	5.50	6.60	2.60
22-Feb	6.04	5.52	6.60	2.60
23-Feb	6.05	5.52	6.62	2.60
24-Feb	6.05	5.53	6.62	2.60
25-Feb	6.09	5.56	6.67	2.60
26-Feb	6.09	5.56	6.68	2.60
27-Feb	6.15	5.62	6.73	2.60
28-Feb	6.19	5.66	6.77	2.60
29-Feb	6.04	4.83	7.55	2.60
1-Mar	7.91	6.96	8.99	2.60
2-Mar	7.96	6.99	9.06	2.60
3-Mar	7.99	7.04	9.06	2.60
4-Mar	8.14	7.23	9.16	2.60
5-Mar	8.16	7.27	9.15	2.60
6-Mar	8.31	7.43	9.29	2.60
7-Mar	8.41	7.54	9.38	2.60
8-Mar	8.55	7.68	9.53	2.60
9-Mar	8.59	7.70	9.59	2.60
10-Mar	8.66	7.76	9.66	2.60
11-Mar	8.84	7.93	9.85	2.60
12-Mar	8.93	8.01	9.95	2.60
13-Mar	9.03	8.10	10.07	2.60
14-Mar	9.09	8.14	10.15	2.60
15-Mar	9.15	8.20	10.22	2.60
16-Mar	9.24	8.27	10.32	2.60
17-Mar	9.36	8.39	10.45	2.60
18-Mar	9.49	8.52	10.56	2.60
19-Mar	9.63	8.65	10.72	2.60
20-Mar	9.82	8.83	10.91	2.60
21-Mar	9.98	8.97	11.10	2.60
22-Mar	10.28	9.22	11.45	2.60
23-Mar	10.53	9.40	11.80	2.60
24-Mar	10.56	9.42	11.84	2.60
25-Mar	10.77	9.57	12.12	2.60
26-Mar	11.11	9.85	12.52	2.60
27-Mar	11.49	10.20	12.94	2.60
28-Mar	11.33	10.14	12.67	2.60
29-Mar	11.15	10.01	12.42	2.60
30-Mar	11.37	10.20	12.68	2.60
31-Mar	11.68	10.43	13.08	2.60
1-Apr	10.28	8.36	12.50	6.75
2-Apr	10.40	8.36	12.77	6.75
3-Apr	11.06	8.84	13.65	6.75
4-Apr	11.26	8.96	13.93	6.75
5-Apr	12.65	10.10	15.63	6.75
6-Apr	13.16	10.77	15.93	6.75
7-Apr	12.92	10.56	15.65	6.75
8-Apr	13.42	10.87	16.39	6.75
9-Apr	14.17	11.60	17.15	6.75
10-Apr	14.41	11.80	17.43	6.75
11-Apr	15.09	12.52	18.05	6.75
12-Apr	16.54	13.73	19.79	6.75
13-Apr	17.88	15.04	21.15	6.75
14-Apr	18.99	16.16	22.21	6.75

15-Apr	19.14	16.38	22.27	6.75
16-Apr	20.59	17.62	23.96	6.75
17-Apr	22.69	19.68	26.07	6.75
18-Apr	24.23	20.79	28.15	6.75
19-Apr	23.82	20.40	27.71	6.75
20-Apr	25.29	21.71	29.37	6.75
21-Apr	26.93	23.01	31.42	6.75
22-Apr	28.21	23.65	33.49	6.75
23-Apr	29.99	24.89	35.98	6.75
24-Apr	30.30	25.13	36.35	6.75
25-Apr	30.75	25.56	36.81	6.75
26-Apr	31.40	25.88	37.90	6.75
27-Apr	31.62	26.16	38.02	6.75
28-Apr	32.42	27.02	38.72	6.75
29-Apr	33.65	28.24	39.94	6.75
30-Apr	34.86	29.24	41.40	6.75
1-May	37.63	31.60	44.67	6.75
2-May	39.45	33.27	46.65	6.75
3-May	42.26	35.54	50.11	6.75
4-May	43.54	36.46	51.84	6.75
5-May	46.45	38.81	55.42	6.75
6-May	49.47	41.33	59.04	6.75
7-May	51.96	43.34	62.11	6.75
8-May	54.26	45.05	65.16	6.75
9-May	55.49	46.20	66.45	6.75
10-May	57.35	47.50	69.04	6.75
11-May	59.86	48.81	73.15	6.75
12-May	62.30	50.29	76.89	6.75
13-May	64.48	51.92	79.80	6.75
14-May	67.24	54.16	83.19	6.75
15-May	72.79	58.50	90.28	6.75
16-May	73.39	59.14	90.76	6.75
17-May	75.32	60.71	93.14	6.75
18-May	78.58	63.58	96.81	6.75
19-May	78.38	63.81	95.99	6.75
20-May	81.35	66.34	99.47	6.75
21-May	84.07	68.72	102.56	6.75
22-May	87.44	71.19	107.11	6.75
23-May	87.74	71.74	107.02	6.75
24-May	88.90	72.43	108.81	6.75
25-May	87.73	71.46	107.40	6.75
26-May	87.71	71.87	106.76	6.75
27-May	89.20	72.93	108.79	6.75
28-May	90.29	74.18	109.63	6.75
29-May	90.04	74.15	109.06	6.75
30-May	87.56	72.25	105.83	6.75
31-May	85.81	71.24	103.10	6.75
1-Jun	83.81	69.38	100.98	6.75
2-Jun	82.31	67.77	99.68	6.75
3-Jun	81.43	67.38	98.13	6.75
4-Jun	79.10	65.10	95.82	6.75
5-Jun	76.93	63.21	93.34	6.75
6-Jun	74.92	61.19	91.41	6.75
7-Jun	76.38	61.87	93.96	6.75
8-Jun	73.29	59.32	90.23	6.75

9-Jun	69.86	56.18	86.51	6.75
10-Jun	67.52	54.25	83.67	6.75
11-Jun	63.04	50.37	78.51	6.75
12-Jun	59.93	47.81	74.74	6.75
13-Jun	57.04	45.23	71.51	6.75
14-Jun	55.04	43.31	69.52	6.75
15-Jun	53.03	41.82	66.80	6.75
16-Jun	51.42	40.41	64.99	6.75
17-Jun	49.62	39.05	62.63	6.75
18-Jun	47.22	36.88	60.03	6.75
19-Jun	45.38	35.22	58.01	6.75
20-Jun	43.32	33.50	55.53	6.75
21-Jun	41.97	32.48	53.77	6.75
22-Jun	40.50	31.67	51.35	6.75
23-Jun	38.17	29.75	48.53	6.75
24-Jun	35.43	27.42	45.31	6.75
25-Jun	33.18	25.50	42.67	6.75
26-Jun	31.93	24.65	40.89	6.75
27-Jun	29.98	23.09	38.44	6.75
28-Jun	27.16	20.65	35.19	6.75
29-Jun	25.60	19.40	33.24	6.75
30-Jun	23.36	17.48	30.63	6.75
1-Jul	21.88	16.22	28.92	6.75
2-Jul	20.74	15.33	27.45	6.75
3-Jul	19.92	14.89	26.11	6.75
4-Jul	18.07	13.47	23.71	6.75
5-Jul	17.15	12.86	22.36	6.75
6-Jul	16.48	12.09	21.88	6.75
7-Jul	15.34	11.37	20.13	6.75
8-Jul	15.39	11.52	20.06	6.75
9-Jul	14.96	11.14	19.60	6.75
10-Jul	14.38	10.83	18.66	6.75
11-Jul	13.41	10.05	17.44	6.75
12-Jul	13.28	9.82	17.47	6.75
13-Jul	12.89	9.42	17.13	6.75
14-Jul	11.98	8.62	16.09	6.75
15-Jul	11.46	8.18	15.47	6.75
16-Jul	11.23	8.16	14.94	6.75
17-Jul	10.70	7.67	14.36	6.75
18-Jul	9.91	6.73	13.85	6.75
19-Jul	9.43	6.27	13.38	6.75
20-Jul	9.28	6.31	12.96	6.75
21-Jul	9.37	6.60	12.74	6.75
22-Jul	8.16	5.54	11.35	6.75
23-Jul	8.38	5.96	11.27	6.75
24-Jul	7.78	5.33	10.75	6.75
25-Jul	8.30	5.83	11.28	6.75
26-Jul	9.12	6.70	12.00	6.75
27-Jul	9.22	6.68	12.27	6.75
28-Jul	8.89	6.12	12.30	6.75
29-Jul	8.02	5.19	11.56	6.75
30-Jul	7.70	4.81	11.37	6.75
31-Jul	7.43	4.74	10.81	6.75
1-Aug	8.04	5.27	11.51	4.00
2-Aug	8.25	5.44	11.79	4.00

3-Aug	7.82	5.15	11.15	4.00
4-Aug	7.56	5.12	10.56	4.00
5-Aug	7.87	5.46	10.82	4.00
6-Aug	7.45	5.15	10.25	4.00
7-Aug	7.55	5.18	10.45	4.00
8-Aug	6.91	4.78	9.46	4.00
9-Aug	6.32	4.29	8.78	4.00
10-Aug	6.38	4.24	9.00	4.00
11-Aug	6.27	4.01	9.07	4.00
12-Aug	6.71	4.27	9.77	4.00
13-Aug	7.48	4.77	10.93	4.00
14-Aug	7.10	4.35	10.65	4.00
15-Aug	6.30	3.62	9.81	4.00
16-Aug	5.90	3.24	9.39	4.00
17-Aug	6.18	3.41	9.85	4.00
18-Aug	6.34	3.62	9.91	4.00
19-Aug	6.16	3.42	9.76	4.00
20-Aug	6.35	3.78	9.64	4.00
21-Aug	7.06	4.69	10.03	4.00
22-Aug	6.68	4.55	9.28	4.00
23-Aug	6.13	4.06	8.66	4.00
24-Aug	5.80	3.81	8.24	4.00
25-Aug	5.30	3.31	7.75	4.00
26-Aug	5.12	3.16	7.54	4.00
27-Aug	4.35	2.42	6.75	4.00
28-Aug	4.45	2.59	6.78	4.00
29-Aug	3.97	2.30	6.02	4.00
30-Aug	4.00	2.42	5.89	4.00
31-Aug	3.87	2.32	5.75	4.00
1-Sep	3.63	2.13	5.45	4.00
2-Sep	3.24	1.77	5.03	4.00
3-Sep	3.24	1.65	5.22	4.00
4-Sep	3.57	2.06	5.42	4.00
5-Sep	3.51	2.09	5.23	4.00
6-Sep	4.46	2.98	6.26	4.00
7-Sep	4.04	2.63	5.74	4.00
8-Sep	4.45	3.20	5.91	4.00
9-Sep	4.64	3.41	6.08	4.00
10-Sep	4.67	3.40	6.14	4.00
11-Sep	4.34	3.10	5.80	4.00
12-Sep	4.31	3.05	5.80	4.00
13-Sep	4.00	2.76	5.45	4.00
14-Sep	3.85	2.70	5.19	4.00
15-Sep	3.31	2.08	4.77	4.00
16-Sep	3.16	1.93	4.60	4.00
17-Sep	3.69	2.50	5.09	4.00
18-Sep	4.10	2.91	5.50	4.00
19-Sep	4.43	3.25	5.80	4.00
20-Sep	4.56	3.34	5.99	4.00
21-Sep	4.70	3.44	6.18	4.00
22-Sep	4.60	3.39	6.03	4.00
23-Sep	4.70	3.57	6.02	4.00
24-Sep	4.51	3.37	5.82	4.00
25-Sep	4.76	3.59	6.11	4.00
26-Sep	4.82	3.62	6.23	4.00

27-Sep	4.66	3.50	6.02	4.00
28-Sep	4.70	3.60	5.97	4.00
29-Sep	4.70	3.57	6.03	4.00
30-Sep	4.88	3.69	6.27	4.00
1-Oct	4.74	3.69	5.94	4.00
2-Oct	4.96	3.93	6.13	4.00
3-Oct	4.86	3.88	5.99	4.00
4-Oct	4.95	3.93	6.11	4.00
5-Oct	5.05	4.08	6.15	4.00
6-Oct	5.06	4.06	6.20	4.00
7-Oct	5.30	4.17	6.60	4.00
8-Oct	5.52	4.42	6.77	4.00
9-Oct	5.37	4.27	6.62	4.00
10-Oct	5.32	4.27	6.51	4.00
11-Oct	5.19	4.17	6.35	4.00
12-Oct	5.32	4.29	6.51	4.00
13-Oct	5.41	4.35	6.63	4.00
14-Oct	5.48	4.33	6.82	4.00
15-Oct	5.75	4.59	7.09	4.00
16-Oct	5.95	4.78	7.30	4.00
17-Oct	6.18	4.92	7.65	4.00
18-Oct	5.92	4.78	7.23	4.00
19-Oct	6.05	4.91	7.37	4.00
20-Oct	6.22	5.04	7.57	4.00
21-Oct	6.08	4.96	7.34	4.00
22-Oct	6.22	5.15	7.44	4.00
23-Oct	6.07	5.02	7.25	4.00
24-Oct	5.90	4.86	7.08	4.00
25-Oct	5.73	4.69	6.90	4.00
26-Oct	5.93	4.88	7.11	4.00
27-Oct	6.00	4.93	7.22	4.00
28-Oct	5.99	4.90	7.23	4.00
29-Oct	6.12	5.08	7.29	4.00
30-Oct	6.06	5.04	7.20	4.00
31-Oct	6.25	5.18	7.44	4.00
1-Nov	8.98	8.03	10.03	4.00
2-Nov	8.72	7.78	9.78	4.00
3-Nov	8.82	7.85	9.92	4.00
4-Nov	8.88	7.91	9.96	4.00
5-Nov	8.83	7.79	10.01	4.00
6-Nov	8.96	7.96	10.08	4.00
7-Nov	8.85	7.89	9.94	4.00
8-Nov	8.61	7.66	9.67	4.00
9-Nov	8.67	7.76	9.68	4.00
10-Nov	8.33	7.41	9.37	4.00
11-Nov	8.32	7.47	9.28	4.00
12-Nov	8.25	7.36	9.26	4.00
13-Nov	8.05	7.23	8.97	4.00
14-Nov	8.20	7.38	9.12	4.00
15-Nov	7.83	7.04	8.72	4.00
16-Nov	7.86	7.08	8.73	2.60
17-Nov	7.87	7.14	8.68	2.60
18-Nov	7.73	7.02	8.50	2.60
19-Nov	7.63	6.91	8.42	2.60
20-Nov	7.55	6.85	8.33	2.60

21-Nov	7.47	6.75	8.27	2.60
22-Nov	7.40	6.69	8.18	2.60
23-Nov	7.37	6.68	8.14	2.60
24-Nov	7.30	6.59	8.10	2.60
25-Nov	7.40	6.68	8.20	2.60
26-Nov	7.36	6.60	8.21	2.60
27-Nov	7.20	6.44	8.04	2.60
28-Nov	7.08	6.33	7.91	2.60
29-Nov	6.88	6.10	7.77	2.60
30-Nov	6.96	6.20	7.82	2.60
1-Dec	6.25	5.71	6.85	2.60
2-Dec	6.28	5.74	6.87	2.60
3-Dec	6.27	5.70	6.89	2.60
4-Dec	6.15	5.57	6.78	2.60
5-Dec	6.10	5.51	6.75	2.60
6-Dec	5.98	5.37	6.66	2.60
7-Dec	5.88	5.25	6.59	2.60
8-Dec	5.82	5.21	6.52	2.60
9-Dec	5.77	5.14	6.48	2.60
10-Dec	5.70	5.07	6.40	2.60
11-Dec	5.70	5.08	6.39	2.60
12-Dec	5.68	5.12	6.30	2.60
13-Dec	5.79	5.25	6.38	2.60
14-Dec	5.70	5.17	6.28	2.60
15-Dec	5.65	5.11	6.24	2.60
16-Dec	5.64	5.11	6.24	2.60
17-Dec	5.69	5.15	6.29	2.60
18-Dec	5.67	5.13	6.27	2.60
19-Dec	5.56	5.00	6.18	2.60
20-Dec	5.63	5.07	6.25	2.60
21-Dec	5.53	4.91	6.24	2.60
22-Dec	5.61	4.96	6.34	2.60
23-Dec	5.58	4.92	6.33	2.60
24-Dec	5.54	4.88	6.30	2.60
25-Dec	5.54	4.88	6.29	2.60
26-Dec	5.59	4.93	6.35	2.60
27-Dec	5.58	4.88	6.37	2.60
28-Dec	5.39	4.64	6.28	2.60
29-Dec	4.87	3.75	6.33	2.60
30-Dec	5.26	4.27	6.48	2.60
31-Dec	5.23	4.24	6.44	2.60

Existing Water Right Information

Staff has analyzed the water rights tabulation and contacted the Division Engineer Office (DEO) to identify any potential water availability problems. There are 18 decreed surface diversions within this reach of stream: Turner Ditch (1.2 cfs, 1881 appropriation), Henry White Ditch (1.0 cfs, 1881 appropriation), /LD Ditch No. 1 (3.0 cfs, 1969 appropriation), Little Kerber Ditch 1 (3.0 cfs, 1969 appropriation), White Ditch (0.4 cfs, 1883 appropriation), /LD Ditch No. 2 (3.0 cfs, 1969 appropriation), Clayton Old Channel Ditch (2.7 cfs (1873 & 1888 appropriations), Cody Ditch (1.0 cfs, 1872 appropriation), Wagner Ditch (3.0 cfs, 1989 appropriation), Wagner Ditch No. 3 (3.0 cfs, 1986 appropriation), Clayton Ditch D (3.4 cfs, 1872 appropriation), Clayton Ditch E (4.0 cfs, 1872 appropriation), Wagner Ditch No. 1 (2.5 cfs, 1995 appropriation), Wagner Ditch No. 2 (2.1 cfs, 1995 appropriation), Amer Ditch No. 1 (2.0 cfs, 1939 appropriation), Amer Ditch No. 2 (2.0 cfs, 1940 appropriation), Morning Star Haven Ditch (1.5 cfs, 1995 appropriation), Clayton Ditch ABC (10 cfs, 1874 & 1884 appropriations). Staff has determined that water is available for appropriation on Kerber Creek, between the confluence with Brewery Creek and the Wells Kerber Ditch headgate, to preserve the natural environment to a reasonable degree without limiting or foreclosing the exercise of valid existing water rights.

CWCB Staff's Instream Flow Recommendation

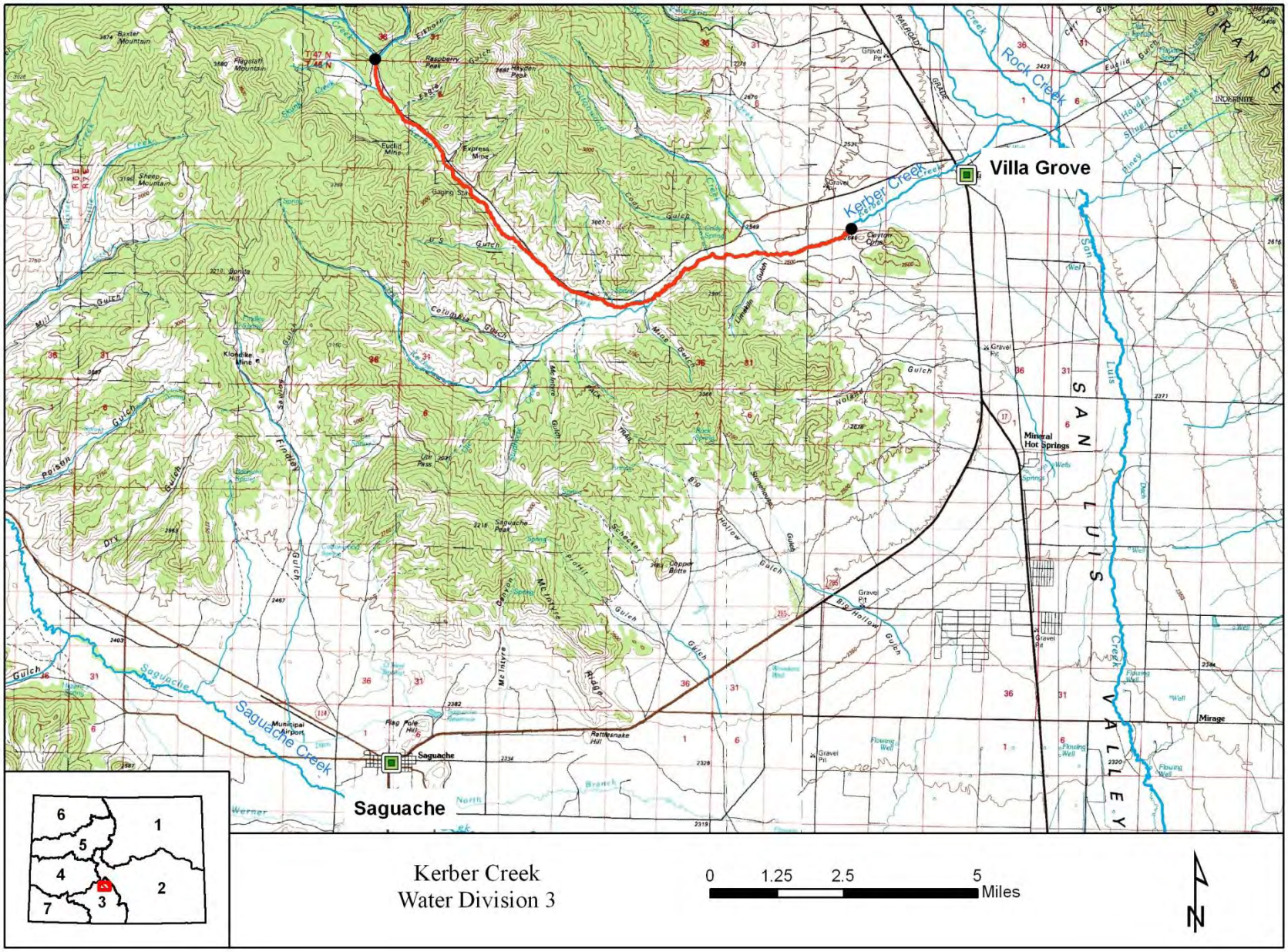
Staff recommends the Board form its intent to appropriate on the following stream reach:

Segment: Confluence with Brewery Creek to Wells Kerber Ditch Headgate
Upper Terminus: CONFLUENCE WITH BREWERY CREEK
(Latitude 38° 16' 37.53"N) (Longitude 106° 08' 59.61"W)
UTM North: 4237184.91 UTM East: 399422.13
SE SW Section 36, Township 47 North, Range 7 East NMPM
1851' East of the West Section Line; 85' North of the South Section Line

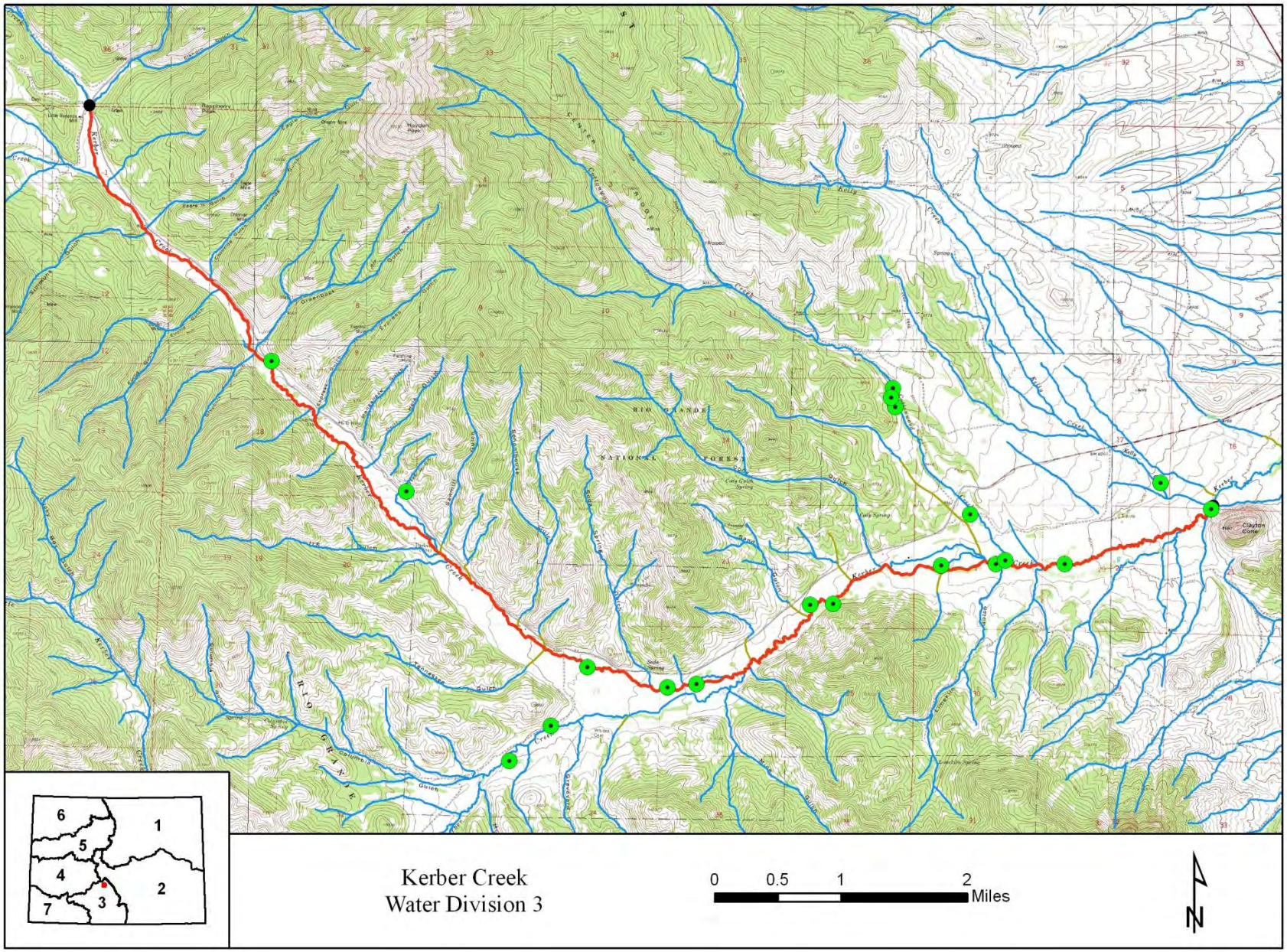
Lower Terminus: WELLS KERBER DITCH HEADGATE
(Latitude 38° 13' 57.8"N) (Longitude 105° 59' 8.71"W)
UTM North: 4232095.90 UTM East: 413726.70
SE SW Section 16, Township 46 North, Range 9 East NMPM
1827' East of the West Section Line; 116' North of the South Section Line

Watershed: San Luis (HUC#: 13010003)
Counties: Saguache
Length: 13.1 miles
USGS Quad(s): Villa Grove, Graveyard Gulch, Klondike Mine, Bonanza
Flow Recommendation: 6.75 cfs (April 1 – July 31)
4.0 cfs (August 1 – November 15)
2.6 cfs (November 16 – March 31)

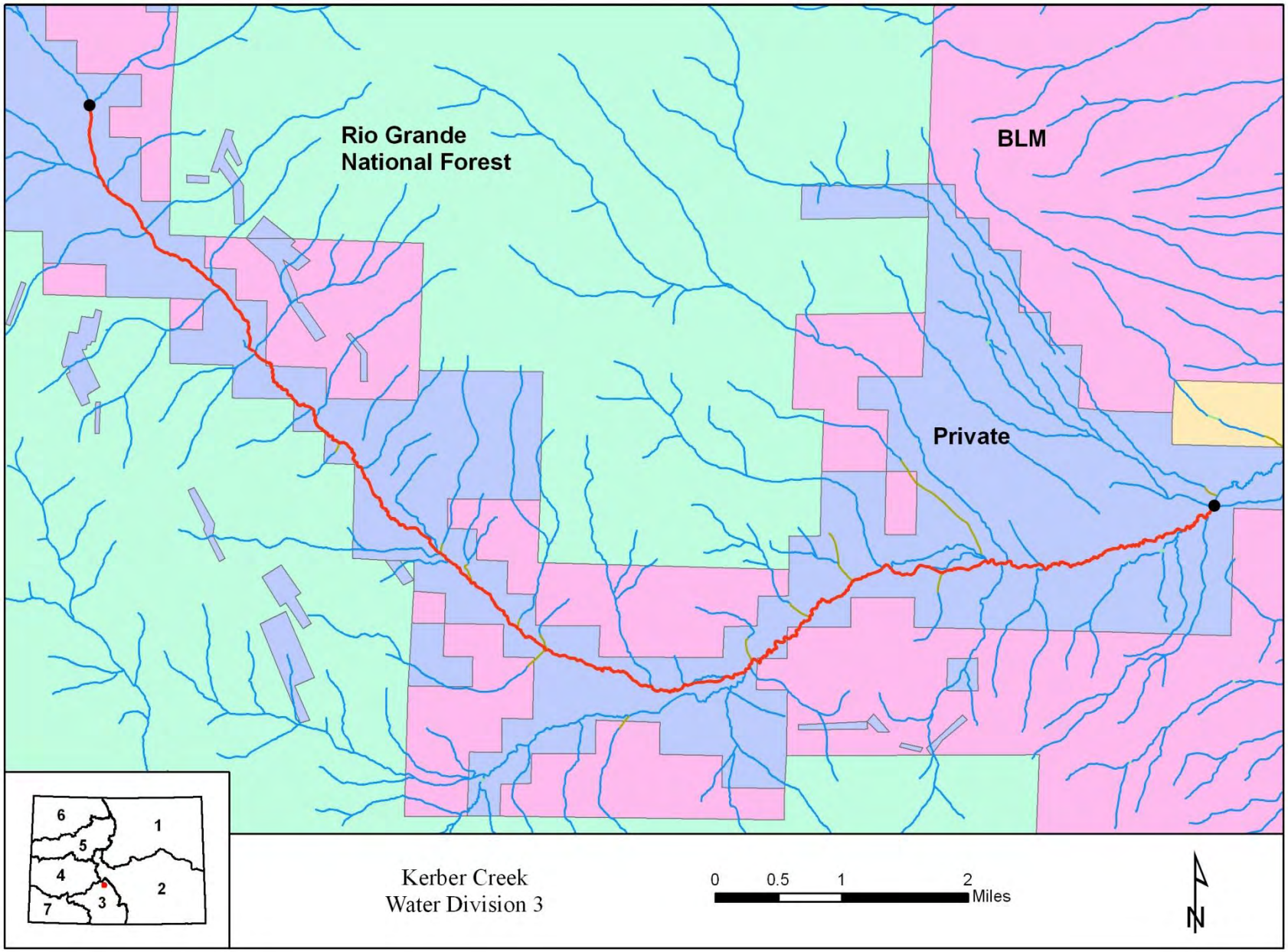
Vicinity Map



Water Rights Map



Land Use Map


Rio Grande
National Forest
BLM
Private
6
1
5
4
2
7
3
Kerber Creek
Water Division 3
0
0.5
1
2
Miles
N