BEFORE THE COLORADO WATER CONSERVATION BOARD

STATE OF COLORADO

IN THE MATTER OF PROPOSED INSTREAM FLOW APPROPRATION IN WATER DIVISION 4: DOLORES RIVER (confluence San Miguel River to confluence West Creek)

REBUTTAL STATEMENT OF CONSERVATION COLORADO EDUCATION FUND, SAN JUAN CITIZENS ALLIANCE, AND WESTERN RESOURCE ADVOCATES

Pursuant to the June 5, 2015 Notice of Prehearing Conference & Deadlines for Submissions, and Rule 5n(5) of the Rules Concerning Instream Flow and Natural Lake Level Program, 2 CCR 408-2 (ISF Rules), Conservation Colorado Education Fund, San Juan Citizens Alliance, and Western Resource Advocates (collectively, Conservation Groups), by and through the undersigned counsel, submit the following Rebuttal Statement in support of the Staff's ISF Recommendation on the Dolores River,[1] Water Division No. 4. *See* Notice of Contested 2015 ISF Appropriations (April 9, 2015), before the Colorado Water Conservation Board (CWCB or Board).

CWCB Staff, Colorado Parks and Wildlife, and the Bureau of Land Management have submitted ample evidence into the record establishing each of the three required findings under ISF Rule 5i. The carve-out proposals urged by certain opposing parties are illegal and would set a negative precedent for the instream flow program. We again urge the Board to protect the natural environment in the Dolores River to a reasonable degree by appropriating the proposed instream flow water right.

---

[1] Executive Summary of CWCB Staff's Analysis & Recommendation ("CWCB Staff Recommendation"), CWCB ID 14/4/A-006, *available at* http://cwcb.state.co.us/environment/instream-flow-program/Pages/2014ProposedInstreamFlowAppropriations.aspx.

I. Staff and the Recommending Agencies Have Established Each of the Three Required Findings for the Dolores ISF.

a. The proposed ISF flows are necessary to support existing populations of the Three Species in the Subject Reach.

None of the opposing parties appears to contest the urgent need to protect habitat for the Flannelmouth Sucker, Bluehead Sucker, and Roundtail Chub (Three Species) pursuant to the Range-wide Conservation Agreement and Strategy for Roundtail Chub, Bluehead Sucker, and Flannelmouth Sucker (Three Species Agreement). Nor does any party appear to contest the importance and value of this reach of the Dolores River as habitat for the Three Species. Instead, the opposing parties ask this Board to reduce the amount of the proposed instream flow meant to protect the Three Species in the Dolores River, without regard to the extensive scientific evidence in the record uniformly showing that the proposed flow volumes are necessary to protect the long-term viability of Three Species in this reach of the Dolores River.

One opposer, Southwestern, reasons that because the fish can – for limited periods of time – survive lower flows than the proposed Dolores ISF, that dry year flows are therefore the "minimum" within the meaning of the statute.[2] Southwestern's argument finds no support in law, the record, or the prior decisions of this Board.

In 2011, this Board properly rejected virtually identical arguments against the San Miguel River ISF that Southwestern raises here. There, an opposing party argued that the equivalent of historic dry-year condition flows is all that is needed to preserve the natural environment to a reasonable degree.[3] Yet, this argument ignored that the Three Species' spawning success is positively correlated with high spring peak flows and that a loss of sufficient peak flows over many years risks a loss of Three Species populations in a given river.[4] In 2011, this Board correctly recognized that although a fish population may limp through one bad drought year, it does not follow that they can survive such extreme conditions in perpetuity.

---

[2] Prehearing Statement of Southwestern Water Conservation District (Southwestern PHS) at 9-10.

[3] Memorandum from Don Conklin to CWCB at 3, Montrose County Prehearing Statement Exhibit A, San Miguel Contested ISF Hearing (July 8, 2011) (arguing that dry years flows are all that is needed to preserve the Three Species), *available at* http://cwcb.state.co.us/environment/instream-flow-program/Pages/main.aspx.

[4] Memorandum from John Woodling Ph.D, Woodling Aquatics, to Western Resource Advocates at 2-3 (Aug. 4, 2015) (Woodling Rebuttal), *attached as* Exh. 4.

Southwestern's assertion that the flow rates proposed in the CWCB Staff recommendation "maximize habitat" for the Three Species[5] is false. Dr. Woodling notes that:

> Each of the seasonal flows requested for the claimed reach by the CWCB staff provides water depths or water velocities that are markedly less than optimal and in some instances are only "marginal" based on the analyses I presented in my June 29, 2015 memorandum.[6]

For example, the proposed 100 c.f.s. base flow could result in less than "marginally suitable" average depths for bluehead suckers.[7] Even at the 900 c.f.s. peak flow, Dr. Woodling concludes that "[t]he average depth of riffles will be less than 50% of the maximum optimal depth for flannelmouth sucker and bluehead sucker in the claimed reach of the Dolores River."[8] The proposed instream flow water right provides a marginal, and therefore minimum, protection for the natural environment in the Dolores River.

Finally, the record shows that any reduction in the proposed flows would adversely affect the Three Species in the Dolores River. The base flow of 100 c.f.s. is especially important to the Three Species survival through the winter.[9] The agencies also found that the minimum 900 c.f.s. peak flow is already significantly less than optimal for bluehead suckers[10] and especially important for the Three Species' reproduction and for juvenile fish.[11] Furthermore, the shoulder flows have already been reduced based upon water availability concerns.[12] The Districts' speculative suggestions to the contrary are without record support and should be rejected.

b. Water is available for the proposed Dolores ISF.

The parties appear to agree that water is available at least 50% of the time for 351 days of the year. The opposing parties note that the Statemod Baseline

---

[5] Southwestern PHS at 9.
[6] Woodling Rebuttal at 4.
[7] *Id.* at 5.
[8] *Id.* at 6.
[9] CPW-BLM Stakeholder recommendation at 53. For ease of reference, page citations for the CPW-BLM Stakeholder recommendation refer to the "PDF" page number of the electronic file posted on the CWCB 2015 Contested ISF Appropriation webpage, http://cwcb.state.co.us/environment/instream-flow-program/Pages/2015ContestedISFAppropriations.aspx.
[10] CWCB Staff Recommendation at 8.
[11] CPW-BLM Stakeholder recommendation at 6-7.
[12] CWCB Staff Recommendation at 9.

simulation shows that the median flow line briefly dips below the proposed ISF for a total of 14 days during the months of July, August, and September. However, during these limited times, the ISF is well-within the model's confidence interval for median flows.[13]

In addition, Southwestern and Colorado River Water Conservation District (CRWCD) make much of the unremarkable fact that the proposed instream flow will not always be met.[14] On this point, the Districts' true disagreement is with this Board's long-standing practice of appropriating approximately the median of physically-available flows for nearly all of its instream flow water rights. By definition, this practice results in water rights that are met most of the time, but not all of the time.

It is it unreasonable to expect otherwise. In an arid state like Colorado, rivers can – and sometimes do – go dry. The whole point of the proposed instream flow water right and others like it is to help minimize the cumulative impacts of drought and future water development upon high-value fish populations and aquatic habitat.[15] It is precisely because water might not always be available to meet the needs of the Three Species that this instream flow water right is needed. The Board should maintain the CWCB Staff's proposed flow volumes and affirm its long-standing practices for balancing human development with key environmental preservation efforts.

Finally, Laura Belanger, P.E., finds that even using a drier-than-average period of record from the year 2000 through March 2015, water is still available for the proposed Dolores ISF.[16] During this period, the proposed instream flow was below the average daily flow for 349 out of 365 days.[17] Even during this drier period of record, Ms. Belanger finds that an average of over 120,000 acre feet annually is available for future development above and beyond the proposed Dolores ISF.[18]

---

[13] *Id.* at 13 (Fig. 1).
[14] Southwestern PHS at 9; Prehearing Statement of Colorado River Water Conservation District (CRWCD PHS) at 2.
[15] *See CWCB v. City of Central*, 125 P.3d 424, 439 (Colo. 2005) ("The legislature . . . clearly envisioned that the instream flow program would obtain, in reasonable measure, its goal of preserving the environment by ensuring that certain stream reaches would not be further depleted without conditions to protect against injury.").
[16] Memorandum from Laura Belanger, P.E., WRA, to Robert Harris, WRA at 2-3 (Aug. 14, 2015) (Belanger Memo), *attached as* Exh. 5.
[17] *Id.*
[18] *Id.* at 4. Ms. Belanger notes that using a median data set here "is not appropriate because that metric is intended for use with longer periods that include a broader range of year types." *Id.* at 3.

c. No party alleges that the Dolores ISF will injure their water rights and the Board should instruct staff to file an application for the Dolores ISF with the water court.

For the above-stated reasons, and because no party alleges injury to their water rights, Board should render affirmative findings for each of the three required findings in support of the Dolores ISF.

II. Like the San Miguel ISF, the Proposed Dolores ISF is Consistent with Development of Colorado's Compact Entitlements.

The proposed Dolores River ISF is consistent with and advances beneficial use of Colorado's compact entitlements. The proposed Dolores River ISF has many precedents in other significant instream flow water rights held by this Board. The most relevant include the substantial instream rights that this Board appropriated for the 15-Mile Reach of the Colorado River,[19] and on the mainstem of the Colorado River above the 15-Mile Reach.[20] However, the most comparable is the San Miguel ISF[21] which this Board appropriated in 2011 and is located immediately above the proposed Dolores ISF at the confluence of the two river systems.

Like the San Miguel ISF, the proposed Dolores ISF would leave many tens of thousands of acre-feet available for future development by junior appropriators in a median year. The objecting parties concede that the proposed Dolores ISF allows for further consumptive development of water from the Dolores River.[22] Laura Belanger, P.E., confirms this fact, showing that even in the drier-than-average 2000-2014 period, there is an average of 120,400 acre feet of excess flows physically available above and beyond the Staff's ISF Recommendation.[23] During this same dry period of record, in 53% of years 85,963 acre-feet or more would have been available annually in excess of the proposed ISF, and in 87% of years more than 37,000 acre-feet would have been available.[24] In more average and wetter periods of record, the volume of excess flows would be substantially greater.

---

[19] 92CW286 (Div. 5) (581 c.f.s. between 7/1 and 9/30); 94CW330 (Div. 5) (300 c.f.s. enlargement between 7/1 and 9/30).

[20] 11CW159 (Div. 5) (Colorado River between Blue River and Piney River: 600 c.f.s. between 5/15 and 7/31; 750 c.f.s. between 8/1 and 9/15; 500 c.f.s. from 9/16 to 5/14); 11CW160 (Div. 5) (Colorado River between Piney River and Cabin Creek: 650 c.f.s. between 5/15 and 7/31; 800 c.f.s. between 8/1 and 9/15; 525 c.f.s. from 9/16 to 5/14); 11CW161 (Div. 5) (Colorado River between Cabin Creek and Eagle River: 900 c.f.s. between 5/15 and 6/15; 800 c.f.s. between 6/16 and 9/15; 650 c.f.s. from 9/16 to 5/14).

[21] 11CW129 (Div. 4) (confluence Calamity Draw to confluence Dolores River).

[22] Southwestern PHS at 1, 5; CRWCD PHS at 2.

[23] Belanger Memo at 4.

[24] *Id.* at 5.

The Districts make much of the relative proximity of the proposed Dolores ISF to the state line. However, there is little practical difference between the location of the proposed Dolores ISF and the neighboring San Miguel ISF that this Board approved in 2011. Flows in the mainstem of the Dolores above the confluence with the San Miguel are largely appropriated in drier years where McPhee Dam has no appreciable spill.[25] Therefore, this junior instream flow water right will have relatively little impact on the mainstem of the Dolores above the confluence with the San Miguel. As for the San Miguel half of the basin, this ISF proposal occupies essentially the same location on the river between the communities of Naturita and Gateway. Just as the San Miguel ISF is consistent with further development of that river system, the Dolores ISF is consistent with further development of the Dolores River Basin as a whole.

Finally, the Districts state that they want to avoid the necessity of even small amounts of new storage or other joint new supply development.[26] However, the Southwestern Basin Roundtable's Basin Implementation Plan[27] (BIP) already calls for development of additional storage.[28] As Laura Belanger, P.E., notes, in the BIP "storage is already a recognized necessity in order to develop reliable supplies and does not appear to be contingent on the proposed ISF being appropriated."[29] For example, the BIP cites Montrose County's planned firming project which includes up to two new reservoirs and is intended to provide a reliable water source for a number of uses in western Montrose County.[30] In addition, the BIP quotes Southwestern as supporting additional storage in the southwestern region:

> The SWCD and [the basin roundtable] agree that all uses are important to the future of this region, and the development of multi-purpose projects (including the creative management of existing facility and the development of new storage as needed) within the southwest basin should be pursued.[31]

---

[25] *See* The Lower Dolores River Implementation, Monitoring, and Evaluation Plan for Native Fish at 59 (Aug. 2012) (the Dolores River between McPhee Dam and confluence with the San Miguel River is "limited, fully allocated and over-appropriated").
[26] *See* Southwestern PHS at 6-7; CRWCD PHS at 2.
[27] *Available at* http://coloradowaterplan.com/.
[28] *See* Belanger Memo at 5-6.
[29] *Id.* (emphasis added).
[30] BIP at Appx. A, p.17 (Identified Projects and Processes (IPP) list); *see also* Belanger Memo at 5-6.
[31] *Id.* at Appx. D, p. 2.

The BIP recognizes that in modern-day Colorado, storage is often necessary to assure a reliable supply for large and small water users alike. This ISF is compatible with significant amounts of new water development in the Dolores River basin.

III. The Proposed Dolores ISF Properly Balances Preservation of the Natural Environment with the Activities of Mankind.

Southwestern falsely accuses Staff of failing to seek a balance between human activities and environmental preservation in this proposal.[32] As Laura Belanger, P.E., notes, even in a drier-than-average period, there is an average of 120,400 acre feet of excess flows physically available above and beyond the Staff's ISF Recommendation.[33] The record also shows that the Three Species would benefit from more water than the proposed water right would protect.[34] Furthermore, no law or policy directly prohibits Staff from recommending a larger instream water right than is proposed here. In the past, this Board has exercised its discretion to appropriate higher-than-median flows where appropriate.[35] Southwestern fails to recognize that the Board's usual practice of appropriating less than median flows, as Staff proposes here, is but one way that the Board's instream flow appropriations successfully "correlate the activates of mankind with some reasonable preservation of the natural environment[.]"[36]

Appropriation of the proposed Dolores ISF is also timely to resolve, through the application of existing state law, concerns raised in a federal resource management process. In April 2015, BLM issued its Proposed Resource Management Plan and Final Environmental Impact Statement (PRMP/FEIS) for the Grand Junction Field Office, whose jurisdiction includes federal lands in the subject reach of the Dolores River.[37] In the PRMP/FEIS, the BLM noted that the proposed

---

[32] Southwestern PHS at 9.
[33] Belanger Memo at 4.
[34] CPW-BLM Stakeholder recommendation at 11.
[35] *See*, *e.g.*, Findings of Fact, Conclusions of Law, Ruling of Referee and Decree of the Water Court, Case No. 10CW184 (Dec. 17, 2012) *and* Findings of Fact, Conclusions of Law, Ruling of Referee and Decree of the Water Court, Case No. 10CW185 (Dec. 17, 2012) (granting the CWCB a instream flow water right for all of the annual flow of Big and Little Dominguez creeks minus a development allowance for specific private inholdings and federal land management agencies). Unlike the Districts' proposed carve-outs, which lack any proffered biological evidentiary support, the development allowance on Big and Little Dominguez creeks were developed in consultation with the relevant fish and wildlife agencies and, among other reasons, are readily distinguishable from the carve-out and under-administration provisions that the Districts seek here. *See* Part IV *infra*.
[36] *See* C.R.S. § 37-92-102(3).
[37] *Available at* http://www.blm.gov/co/st/en/fo/gjfo/rmp/rmp/docs.html.

Dolores ISF would adequately protect "outstandingly remarkable values" in the Dolores River for native fish species[38] and stated that:

> If the Colorado water court system decrees an instream flow water right for the lower Dolores River in the locations, flow rates, and timing appropriated by the CWCB at its March 2014 board meeting, and if the instream flow right is vigorously enforced by the CWCB, the BLM does not believe it would be necessary to quantify, assert, or adjudicate a federal reserved water right if this segment is ultimately designated into the National Wild and Scenic Rivers system.[39]

Therefore, appropriation of this Dolores ISF could resolve long-standing stakeholder concerns regarding a potential federal water right for the Dolores River under the Wild and Scenic Rivers Act[40].

San Juan Citizens Alliance is a Dolores River Dialogue stakeholder and is unaware of the "emerging consensus" referenced by CRWCD that could preclude the Board from seeking the full suite of flows recommended by CWCB Staff.[41] The full Dolores River Dialogue has not met in over two years and, to our knowledge, no additional meetings are currently scheduled.[42] One of the stakeholder concerns that the Dolores River Dialogue has discussed is the potential impacts of a congressionally mandated federal water right under the Wild and Scenic Rivers Act and potential alternatives to such a designation.[43] These discussions have been active through the Legislative Subcommittee of the Lower Dolores River Plan Working Group, and are ongoing. Importantly, discussions of an alternative are focused on the stretch of the Lower Dolores River between the base of McPhee Reservoir and the town of Bedrock, which is upstream of the proposed ISF. However, as noted above, appropriation of the state law-based Dolores ISF could provide BLM with the assurances that it needs that the Dolores River's "outstandingly remarkable values" will receive adequate protection without the need for a federal water right.

---

[38] PRMP/FEIS at Appx. C, p. 3-30.
[39] *Id.* at Appx. C, p. 3-35.
[40] 16 U.S.C. §§ 1271 *et seq*.
[41] CRWCD PHS at 3.
[42] Dolores River Dialogue Meetings, http://ocs.fortlewis.edu/drd/meetings.asp (last visited Aug. 6, 2015).
[43] *See*, *e.g.*, Lower Dolores Working Group Fact Sheet Meeting #4 (Mar. 16, 2009), *available at* http://ocs.fortlewis.edu/drd/factsheets.htm.

IV. The Districts' Illegal Carve-Out & Under-Administration Proposals Must be Rejected.

a. This Board may not appropriate less than the minimum amount of water that it determines is necessary to protect the natural environment to a reasonable degree.

The Districts explicitly ask this Board to appropriate less than the minimum amount of water that the Board determines is necessary to protect the natural environment to a reasonable degree.[44] Specifically, the Districts seek a speculative future development carve-out from the instream flow, and non-administration of the water right when measured flows are some number below the decreed volume.[45] Yet the plain language of the instream flow statute only authorizes this Board to appropriate the amount that "the board determines may be required for minimum stream flows . . . to preserve the natural environment to a reasonable degree."[46] Accordingly, the Districts' proposals violate the spirit and letter of the instream flow statute and must be rejected.

The Colorado Supreme Court has unambiguously rejected the sort of future development carve-out or under-administration that the Districts seek as entirely incompatible with the General Assembly's intent in passing the instream flow statute:

> The legislative intent is quite clear that [instream flow] appropriations are to protect and preserve the natural habitat and the decrees confirming them award priorities that are superior to the rights of those who may later appropriate. Otherwise, upstream appropriations could later be made, the streams dried up, and the whole purpose of the legislation destroyed. . . . [T]o effectuate the General Assembly's purpose of preserving the environment through minimum streamflows, the Board is entitled to necessary protective terms and conditions in a decree approving an augmentation plan.[47]

This Board unquestionably has discretion to choose which aquatic resources to protect and a minimum amount of water that will correlate all uses;[48] however, once

---

[44] Southwestern PHS at 2, 7-8, 11; CRWCD PHS at 4-5.
[45] Southwestern PHS at 8; CRWCD PHS at 4.
[46] C.R.S. § 37-92-102(3); *Aspen Wilderness Workshop, Inc. v. CWCB*, 901 P.2d 1251, 1257 (Colo. 1995) ("[S]tatutory authority grants the Board the right to determine and appropriate only the minimum amount of water necessary for the preservation of the natural environment." (emphasis added)).
[47] *City of Central*, 125 P.3d at 439 (emphasis in original; internal quotations omitted).
[48] *Farmers Water Development Co. v. CWCB*, 346 P.3d 52, 59 (Colo. 2015).

it has made its choice it cannot appropriate less water than it has determined is necessary to preserve the natural environment to a reasonable degree.

Any proposed reduction in the flow volumes must be supported by "substantial evidence."[49] Yet, there is no indication that the Districts' proposed diminishments of the instant Dolores ISF were developed in consultation with relevant the fish and wildlife management agencies; nor are they based even partially upon any apparent expert biological opinion. Indeed, the Districts have, to date, failed to proffer any expert biological testimony or other evidence into the record that could form a reasoned basis for a reduction in the size of this proposed instream flow.

The proposed carve-out and under-administration provisions would result in the appropriation of a water right that would be expressly less than the amount necessary to preserve the natural environment to a reasonable degree. The Board should reject the Districts' illegal diminishments of the proposed Dolores ISF.

b. This Board may not administer its decreed instream flow water rights at less than the minimum amount of water that it determines is necessary to protect the natural environment to a reasonable degree.

Contrary to the Districts' arguments, the Board cannot under-administer its instream flow water rights. In *Aspen Wilderness Workshop*, the Colorado Supreme Court rejected administration of instream flow water rights at less than the decreed amount that the Board had found necessary to preserve the natural environment to a reasonable degree. Although other appropriators may elect to under-administer their water rights, the court held that:

> The Conservation Board is . . . unlike other parties who seek to appropriate and use water. . . . The Conservation Board has a unique statutory duty to protect the public in the administration of its water rights decreed to preserve the natural environment.[50]

Accordingly, the Court concluded that the Board could not under-administer its instream flow water rights at less than the "minimum" as set forth in the decree.[51]

---

[49] *See* C.R.S. 24-4-106(7) (incorporated into the instream flow statute at C.R.S. 37-92-102(4)(c)).
[50] 901 P.2d at 1260.
[51] *Id.* at 1261.

The Districts' under-administration proposal is a *de facto* illegal carve-out. Instead of sharing the risk of gage error equally amongst all users, the Districts would shift much of the risk of gage measurement error to the instream flow.[52] As Laura Belanger, P.E., notes, gage error has the potential to both benefit and harm the instream flow.[53] Yet, utilizing the Districts' proffered 5% assumed gage error rate, constant administration of the water right at 5% less than the decreed amount could result in an effective ISF flow rate that is 10% lower than the amount that the Board determines to be necessary to preserve the natural environment to a reasonable degree.

The Districts' proposals must fail because the General Assembly intended for instream flow program to function within the prior appropriation system and not apart from it.[54] The Board should reject the Districts' invitation to ignore binding Supreme Court precedent prohibiting under-administration of instream flow water rights.[55]

c. The Districts – and not the Board – are in the best position to plan for and meet the reasonably anticipated future water needs in their service areas.

If the Districts believe that there is need for water rights for future water users in the Dolores River Basin, these districts are in the best position to secure such rights. The Districts' legislative purpose is to enable the "conservation, use, and development of the water resources" of, among other rivers, the Dolores River and its principal tributaries.[56] The Districts enjoy the broad authority to investigate water needs, build diversion infrastructure, and appropriate water rights for the benefit of its constituents.[57] Importantly, the Districts also possess extensive powers to finance construction of works, like reservoir storage, that may be too expensive for smaller users to build on their own.[58]

Government water suppliers like the Districts enjoy a "limited exception from the anti-speculation and beneficial use standards applicable to

---

[52] *Contrast* Southwestern PHS at 8 *and* CRWCD PHS at 4, *with* Belanger Memo at 6-7.
[53] Belanger Memo at 7.
[54] *See Farmers Water Development Co.*, 346 P.3d at 61 (like all water rights, instream flows "complicate the efforts of new or existing users to develop sources of supply").
[55] *Aspen Wilderness Workshop*, 901 P.2d at 1261.
[56] C.R.S. §§ 37-46-101, -103; C.R.S. § 37-47-101.
[57] C.R.S. § 37-46-107(1)(c); C.R.S. § 37-47-107(1)(c).
[58] *See* C.R.S. § 37-46-107(1)(g), (1)(j.5), (1)(k), (2); C.R.S. § 37-47-107(1)(c); *see also* BIP at 104 (naming Southwestern as a potential source of funding for implementation of IPPs).

nongovernmental conditional water right appropriators."[59] Unlike private appropriators, the Districts may, among other relevant actions, secure conditional water rights for the reasonably anticipated future water uses in their service areas based upon substantiated projections of future growth over a reasonable time frame, the so-called "great and growing cities" doctrine.[60]

At least one other governmental water supplier has already filed for conditional water rights in anticipation of instream flow water rights in the Dolores River Basin. In 2010 Montrose County applied for conditional water rights, including storage rights, after this Board delayed the San Miguel ISF to 2011, thereby securing a senior priority relative to the San Miguel ISF.[61] Similarly, after the Board delayed this hearing by a year the Districts could have, and may still, appropriate water in the Dolores River Basin to meet the reasonably anticipated needs of their current and future constituents.

This Board has a long history of constructively working with those governmental bodies whose responsibility it is to plan for their jurisdiction's long-term consumptive water needs. Shifting that burden to the Board here would upset the General Assembly's statutory delegation of authority between the Districts and this Board and set a precedent that promises to greatly complicate future instream flow proposals. The Board should adhere to its past practice of letting governmental water suppliers take the lead in providing water for their constituents.

V. Additional Exhibits, Reports, or Other Documents to be Introduced at Hearing

The Conservation Groups submit the following additional technical documents, attached to this rebuttal statement (listed by exhibit number):

4. Memorandum from John Woodling Ph.D, Woodling Aquatics, to Western Resource Advocates at (Aug. 4, 2015) (Woodling Rebuttal).

4A. Curriculum Vitae of John Woodling, Ph.D.

5. Memorandum from Laura Belanger, P.E., WRA, to Robert Harris, WRA (Aug. 14, 2015) (Belanger Memo).

5A. Curriculum Vitae of Laura Belanger, P.E.

---

[59] *See*, *e.g.*, *Pagosa Area Water & Sanitation Dist. v. Trout Unlimited*, 219 P.3d 774, 779 (Colo. 2009).
[60] *See id.*
[61] Case Nos. 10CW165, 10CW166, 10CW167, and 10CW169 (Water Div. 4).

VI. Witnesses

The Conservation Groups anticipate that the following witnesses will testify at the September 15, 2015 hearing as described below, and will be available at the hearing to answer questions from the Board:

A. John Woodling, Ph.D., Contract Biologist (curriculum vitae attached as Exh. 4A), will testify and provide rebuttal regarding the habitat needs of Flannelmouth Suckers, Bluehead Suckers, and Roundtail Chub.

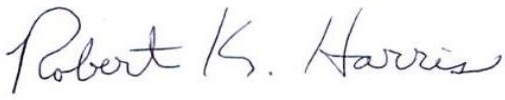
B. Laura Belanger, P.E., Water Resources and Environmental Engineer for Western Resource Advocates (curriculum vitae attached as Exh. 5A) will provide rebuttal testimony regarding hydrology in the Dolores River.

C. Robert K. Harris, Esq., will provide brief legal testimony and rebuttal.

VII. Conclusion

Wherefore, the Conservation Groups hereby request that the Board approve the Staff's ISF Recommendation for the Dolores River (confluence San Miguel River to confluence West Creek).

Respectfully submitted this 17th day of August, 2015.



Robert K. Harris, Attorney Reg. No. 39026
Bart Miller, Attorney Reg. No. 27911
Western Resource Advocates
2260 Baseline Road, Suite 200
Boulder, CO 80302
Tel: 303-444-1188
bart.miller@westernresources.org
rob.harris@westernresources.org

CERTIFICATE OF SERVICE

I hereby certify that on August 17, 2015, the above **Rebuttal Statement** was served upon all parties herein by email as follows:

Linda Bassi, Esq. Colorado Water Conservation Board 1313 Sherman Street, Room 721 Denver, CO 80203 linda.bassi@state.co.us	Roy Smith DOI, BLM, Colorado State Office 2850 Youngfield Street Lakewood, CO 80215-7093 r20smith@blm.gov
Susan Schneider, Esq. First Assistant Attorney General Colorado Attorney General's Office 1300 Broadway, 7th Floor Denver, CO 80203 susan.schneider@state.co.us [Colorado Water Conservation Board]	Jay Skinner Colorado Parks and Wildlife 6060 Broadway Denver, CO 80216 jay.skinner@state.co.us
Peter Fleming, General Counsel Colorado River Water Conservation District P.O. Box 1120 Glenwood Springs, CO 81602-1120 pfleming@crwcd.org	Mark E. Hamilton, Esq. William H. Caile, Esq. Holland & Hart LLP 600 E. Main St., Suite 104 Aspen, CO 81611-1991 mehamilton@hollandhart.com whcaile@hollandhart.com [John S. Hendricks; Western Sky Investments, LLC]
John B. Spear, Esq. Maynes, Bradford, Shipps & Sheftel, LLP P.O. Box 2717 Durango, CO 81302 bspear@mbssllp.com [Southwestern Water Conservation District; Dolores Water Conservancy District]	Jennifer Russell, Esq. Russell & Pieterse, LLC PO Box 2673 Telluride, CO 81435 jenny.russell@lawtelluride.com [Sheep Mountain Alliance]
Steven Zwick, Esq. San Miguel County Attorney P.O. Box 791 Telluride, CO 81435 stevez@sanmiguelcountyco.gov	

Robert K. Harris

MEMORANDUM

TO: Western Resource Advocates

FROM: John Woodling, Ph.D., Woodling Aquatics

DATE: 8/4/2015

SUBJ: Rebuttal comments concerning the relationship of proposed instream flow regimes in the Dolores River to native fishes

---

I read and analyzed two documents submitted to the Colorado Water Conservation Board (CWCB) in opposition to the instream flows claimed in the Dolores River from downstream of the San Miguel River at the request of the Western Resource Advocates. These documents are,

1. A letter from Peter Foster of Wright Water Engineers dated June 29, 2015 to Mark Hamilton submitted as Exhibit 1 of the Prehearing Statement of John S. Hendricks and Western Sky Investments, LLC.
2. Prehearing statement of the Southwestern Water Conservation District (SWCD) in the matter of proposed instream flow appropriation in Water Division 4: Dolores River, dated June 29, 2015.

Aspects of these documents seemed to indicate a response to the CWCB is appropriate.

I must also correct errors in the legend of two figures that were submitted as part of my written testimony in the prehearing statement of Western Resource Advocates. These figures are attached as part of this rebuttal document and I apologize to the CWCB and other parties for these two errors.

A. Comments pertaining to the June 29, 2015 Letter from Peter Foster

As noted in statement number 1 above, Peter Foster's letter was submitted as Exhibit 1 of the John Hendricks and Western Sky Investments Prehearing Statement.

On the final page of this letter (page 2) Mr. Foster writes,

> "Drought year conditions will limit water availability, and ISF Recommendation flow conditions may not be met for the period of April through September during a dry year. It is WWE's opinion that the ISF Recommendation should be revised to factor in drought year conditions."

In the Summary for that letter WWE includes as recommendation #3 that "The ISF flow amounts should be revised based on drought year conditions."

Mr. Foster presents no support for the idea that that lower ISF flows would provide "reasonable protection" for the Three Species in the claimed reach of the Dolores River. Mr. Peters' concept

is one that the CWB rejected in a 2011 ISF hearing where the Board adopted instream flows for a stream reach of the San Miguel River upstream of the Dolores River.

The CWCB may well recall that Montrose County proposed lower ISF flow recommendations than those brought forward by staff in 2011 for the San Miguel River. Mr. Peters' assertion that ISF recommendations for the claimed reach of the Dolores River should be lower than staff recommendations is the same as the basic idea presented by Montrose County in 2012, but is based on use of drought conditions to set instream flows. The CWCB rejected the claims of Montrose County due in part due to the fact that the Three Species respond to the entirety of the historic flow regime not just periodic drought conditions.

The existing Dolores River fish assemblage is maintained in part by the historic flow regime that has been present for several decades in the Dolores River; maximum flows, average flows and drought conditions. Other parameters such as temperature and water quality are involved however flow is a critical habitat component of any river. In some years the stream flows exceed the CWCB proposal and in other years the available flows are less than those proposed by the CWCB. Flows lower than those proposed by the CWCB are those that would be present during drought years

The current Dolores River fish assemblage will persist into the future interacting with changes in the long-term flow regime, including periods of drought. The fish assemblage will change if the long term flow regime changes to a sufficient degree. However, the fish assemblage does not change from year to year in response to minor or serious drought conditions. A serious drought in 2002 and several years of relatively high stream flow occurred in the last decade in Colorado yet the Three Species (the bluehead sucker, flannelmouth sucker and roundtail chub) have persisted in the claimed stream reach of the Dolores River. These species are relatively long lived fish species, living perhaps in excess of 20 years. Population persistence does not require successful reproduction each year for such long lived species. Individual adult fish only have to produce one offspring that then attains breeding age to assure persistence of the species in this stream reach.

Spawning success is positively related to stream flow during the spring snowmelt period for bluehead suckers and flannelmouth suckers. High recruitment was documented for west slope suckers in years with high spring snowmelt flows (Burdick 1995). A strong bluehead sucker year class in the Gunnison River was associated with a "normal" spring snowmelt in 2003 and low flows in the 2002 drought year resulted in poor bluehead sucker reproductive success (Anderson and Stewart 2006). Sweet (2007) indicated that low spring flows might have contributed to poor reproductive success in bluehead sucker and flannelmouth sucker in a headwater Wyoming river. High spring and summer snowmelt events enhance reproductive success in bluehead suckers and flannelmouth suckers. The habitat for the Three Species may well not be "optimum" during the days of highest spring snowmelt but elevated flows appear to be needed to support robust populations of the Three Species

Periodic reproductive success is mandatory if the Three Species are to survive in the claimed reach. Reproductive success is positively associated with elevated spring flows in non-drought years. Flows based on drought years would result in reduced reproductive success an annual

basis and perhaps loss of the Three Species. The CWCB rejected this request in the 2011 hearing and has not been presented with any information that justifies the idea of basing instream flow requests on drought year conditions.

B. Comments pertaining to The Southwestern Water Conservation District (SWCD) prehearing statement.

The SWCD's Prehearing Statement includes (on page 9) the assertion that,

> "The appropriation amounts claimed are not consistent with the requirement of C.R.S. 37-92-102(3)…The proposed appropriation seeks more than the amount necessary to 'preserve the environment to a reasonable degree…'
>
> The SWCD also asserts that "the board 'has the duty to appropriate only the minimum amount of water necessary to reasonable preserve the environment' and 'its actual appropriation must comport with that duty.'"

The second paragraph of page nine of the SWCD's Prehearing Statement is comprised of a mixture of statements taken from the CWCB "Staff Analysis and Recommendation" and assertions from the SWCD that the staff recommended Instream Flows are not the minimum needed to protect the three species in the claimed reach. The ideas presented by the in the second paragraph of page nine of the SWCD's Prehearing Statement include the following,

1. That the CWCB staff recommendations are designed to maximize habitat for the identified (Three) species.
2. That the CWCB staff is proposing flow rates based on "maximizing habitat for the identified species and that the proposed flow rates are associated with "maximum amount of useable habitat" for bluehead and flannel mouth suckers and that CWCB staff recommendations exceed the maximum usable amount of habitat for flannelmouth suckers and 90% of habitat for bluehead suckers.
3. CWCB staff recommended flow rates in the June 15 to July 14 and July 15 to August 14 time periods are designed to maintain as much bluehead sucker and flannelmouth sucker habitat as possible during a period of the year when flows are rapidly declining.
4. The CWCB selected flow rates "ensures that in a substantial number of years the instream flow will not be met."
5. The CWCB did not present any "discussion" of what is a "reasonable degree for preserving the environment."
6. An assertion that since "these species have persisted with flows substantially less than the minimum claimed in many years suggest(s) that the proposed flows are not the minimum necessary and that a modest depletion allowance would be appropriate."
7. A postulation that the environment could be "reasonably preserved" if half of available habitat were protected or 75%.

Each of the seven listed statements above will be analyzed in the following paragraphs.

Assertion 1. That the CWCB staff recommendations are designed to maximize habitat for the identified (Three) species.

The SWCD's assertion is false. The CWCB staff followed the same procedures used in hundreds of filings for instream flow rights over the last decades. The objective in all cases has been the same, to claim the minimum amount of water to provide "reasonable" protection of the resource in question. The CWCB responded by adopting instream flows based on the staff recommendations for decades for many waters throughout the state of Colorado for both warm water and coldwater systems.

The CWCB recognized that protection of the Three species (bluehead sucker, flannelmouth sucker and roundtail chub) using instream flows as a management option was appropriate in a 2011 decision to establish seasonal instream flows in the San Miguel River just upstream of the claimed reach in the Dolores River. The CWCB staff has now brought forward a similar recommendation for the Dolores River in a stream reach immediately downstream of the confluence with the San Miguel River. The current claimed flows were developed using the same methodologies and procedures used to develop the instream flow rates for the San Miguel River in 2011.

The methods used to develop the instream flow recommendations for the claimed reach of the Dolores River are in fact a modeling exercise. All models should be validated to demonstrate that model output is valid. One method of validation is to compare model output to habitat information for the species of interest. In the case of the Three Species the water depth and velocity predicted for different instream flows can be compared to the water depth and velocity needs of the species in question.

The June 29, 2015 memorandum I prepared for the CWCB in this matter did compare the water depths and water velocities at the various claimed flows to the habitat needs of the Three Species as developed by Colorado Division of Parks and Wildlife Researcher Rick Anderson (2003, 2006 and 2007). The objective of my analysis was to determine if the instream flows recommended for the claimed reach of the Dolores River were indeed minimum amounts to provide reasonable protection for the Three Species. My conclusion was that the claimed flows are appropriate and are the minimum flows needed to provide reasonable protection.

Each of the seasonal flows requested for the claimed reach by the CWCB staff provides water depths or water velocities that are markedly less that optimal and in some instances are only "marginal" based on the analyses I presented in my June 29, 2015 memorandum. A full recitation of my original findings is too extensive to be repeated in this rebuttal statement but a brief summary will demonstrate that each seasonal flow is the minimum that provides reasonable protection[1].

A flow of 100 cfs (as recommended by the CWCB from 8/15 through 3/15) results in average depths ranging from 0.62 feet to 1.16 in riffle areas throughout the claimed reach (Figure 1). The

[1] The graphs from my June memorandum are included in this rebuttal. Legends were corrected in two of these graphs. The reader is referred to my June 2015 memorandum for a full explanation of the following ideas.

average riffle depth would often be less than 1.0 feet, the level marginally supportive of bluehead sucker. These average riffle depths will vary slightly around the minimum level needed to protect bluehead sucker through the claimed reach to a reasonable degree.

Figure 1. Average and maximum riffle depths at a flow of 100 cfs in claimed reach of Dolores River compared to marginally suitable depth required by bluehead suckers.

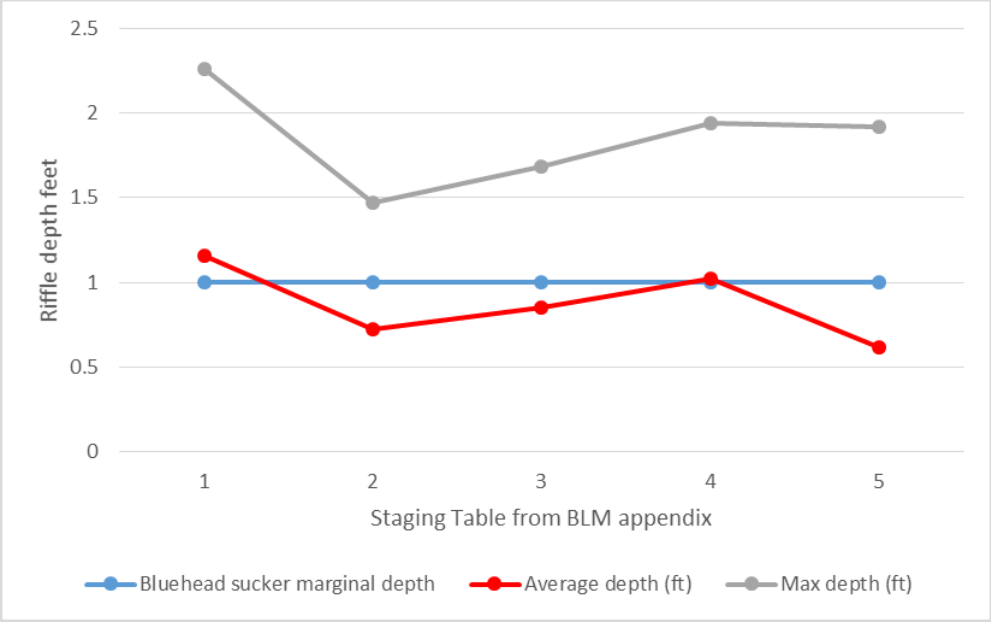
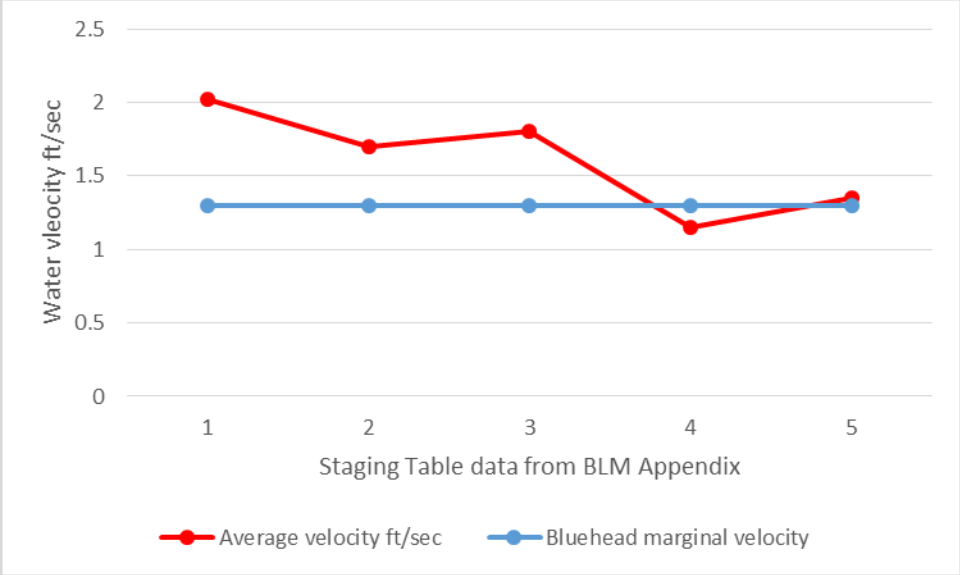


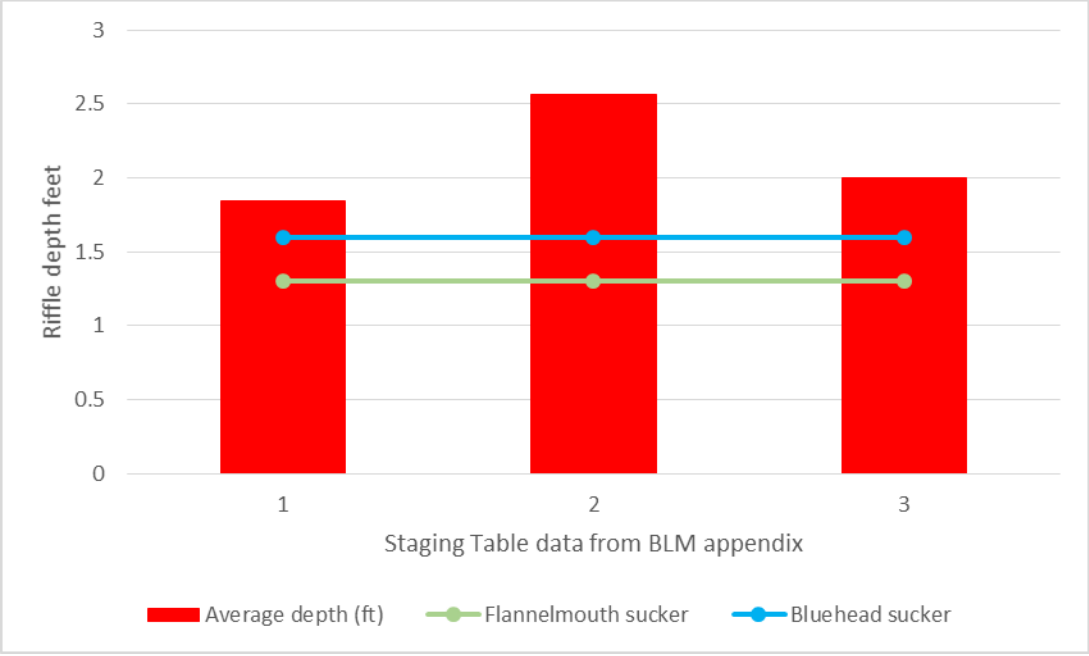
Figure 2. Average riffle velocity at a flow of 100cfs in claimed reach of Dolores River compared to marginally acceptable velocity required by bluehead suckers.



Average riffle water velocity will range from 1.15 to 2.02 feet/second during the base flow period of 100 cfs (Figure 2). These levels bracket the velocity of 1.3 feet/second considered to the marginally supportive of bluehead suckers. As with average riffle depth, the average riffle velocities within the claimed reach will not be "marginally" supportive of bluehead sucker in all riffles. As such, these water velocities represent minimum flows that will reasonable protect the Three Species.

CWCB Staff proposed a flow of 900 cfs through the claimed reach of the Dolores River from April 15 through June 14 for the spring spawning period. The average riffle flow depth exceeds the low end of preferred water depths for flannelmouth sucker and the bluehead sucker (Figure 3). The optimal water depth for flannel mouth sucker ranges from 1.3 feet to 6.6 feet. The optimal water depth for bluehead sucker ranges from 1.6 feet to 5.0 feet. The average depth of riffles ranges from 1.8 feet to 2.56 feet in the claimed reach at the 900 cfs flow. The average depth of riffles will be less than 50% of the maximum optimal depth for flannelmouth sucker and bluehead sucker in the claimed reach of the Dolores River. These depths are warranted to assure successful reproduction and represent the minimum levels needed to protect these species

Figure 3. The low end of optimal riffle depth (feet) for bluehead sucker and flannelmouth sucker compared to average riffle depth in the claimed reach of the Dolores River at a 900 cfs flow.



West slope native suckers have a high reproductive success in years with high spring snowmelt flows (Burdick 1995). A strong bluehead sucker reproductive success in the Gunnison River was associated with a "normal" spring snowmelt in 2003, while low flows in the 2002 drought year resulted in poor bluehead sucker reproductive success (Anderson and Stewart 2006). Sweet (2007) indicated that low spring flows might have contributed to poor reproductive success in bluehead sucker and flannelmouth sucker in a headwater Wyoming river. High spring and

summer snowmelt events enhance reproductive success in bluehead suckers and flannelmouth suckers. The habitat for the Three Species may well not be "optimum" during the days of maximum spring snowmelt but elevated spring flows appear to be needed to support robust populations of the Three Species.

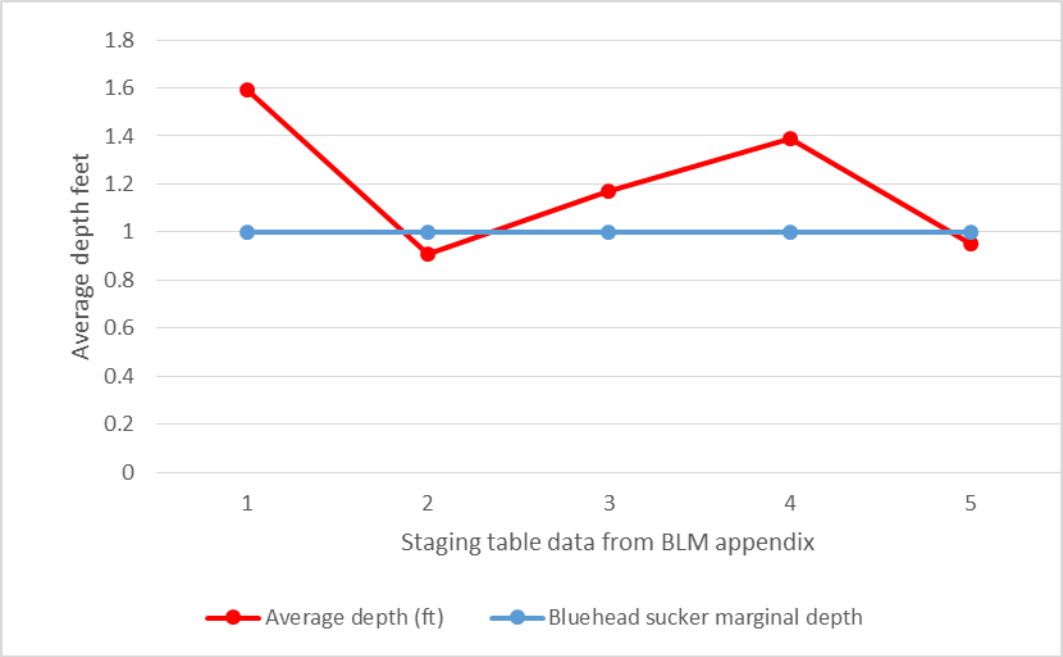
CWCB staff proposed a flow of 400 cfs for the time period of June 15 to July 15, based on the existing Dolores River flow regime, not biological requirements. Flannelmouth sucker spawning season can extend into the middle of June in some Colorado waters. The staff proposal for the June 15- July 15 addresses the needs of sustaining the reproductive success of the Three Species based on the existing flow regime of the Dolores River in the claimed reach.

Flows of 400 cfs also result in more wetted perimeter than lower stream flow levels. Emerging larvae and fry of the Three Species will have more habitat in which to disperse at a flow of 400 cfs compared to all lower stream flows. This additional habitat, for even a short time, may enhance fry survival.

The average riffle depth in the claimed reach would range from 1.23 feet to 1.66 feet (Table 1) at a flow of 400 cfs from June 15 to July 15. A level of 1.23 feet is more than the water depth of one foot that is marginally supportive of bluehead sucker and is less than a depth of 1.6 feet, the low end of the optimal range for bluehead sucker. Riffle depths at a 400 cfs flow will generally provide bluehead sucker habitat that is more than marginally acceptable and less than optimal. This 400 cfs flow is a minimum level that provides reasonable protection for several life stages of the Three Species in the time period where flows in Colorado streams begin to decline after the peak spring snowmelt period.

A flow of 200 cfs was recommended by the CWCB staff from March 16-April 14 and July 16-August 14. A flow of 200 cfs results in average depths ranging from 0.91 feet to 1.59 in riffle areas throughout the claimed reach (Figure 4). The average riffle depth would often be less than 1.0 feet, the level marginally supportive of bluehead sucker at the claimed flow of 100 cfs in some riffle areas. In other riffles, the average riffle depth would slightly exceed 1.0 feet. The claimed flows at 200 cfs will still vary slightly around the "marginally" protective level of 1.0 feet for bluehead sucker.

Figure 4. Average riffle depths at a flow of 200 cfs in claimed reach of Dolores River compared to marginally suitable depth required by bluehead suckers.



The flow data presented by the CWCB are representative of minimum flows that provide reasonable but not complete protection for the Three Species. The SWCD's assertion that the claimed flows provide maximum protection is not supported comparing the depths and velocities predicted at the claimed flows to habitat data for the bluehead and flannelmouth suckers.

Assertion 2. That the CWCB staff is proposing flow rates based on "maximizing habitat for the identified species and that the proposed flow rates are associated with "maximum amount of useable habitat" for bluehead and flannel mouth suckers and that the CWCB staff recommendations exceed the maximum usable amount of habitat for flannelmouth suckers and 90% of habitat for bluehead suckers.

This assertion was created in opposition to a claimed flow of 900 cfs during the time period of April 15 through June 14. The SWCD's comment was created by taking the phrase "maximum amount of useable habitat" out of context and combining that phrase with a second idea on page 8 of the CWCB staff recommendation document in this matter.

The staff document actually was written as follows,

> "The maximum amount of usable habitat for bluehead suckers is produced at a flow of 1200 cfs and for flannelmouth sucker at a flow of 875 cfs. The BLM and CPW staff determined that a flow rate of 900cfs would adequately protect the flannelmouth sucker habitat while protecting more than 90% of the useable habitat for the bluehead sucker."

Full protection for bluehead sucker was achieved at 1200 cfs. However, the CWCB staff did not recommend a flow of 1200 but did recommend a flow of 900 cfs in the time period of April 15 to June 14. The requested flow was reduced to a level of 900 cfs due to water availability. Flannelmouth sucker are indeed fully protected at a flow of 900 cfs according to the staff analysis. The bluehead is not fully protected at the 900 cfs flow. Different fish species have different habitat requirements, so not all fish will be protected at the same minimum flow. The minimum flow is the one that protects the most sensitive species, in this case the bluehead sucker. The CWCB staff recommendation for the claimed reach is not one that "maximizes" habitat but is a flow that protects water depths and water velocities at a minimal level compared to optimum conditions.

My analysis of the 900 cfs flow recommendation (Woodling memorandum 2015) demonstrated that, the average riffle flow depth will be greater than the low end of preferred water depths for flannelmouth sucker and the bluehead sucker at a flow of 900 cfs (Figure 3). The optimal water depth for flannel mouth sucker ranges from 1.3 feet to 6.6 feet. The optimal water depth for bluehead sucker ranges from 1.6 feet to 5.0 feet. The average depth of riffles ranges from 1.8 feet to 2.56 feet in the claimed reach at the 900 cfs flow. The average depth of riffles will be less than 50% of the maximum optimal depth for flannelmouth sucker and bluehead sucker in the claimed reach of the Dolores River. The 900 cfs flow recommendation is warranted to assure successful reproduction and represent the minimum levels needed to protect these species" (Woodling memorandum 2015).

The CWCB flow recommendations do not maximize habitat. The CWCB flow recommendations for the claimed reach result in flow depths and water velocities that are on the low end of "protective" for the Three Species based on habitat requirements of those species.

Assertion 3. CWCB staff recommended flow rates in the "June 15 to July 14" and "July 15 to August 14" time periods are designed to maintain as much bluehead sucker and flannelmouth sucker habitat as possible during a period of the year when flows are rapidly declining.

June 15 through July 14 claimed flow of 400 cfs. Written human discourse is not precise. Words and phrases may not transfer the information intended by the author. For instance, the CWCB staff recognizes that reproductive success of the Three Species is positively associated with higher spring and early summer water levels. Higher spring runoff conditions result in higher reproductive success for the Three Species, while reproductive success is lower during low flow years.

The CWCB staff wants to protect the spawning activities of the Three Species for as long a time period as possible in the claimed reach during the latter part of the spring snowmelt period. Flannelmouth suckers are known to spawn in June so maintaining higher water levels in the riffle areas is a vital need. The CWCB staff recognized that instream flows drop rapidly in the latter part of the spring snowmelt season. The CWCB staff proposed two different flows during the snowmelt season that more accurately conformed to actual instream flow patterns. The early, one from April 15 to June 14 corresponds to the early part of the spring snowmelt period while

the second (June 15 to July 14) was based on a period of declining flows. The claimed flow of 400 cfs from June 15 to July 14 provides some protection for late spawning fish and increased shallow water habitat for recently hatched fish larvae and fry.

July 15 through August 15 claimed flow of 200 cfs. The CWCB staff recommendation in this time period is based on water availability in the middle part of the summer. The staff recommendation hardly protects "as much…sucker habitat as possible" (SWCD Prehearing Statement page nine) since riffle depths at a flow of 200 cfs vary slightly around the "marginally" protective level of 1.0 feet for bluehead sucker (Figure 4). Instead, the claimed flow of 200 cfs was selected based on the historic flow data and the need to provide reasonable protection. Reasonable protection in this instance is the flow level that provides "marginal" protection.

The CWCB staff recommendations appear to be appropriate for both time periods (June 15 through July 14 and July 15 through August 15). The claimed flows provide reasonable water depths and water velocities but do not provide maximum habitat in any manner.

Assertion 4. The CWCB selected flow rates "ensures that in a substantial number of years the instream flow will not be met."

The SWCD's assertion is basically the same as one brought forth in Peter Foster's letter which was submitted as Exhibit 1 of the John Hendricks and Western Sky Investments Prehearing Statement. Mr. Foster asserted that the CWCB selected flow rates would not be achieved during drought years. The SWCD seems to be asserting the same idea. The SWCD presented no information as to what seasons the claimed flow will not be met or any input as to what a "substantial" number of years means.

My response to this assertion is the same as presented in Section A (Above) of this document. The reader is referred to that section for details. However, the fish assemblage in the claimed reach responds to the annual flow regimen, not what happens during any single water year. Reducing the instream flows for the claimed reach will not provide reasonable protection for the Three Species.

Assertion 5. The CWCB did not present any "discussion" of what is a "reasonable degree for preserving the environment."

The CWCB staff proposal is designed to assure that the Three Species populations in the claimed reach are "reasonably" protected through time. The flow levels recommended by the CWCB Staff are less those currently found in the claimed reach. Lower water levels can be expected in the future as additional water rights are approved and exercised. Lower water levels will negatively impact the Three Species in the claimed reach. The CWCB proposal recognized the need and right for additional water rights. As such the CWCB proposal does not "maximize" habitat for the Three Species. The level of habitat protection ranges from marginal to less than optimal at all the seasonal flow levels in the claimed reach (Woodling 2015 and previous sections of this document). The flows in the claimed reach are "reasonable" based on biological needs of the Three Species.

The amount of habitat required by different species influences the amount of instream flow according to different life stages of the fish species involved. The Three Species are widely distributed in the Colorado River Basin. However, about 45 % of the populations of these species have become extirpated. Protection of remaining populations is needed to keep the species from receiving possible federal listing under the Endangered Species act. The CWCB appears to have balanced not only the state requirement adopting a minimum flow to provide reasonable protection but the important aspect of protecting these fish populations. Although the CWCB may not have presented a discussion of what is reasonable their flow recommendations did take into consideration the needs of the species involved balanced against the amount of water remaining in the stream under current conditions. Such an approach certainly is "reasonable."

Assertion 6. An assertion that since "these species have persisted with flows substantially less than the minimum claimed in many years suggest(s) that the proposed flows are not the minimum necessary and that a modest depletion allowance would be appropriate."

This statement is not correct. "These species" have persisted due to the current flow regime of the Dolores River in the claimed stream reach and not lower flows that exist during low precipitation years. These fish species respond to all aspects of the flow regime, the maximum events, minimum flow events, and even median flow events. The Three Species are relatively long-lived fishes that do not have to successfully reproduce each year (See response to Assertion 1 above). The spawning success of the Three Species is positively correlated with higher flows during the spring snowmelt period.

The reader of this document is referred to Figure 1 in the SWCD's prehearing statement. The CWCB's flow recommendations for the claimed reach actually would preserve much less water than flows through the claimed reach during most years. Future water rights in the claimed reach will reduce the amount of water flowing thru the river. The 900 cfs water right may well become the maximum flow in the river during spring snowmelt periods. That flow regime would lead to decreases in the size and number of the Three Species through the claimed reach. The CWCB flow recommendations indeed represent a minimum flow that will reasonable protect the Three Species continued survival in the claimed reach, but not at the size and numbers currently present.

As described in detail above (Page 2 paragraph four), the current Dolores River fish assemblage will persist until the long term flow regime changes to a sufficient degree. However, the fish assemblage does not change from year to year in response to even serious drought conditions. A serious drought in 2002 and several years of relatively high drought and high spring flows occurred in the last decade in Colorado. The Three Species persisted in the claimed stream reach of the Dolores River. These species relatively long lived fish species do not have to successfully spawn every year to assure survival of the Three Species in the claimed reach.

The SWCD's assertion that the Three Species would survive continue to persist at a flow regime less that the claimed seasonal flows is not correct. The SWCD did not provide any support for this assertion while my June 29, 2015 memorandum provided literature citations supporting the adoption of the claimed seasonal flows in the claimed reach of the Dolores River.

Assertion 7. A postulation that the environment could be "reasonably preserved" if half of available habitat were protected or 75%.

Quite literally, if lower flows could "reasonably" protect the Three Species the CWCB staff recommendations would be lower. The CWCB staff developed the recommendations for the claimed reach using the same processes, data collection protocols and analyses used for hundreds of stream filings that have been approved by the CWCB in past years. The CWCB procedures were designed to identify the minimum flows needed to protect fish to a reasonable degree and that has been the outcome for hundreds of past actions before the CWCB.

In addition, I would have recommended lower flows if my analysis had indicated such action was warranted to provide more than "reasonable" protection. However my examination of the data provided by the CWCB indicated that the recommended instream flows in the claimed reach will result in flows that range from "marginal" to less than optimal for the Three Species (Woodling memorandum June 29. 2015).

Both the CWCB procedures and my analysis demonstrated that the seasonal flows requested by the CWCB Staff are appropriate and should be adopted. The SWCD's claim that lower amounts of habitat may be appropriate are unfounded and as such represent opinions that are not supported by any other data or analysis.

Summary

The CWCB staff recommendations for the claimed reach represent the minimum flows that will provide reasonable protection for the populations of the Three Species that inhabit this river reach. The claims in opposition submitted by entities in opposition incorporated many of the same points that were presented during a previous CWCB hearing that established instream flows for a segment of the San Miguel River immediately upstream of the claimed reach of the Dolores River. The CWCB rejected these ideas at that hearing and should do the same in the current proceedings.

Literature Cited

R. Anderson and G. Stewart. 2003. Riverine fish flow investigations Federal Aid Project F-289-R6. Colorado Division of Wildlife. Fort Collins, Colorado.

R. Anderson and G. Stewart. 2006. Riverine fish flow investigations Federal Aid Project F-289-R6. Colorado Division of Wildlife. Fort Collins, Colorado.

R. Anderson and G. Stewart. 2007. Impacts of stream flow alterations on the native fish assemblage and their habitat availability as determined by 2d modeling and the use of fish population data to support instream flow recommendations for the sections of the Yampa,

Colorado, Gunnison and Dolores Rivers in Colorado. Special report number 80. Colorado Division of Wildlife. Denver, Colorado.

Bezzerides N., K. Bestgen. 2002. Status review of the roundtail chub, *Gila robusta*, flannelmouth sucker, *Catostomus latipinnis* and bluehead sucker Catostomus *discobolus* in the Colorado River basin. Colorado State University, Larval Fish Laboratory, Fort Collins Colorado.
Burdick, B.D. 1995. Ichthyofauna studies of the Gunnison River, Colorado, 1992-1994. Final report prepared for the Recovery Implementation Program for endangered fishes in the Upper Colorado River Basin. U. S. Fish and Wildlife Service, Colorado River Fishery Project, Grand Junction, Colorado. 66 pp.

Colorado Division of Wildlife. 2010. Colorado Division of Wildlife instream flow recommendations for San Miguel River, Enclosure 4. Colorado Division of Wildlife. Denver, CO.

Conklin, D. Jan. 2011. Proposed San Miguel River instream flow recommendations. GEI. Denver, Colorado.

Master, L.L., B.A. Stein, L, S. Kutner, and G.A. Hammerson. 2000. Vanishing assets: conservation status of U.S. species. Pages 93-118 *in* B.A. Stein et al. editors. Precious heritage: The status of biodiversity in the United States. Oxford University Press, New York.

Nehring, R.B. and R.M. Anderson. 1993. Determination of population-limiting critical salmonids habitats in Colorado streams using the Physical Habitat Simulation System. Rivers 4:1-19.

Rees, D.E., J.A. Ptacek, W.J. Miller. 2005a. Roundtail chub, (*Gila robusta*): A technical assessment. USDA Forest Service, Rocky Mountain Region, Species conservation project.

Rees, D.E., J.A. Ptacek, R.J. Carr and W.J. Miller. 2005b. Flannelmouth sucker, (*Catostomus latipinnis*): A technical conservation assessment. USDA Forest Service, Rocky Mountain Region, Species conservation project

Stewart, G., R. Anderson, E. Wohl. 2005. Two-dimensional modeling of suitability as a function of discharge on two Colorado Rivers. 2005. River research and applications. 21:1061-1074.
Sweet D.A. 2007. Movement patterns and habitat associations of native and introduced catostomids in a tributary system of the Colorado River. Master thesis. University of Wyoming. Laramie, Wyoming.

CURRICULUM VITAE

John Woodling, Ph.D. 970-361-7004
Aquatic Biologist
2180 1/2 K 1/2 Road, Grand Junction, Colorado 81505 woodling@colorado.edu

EDUCATION

Ph.D., Biology Major, University of Colorado, Boulder, Colorado, 1993.

Title of Doctoral Dissertation: "Factors Effecting Toxicity of Metals To Brown Trout, An In Situ study of the Arkansas River"

M.S., Biology Major, Chemistry Minor, University of Louisville, Louisville, Kentucky, 1971.

Masters Thesis: "Biological, Chemical, and Physical Characteristics of Brashears Creek, Spencer and Shelby Counties"

B.S., Biology Major, Mathematics Minor, Southern Colorado State College, Pueblo, Colorado, 1968.

PROFESSIONAL EXPERIENCE

Jan 2007 Present — **College Instructor**
Colorado Mesa University, Grand Junction, Colorado. Scientific Writing, Aquatic Entomology, Fish Biology and Senior Thesis (Undergraduate courses)

Jan. 2004 Present — **Consultant, Woodling Aquatics, LLC.**
Clients include Colorado Trout Unlimited, Colorado State Land Board, Colorado Division of Hazardous Materials and Waste Management, West Slope Water Network, Sierra Club, Western Resource Advocates, Eagle River Watershed Council and Eagle Mine Limited. Prepare technical assessments of environmental issues in aquatic systems. Represent organizations at Colorado Water Quality Control rulemaking hearings and testify as expert witness in US District Court and water court.

Jan. 1994 - 2005. — **University Instructor**
University of Denver, Community College, Environmental Policy Management
Instructor , Wetland Ecology, General Ecology, Aquatic Toxicology, Research Writing, Endangered Species and Introduction to Water Quality (Graduate level classes) and capstone student advisor.

Jan 1998 Present — **Research Associate**
University of Colorado Boulder, Colorado. Awarded US EPA grant in 2003 to study impacts of estrogenic compounds on Colorado fish populations.

Jan. 1997 2003 — **University Instructor**
University of Colorado, EPO Biology. Stream Biology.

July 2002 - Retired May 2003 — **Cost Center Supervisor**
Colorado Division of Wildlife (DOW), Denver Colorado

- Principal duty was to manage and supervise water unit of the habitat section, including water quality and Water Quantity aspects of agency goals and objectives.
- Develop budget and work objectives used by DOW to respond to water resource issues.
- Supervised and directed water unit employees to achieve program goals

Designed and developed web-based model to analyze fishery and habitat data for DOW use.

- Participated in state and federal Superfund and CERCLA by development and writing of and/or review of remedial investigation documents, feasibility studies and remedial action plans; negotiate for the state in settlement actions, testify in water quality related hearings and court cases.

July 1987 - June 2002. — **Program Specialist**
Colorado Division of Wildlife (DOW), Denver Colorado

- Principal duty was to represent the DOW in all matters pertaining to water quality issues.

• Developed policy and programs used by DOW to respond to water quality issues.
• Designed and performed laboratory and field research studies of rivers throughout Colorado to define and quantify impacts of pollutants to aquatic ecosystems. Projects included efforts to create biological stream standard proposals for Colorado's eastern plains warm water streams and rivers and mountain trout streams. Potential biological stream standards were developed using results from genetic analysis of trout and aquatic macroinvertebrates, fish community structure modeling and stress hormone response studies on a variety of fish species. Ancillary studies included a multi-year monitoring program of the Eagle River, Arkansas River and Clear Creek to assess efficacy of remediation programs and systematic studies of the fish genera *Phoxinus* and *Cottus* in Colorado.
• Wrote and submitted successful grant applications to receive funding from US EPA, Colorado Department of Public Health and private enterprise for field and laboratory studies.
• Participated in state and federal Superfund and CERCLA by review and/or development of remedial investigation documents, feasibility studies and remedial action plans; negotiated for the state in settlement actions involving fish kills and CERCLA actions.
• Created DOW position in rulemaking hearings for the Colorado Water Quality Control Commission (WQCC) through which stream standards and use classifications are adopted.
• Member Colorado 319 Nonpoint Pollution Task Force.
• Appointed by WQCC to rewrite Colorado Stream Standards for nitrogen compounds.
• Testified as expert witness in court proceedings and rulemaking hearing of the WQCC.

April 1984 - July 1987 **Coldwater Program Specialist**, DOW

• Developed, implemented and monitored statewide DOW coldwater fishery program.
• Developed annual budgets for DOW–fish hatcheries, aquatics section and aquatic research– $6 million/year.
• Developed statewide DOW fish program budget, including hatcheries.
• Assisted DOW fish hatcheries in increasing production and efficiency.
• Co-authored report that resulted in the reorganization of the DOW fish hatchery system.
• Provided WQCC with technical information regarding water quality issues such as mine drainage.

July 1979 - April 1984 **Warmwater Program Specialist**, DOW

• Developed, implemented and monitored statewide DOW warmwater fishery program.
• Prepared DOW response to legislative queries regarding annual budget.
• Worked with fish hatcheries to increase production and efficiency.
• Provided WQCC and Colorado Wildlife Commission with technical information regarding water quality issues such as nutrient enrichment and acid rain.

Sept. 1978 - July 1979 **Project Manager**
Camp, Dresser and McKee, Denver, Colorado.

• Prepared bids, planned and directed interdisciplinary studies. Wrote final reports for these studies.
• Represented power companies, coal mining and other underground mining corporations.

Sept. 1973 - Sept. 1978 **Research Biologist**
Colorado Water Quality Control Division, Denver, Colorado

• Planned and performed stream and river basin studies concerning impacts of mining, milling, agricultural, domestic and industrial effluents on water quality.
• Monitored and analyzed biological, chemical and physical components of aquatic ecosystems to determine impacts from effluents on these systems.
• Performed in situ assays to determine toxicity of pollutants to resident fish populations.
• Served as expert witness at public hearings and adjudicatory hearings.
• Served as member of subcommittee to develop Colorado water quality standards and use classifications.

Jan. 1971- May 1971 **College Instructor**

• Taught Human Anatomy and Physiology, University of Southern Colorado.

Sept. 1971- June, 1972 **High School Teacher**
Cathedral High School, Denver, Colorado.

• Taught high school biology and coached football and wrestling.

July 1968- Dec, 1970 **Research Assistant**
University of Louisville, Louisville, Kentucky

• Implemented a pre-impoundment study of the Salt River in central Kentucky. Collected and analyzed water quality samples, collected and identified aquatic macroinvertebrate and fish samples.
• Collected and analyzed samples measuring the movement of radioactive nucleotides through a spring-fed system, Doe Run in Kentucky.

Sept. 1966- Dec. 1967. **Laboratory Assistant**
Southern Colorado State College, Pueblo, Colorado.
• Taught laboratory sections in zoology, botany, plant physiology and ecology

PUBLIC SERVICE

Colorado 319 Nonpoint Pollution Council. Voting member 1989-2001.

Cherry Creek Basin Authority. Voting member 2001-2005. Appointed by Governor of Colorado.

PAPERS PRESENTED AT PROFESSIONAL MEETINGS

Woodling, J. 1984. Acid precipitation impacts in the upper Colorado River Basin, a long-term situation . Upper Basin Subtechnical Committee. Western Association of Fish and Wildlife Agencies. Las Vegas, Nevada.

Woodling, J. 1984. Potential impacts on aquatic systems of Colorado attributable to acid precipitation. 9th Annual Colorado Water Workshop. Rural Communities Institute. Gunnison, Colorado.

Woodling, J. 1984. Biologic recovery of Coal Creek: A Colorado stream impacted by mine drainage. 114th Annual Meeting of the American Fisheries Society. Ithaca, New York.

Woodling, J. 1994. The South Platte River from Denver to Nebraska: Water quality monitoring is not a simple process. The South Platte River Forum. Greeley, Colorado.

Jones, R.E., K.H. Lopez, T. Maldonado, T.R. Summers, C.H. Summers, C. Propper, and J. Woodling. 1995. Unilateral ovariectomy influences hypothalamus catecholamine asymmetries in a lizard that exhibits alternation of ovulation. Annual Western Regional Conference on Comparative Endocrinology. Seattle, Washington.

Norris, D.O., S. Felt, J. Woodling, and R.M. Doris. 1995. Internal axis of brown trout, *Salmo trutta*, living in metal-contaminated waters of the Eagle River, Colorado. Annual Western Regional Conference on Comparative Endocrinology. Seattle, Washington.

Woodling, J. 1995. Mine reclamation: What works, what doesn't at the close of the 20th Century. 15th Annual Meeting of the Society of Environmental Toxicology and Chemistry. Denver, Colorado.

Nykerk, S. and J. Woodling. 1996. Nutrient patterns in the mainstem South Platte River, Denver to Julesburg, Colorado: Seasonal and temporal variations, a long-term Tom Sawyer monitoring program. Platte River Basin Ecosystem Symposium. Kearney, Nebraska.

Woodling, J. 1996. What if anything is a redbelly dace in Colorado. 45th annual workshop. Great Plains Fisheries Workers Workshop. Great Plains Fisheries Workers Association. Fort Collins, Colorado.

Woodling, J. 1996. Physiological and weight changes of wild brown trout inhabiting waters with acutely toxic cadmium and zinc concentrations: an *in situ* study. International Congress on the biology of fishes. San Francisco State University. San Francisco, California.

Woodling, J. and S. Brinkman. 1999. Effects of pre-exposure on toxicity of cadmium and zinc in combination to young brown trout (*Salmo trutta*). Society of Environmental Toxicology and Chemistry. Twentieth National Meeting. Philadelphia, Pennsylvania.

Woodling, J., S. Albeke, S. Nykerk. 2000. Fish community stability and change in the eastern plains streams of Colorado from the 1970s to the new millennia. American Fisheries Society, National Meeting. St. Louis, Missouri.

Woodling, J, T. Maldonado, D.O. Norris and A. Vajada. 2003. Initial observations of intersex fish in the eastern plains streams of Colorado. American Fisheries Society, National Meeting, Quebec, Canada.

Woodling, J. 2011. Plecoptera: Yet another group of river dwelling species starting to disappear in Colorado. Upper Colorado River Basin Forum. Colorado Mesa University. Grand Junction, Colorado.

PUBLICATIONS IN REFEREED JOURNALS AND BOOKS

Woodling, J., and P. Davies. 1978. Importance of Laboratory Derived Metal Toxicity Results in Predicting Instream Response of Resident Salmonids. In: Proceedings Third Annual Aquatic Toxicity Symposium. STP 707. American Society of Testing and Materials. Philadelphia, Pennsylvania.

Woodling, J. 1980. Game Fish of Colorado. Colorado Division of Wildlife. Denver, CO. DOW-M-I-25-80. 40 pp.

Todd, J., J. Woodling and D. Reiser. 1983. Re-establishment of Aquatic Biota in a Stream Affected by Acid Mine Drainage. In: Issues and Techniques in Management of Impacted Western Wildlife. Thorne Institute, Boulder, CO.

Woodling, J. 1985. Colorado's Little Fish. Colorado Division of Wildlife, Denver, CO. 77 pp.

Woodling, J. 1994. Fisheries Records: Alamosa River. pp. 228-235 in Proceedings: Summitville Forum (95). H.H. Posey, J.A. Pendleton, D. Vanzyl, *eds.* Colorado Geological Survey, Special Pub. 38.

Jones, R.E., K.H. Lopez, T.A. Maldonado, T.R. Summers, C.L. Summers, C.R. Propper and J.D. Woodling. 1997. Unilateral ovariectomy influences hypothalamic monoamine asymmetries in a lizard (*Anoli*s) that experiences alternation of ovulation. General and Comparative Endocrinology. 108:306-315.

Norris, D.O., S. B. Felt, J.D. Woodling and R.M. Dores. 1997. Immunocytochemical and Histological differences in the interrenal axis of feral brown trout, *Salmo trutta*, in metal-contaminated waters. General and Comparative Endocrinology. 108:343-351.

Norris, D.O., S. Donahue, R.M. Dores, T.A. Maldonado and J.D. Woodling. 1999. Impaired adrenocortical response to stress by brown trout, *Salmo trutta*, living in metal-contaminated waters of the Eagle River, Colorado. General and comparative Endocrinology. 113:1-8.

Albeke, S. and J. Woodling. 2001. Use of regional standard weight equations to assess body condition of feral brown trout (*Salmo trutta*) populations exposed to environmental stress such as elevated metal concentrations. Journal of Freshwater Ecology. 16:501-508.

Gray B., H.M. Smith, J. Woodling and D. Chiszar. 2001. Some bizarre effects on snakes, supposedly from pollution, at a site in Pennsylvania. Bulletin of the Chicago Herpetological Society. 36:144-147.

Kreiser B.R., J.B. Mitton and J.D. Woodling. 2001. Phylogeography of the plains killifish, *Fundulus zebrinus*. Evolution. 55:339-350.

Woodling, J.D., S. Brinkman, B.J. Horn. 2001. Nonuniform accumulation of metals in the kidney of brown trout, *Salmo trutta*, in rivers contaminated by copper, cadmium and zinc. Archives of Environmental Contamination and Toxicology. 40:381-385.

Woodling, J., S. Brinkman and S. Albeke. 2002. Acute and chronic toxicity of zinc to the mottled sculpin *Cottus bairdi*. Environmental Toxicology and Chemistry. 21:1922-1926.

Brinkman. S. and J. Woodling. 2005. Acute and chronic toxicity of zinc to mottled sculpin (*Cottus bairdi*) in high hardness water. Environmental Toxicology and Chemistry. 24:1515-1517.

Woodling J.D., E.M. Lopez, T.A. Maldonado, D.O. Norris, A. Vajda. 2006. Intersex and other reproductive disruption of fish in wastewater dominated Colorado streams. Comparative Biochemistry and Physiology, Part C. 144:10-15.

Vajda, A. M.; Barber, L. B.; Gray, J. L.; Lopez, E. M.; Woodling, J. D.; Norris, D. O. 2008. Reproductive disruption in fish downstream of an estrogenic wastewater effluent. Environ. Sci. Technol. 42, 3407− 3414.

Brinkman, S., A. Vajda, J. Woodling. 2009. Chronic toxicity of ammonia to rainbow trout. 2009. Transactions of the American Fisheries Society. 138:433-440.

Woodling John. 2011. The ghost mayfly. In: Wading for bugs, exploring streams with the experts. Li, J.L. and M.T. Barbour *eds*. Oregon State University Press. Corvalis, Oregon.

Brinkman, S. and J. Woodling. 2014. Acclimation and deacclimation in brown trout (Salmo trutta) to zinc and copper singly in in combination with cadmium or copper. Arch. Environ. Contam. Tox. 67:214-223.

ARTICLES IN POPULAR PRESS

Woodling, J. 1980. Colorado's Sunfish. In: Colorado Outdoors. Colorado Division of Wildlife. 29:4-6.

Woodling, J. 1982. Acid Rain in Colorado. In: Colorado Streamside. Colorado Council of Trout Unlimited. Winter 1982.

Woodling, J. 1986. What did I catch? In: Colorado Outdoors. Colorado Division of Wildlife. 35:10-11.

Woodling, J. 1987. Crappie. In: Colorado Outdoors. Colorado Division of Wildlife 36:16-19.

Woodling, J. 1994. Listen to the murmur of the cottonwood trees. In: Colorado Outdoors. Colorado Division of Wildlife. 43:28-30.

Woodling, J. 2004. How many fish could a garter snake eat if a garter snake could eat fish? Colorado Fishing Guide No. 13. Colorado Division of Wildlife. Denver, Colorado.

REPORTS PUBLISHED BY COLORADO DEPARTMENT OF HEALTH, COLORADO DIVISION OF WILDLIFE OR EAGLE RIVER WATERSHED COUNCIL

Woodling, J. 1974. Water quality investigations of the mainstem Colorado River, Dotsero to Utah. Colorado Water Quality Control Division. Colorado Department of Health, Denver, Colorado. 45 pp.

Woodling, J. 1974. Water quality and benthic investigation of the San Miguel River Basin. Colorado Water Quality Control Division. Colorado Department of Health, Denver, Colorado. 47 pp.

Woodling, J. 1975. Investigations of the Aquatic Ecosystems of Piceance on Yellow Creeks, Northwestern Colorado. Colorado Water Quality Control Division. Colorado Department of Health, Denver, Colorado. 27 pp.

Woodling, J. 1975. Water quality investigations of the North Fork of the Gunnison River, Delta and Gunnison Counties, Colorado. Colorado Water Quality Control Division. Colorado Department of Health, Denver, Colorado. 14 pp.

Woodling, J. 1975. The upper Gunnison River Drainage. Colorado Water Quality Control Division. Colorado Department of Health, Denver, Colorado. 70 pp.

Woodling, J. 1976. Effects of mining activities on Willow Creek, Mineral County, Colorado. Colorado Water Quality Control Division. Colorado Department of Health, Denver, Colorado. 15 pp.

Woodling, J. 1976. Selected chemical and biological aspects of McElmo Creek. Montezuma County, Colorado. Colorado Water Quality Control Division. Colorado Department of Health, Denver, Colorado. 9 pp.

Woodling, J. 1976. Pollution of the Slate River via a mine discharge and sewage treatment plant effluents. Colorado Water Quality Control Division. Colorado Department of Health, Denver, Colorado. 20 pp.

Woodling, J. 1976. Effects of water discharges from Great Western Sugar Mills at Ovid, Sterling, and Fort Morgan, Colorado and the Sterling wastewater treatment facility in the South Platte River. Colorado Water Quality Control Division. Colorado Department of Health, Denver, Colorado. 38 pp.

Woodling, J. 1976. Upper San Miguel River. Colorado Water Quality Control Division. Colorado Department of Health, Denver, Colorado. 49 pp.

Woodling, J. 1977. Chemical and physical aspects of the Roan Creek Ecosystem. Colorado Water Quality Control Division. Colorado Department of Health, Denver, Colorado. 54 pp.

Woodling, J. 1977. Investigations of point sources of acid metals, mine drainage locations I the upper Animas River Basin. Colorado Water Quality Control Division. Colorado Department of Health, Denver, Colorado. 16 pp.

Woodling, J. 1980. Acid Precipitation impacts in Colorado - a long-term situation. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 13 pp.

Woodling, J. and J. Whittaker. 1983. Efficiency and organizational analysis of the Colorado Division of Wildlife's fish hatchery system. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 49 pp.

Woodling, J. 1990. Intensive creel census of Clear Creek, Jefferson and Clear Creek Counties, May through September 1989. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 24 pp.

Woodling, J. 1990. Use attainability study California Gulch. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 34 pp.

Woodling, J. 1990. Metal tissue analysis of Clear Creek trout. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 20 pp.

Woodling, J. 1990. Intensive creel census: Arkansas River. Lake and Chaffee Counties. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 20 pp.

Horn B.J. and J. Woodling, J. 1990. Biological monitoring assessment of Eagle River Superfund Site, Eagle County, Colorado. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 24 pp.

Woodling, J. 1991. Straight Creek, Summit County. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 13 pp.

Woodling, J. 1991. Intensive creel census: Ridgeway Reservoir, Ouray County, Colorado, April through September 1990. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 6 pp.

Woodling, J. 1992. Episodic metal contamination of the Arkansas River by non-point pollution from California Gulch. Colorado Department of Natural Resources. Colorado Division of Wildlife. 11 pp.

Woodling, J. 1993. Annual Report on the Biological Assessment of the Eagle River Superfund Site, Eagle County, Colorado. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 34 pp.

Woodling, J. 1993. Investigations of Impacts of Point and Non-Point Pollution on Eastern Plains Fisheries in Colorado: South Platte and Arkansas Rivers. Annual Segment Report, Federal Aid Project F-84-R-6. Colorado Division of Wildlife, Denver, Colorado.

Woodling, J. And R. DeWeese. 1993. Assessment of the trout population in the upper Arkansas River Basin of Central Colorado. U.S. Bureau of Reclamation. Loveland, Colorado. 34 pp.

Woodling, J. 1994. Investigations of Impacts of Point and Non-Point Pollution on Eastern Plains Fisheries in Colorado: South Platte and Arkansas Rivers. Annual Segment Report, Federal Aid Project F-84-R-6. Colorado Division of Wildlife, Denver, Colorado.

Woodling, J. 1995. Annual Report on the Biological Assessment of the Eagle River Superfund Site, Eagle County, Colorado. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 48 pp.

Woodling, J. 1996. Physical habitat analysis and biological assessment. Appendix B. Use attainability analysis, Alamosa River Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 74 pp.

Woodling, J. 1996. Annual Report on the Biological Assessment of the Eagle River Superfund Site, Eagle County, Colorado. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 83 pp.

Woodling, J. 1997. Clear Creek Biological Monitoring Program. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 77 pp.

Woodling, J. And J. Dorsch. 1997. Annual Report on the Biological Assessment of the Eagle River Superfund Site, Eagle County, Colorado. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 99 pp.

Woodling, J., D. Langlois and W. Andree. 1998. Intensive Creel Census Eagle River, Eagle County, Colorado, July through October, 1998. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 20 pp.

Woodling, J. and Dan Chase. 1998. Annual Biological Assessment of the Eagle River Superfund Site, Eagle County, Colorado. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 107 pp.

Woodling, J., M. Gasaway and J. Dominquez. 1999. Biological Assessment of Clear Creek. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 98 pp.

Woodling, J. and Dan Chase. 1999. Annual Biological Assessment of the Eagle River Superfund Site, Eagle County, Colorado. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 98 pp.

Woodling, J. and Shannon Albeke. 2000. Annual Biological Assessment of the Eagle River Superfund Site, Eagle County, Colorado. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 98 pp.

Woodling, J. and Ann Widmer. 2001. Annual Biological Assessment of the Eagle River Superfund Site, Eagle County, Colorado. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 98 pp.

Woodling, J. and J. Ketterlin. 2001. Biological Assessment of Clear Creek. Colorado Department of Natural Resources. Colorado Division of Wildlife, Denver, Colorado. 98 pp.

Woodling J. and A. Rollings. 2004. Annual Biological Assessment of the Eagle River Superfund Site. Eagle County, Colorado. Colorado Department of Public Health and the Environment, Hazardous Materials and Waste Management Division. Denver, Colorado.

Woodling J. A. Rollings and J. Wilson. 2005. Annual Biological Assessment of the Eagle River Superfund Site. Eagle County, Colorado. Colorado Department of Public Health and the Environment, Hazardous Materials and Waste Management Division. Denver, Colorado.

Woodling, J. and A. Rollings. 2008. Biological Assessment of Clear Creek. Colorado Department of Public Health and the Environment. Colorado Division of Hazardous Materials and Waste Management, Denver, Colorado.

Woodling J. A. and A. Rollings 2008. Annual Biological Assessment of the Eagle River Superfund Site. Eagle County, Colorado. Eagle River Watershed Council. Avon, Colorado.

Sauter, S., A. Madison, J. Woodling. 2012. Uncompahgre River Water Quality Report. Uncompahgre River Watershed Partnership. Ridgway, Colorado.

Woodling, J. 2013. The Eagle River at Arrowhead A Deteriorating Stream Reach. Eagle River Watershed Council. Eagle, Colorado.

To: Robert Harris

From: Laura Belanger, P.E.

CC: Bart Miller

Date: August 13, 2015

Re: Proposed Instream Flow Appropriation in Water Division 4: Dolores River (confluence with San Miguel River to confluence with West Creek)

Introduction

I have reviewed the Prehearing Statements and exhibits for the proposed Dolores River instream flow. In this memo I address several issues that were raised by various parties in the Prehearing materials, regarding:

- Water availability analyses;
- Availability of water for future appropriations; and
- Assumed gage error and instream flow administration (ISF).

Discussion

ISF Water Availability Analysis

Appropriate Period of Analysis

In their Prehearing Statement (Western Sky PHS, Exhibit 1) Western Sky raised questions about the period used in the Bureau of Land Management's (BLM) initial analysis which accompanied their recommendation. Since that time Colorado Water Conservation Board (CWCB) staff have completed additional analyses, as described in their Dolores River Water Availability Technical Memo (CWCB PHS, Exhibit 3). The CWCB evaluated water availability using a variety of methods, including summing historical data from two upstream USGS gages from 10/1/1984 – 9/30/2012 and completing Statemod historical and "Baseline" runs. The "Baseline" run was a current conditions run which used historical hydrology for the period from 10/15/1974 – 9/30/2006 assuming current management practices, including the full Dolores Project for the entire period. The periods used for these analyses were selected to incorporate Dolores Project[1] flow impacts. Additional Statemod assumptions can be found in the CWCB's Dolores River Water Availability Technical Memo. All of three of these analyses found that water was available for the proposed ISF. Western Sky also raised questions about dry year water availability. The period used in the CWCB's analysis incorporated all year types, including dry years.

[1] Per the CWCB staff's Dolores River Water Availability Technical Memo, McPhee Dam was completed in 1984 and the full Dolores Project was online and in use by 2000.

Arizona
P.O. Box 64128
Tucson, AZ 85728

Colorado
2260 Baseline Rd.
Suite 200
Boulder, CO 80302

Nevada
550 W. Musser Street
Suite I
Carson City, NV 89703

New Mexico
409 East Palace Ave.
Unit 2
Santa Fe, NM 87501

Utah
150 South 600 East
Suite 2AB
Salt Lake City, UT 84102

Water Availability

To put recent hydrology for the period since the full Dolores project came online in context, I plotted up annual flows for the San Miguel at Uravan gage (selected because it is not impacted by the Dolores Project and its flow regime has been less significantly altered) for all years of record with complete daily datasets (Figure 1). The average annual flow for the San Miguel at Uravan gage for the historical period of record was just under 254,000 acre-feet while the average for the drier 2000 to 2014 period was 25% lower, at just over 190,000 acre-feet. Note that for the 2000 to 2014 period all but two years fall below the average of the full period of record.

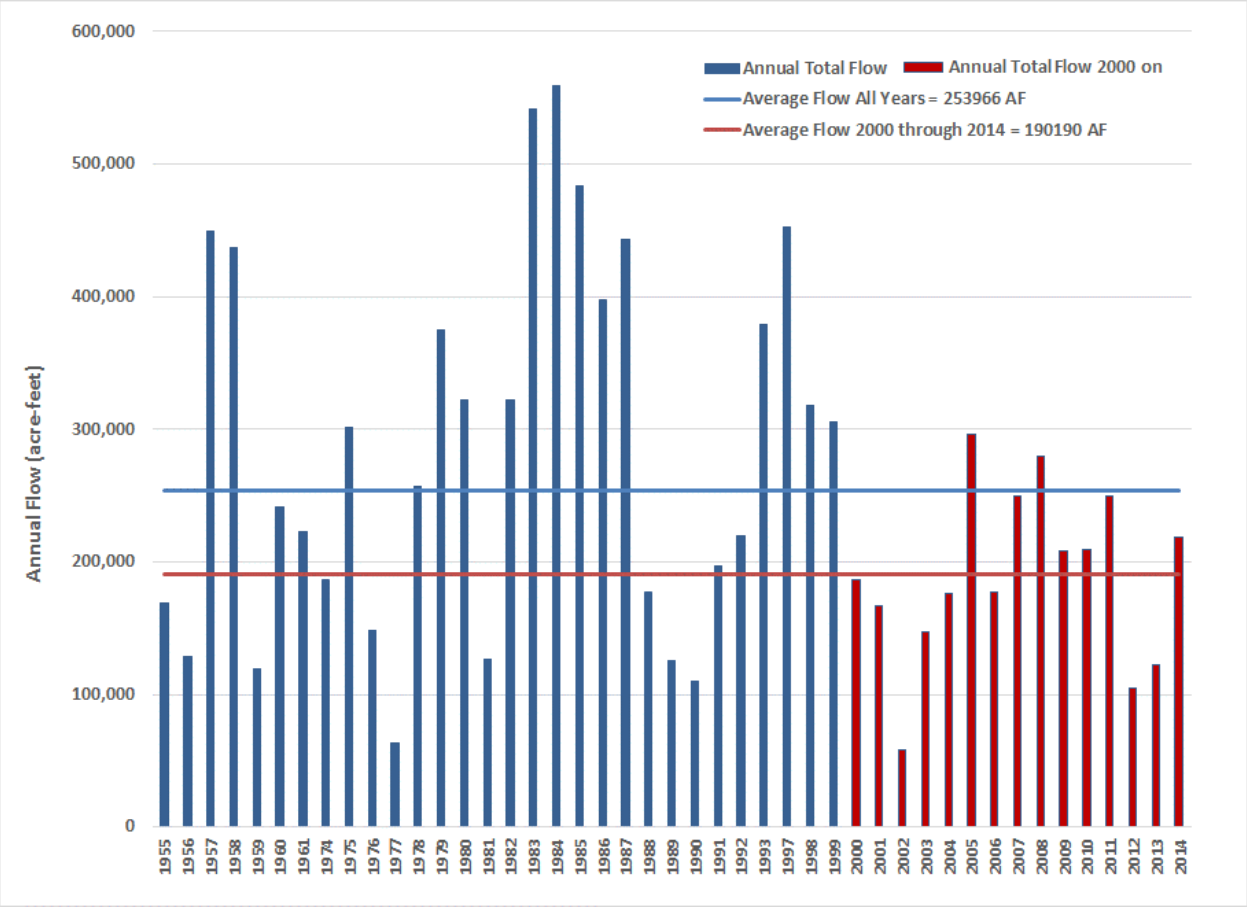


Figure 1: Historical Annual Streamflow (acre-feet) for the San Miguel at Uravan Gage (USGS #09177000) for Years with Complete Daily Datasets.

To better understand streamflows and ISF water availability, I completed my own analysis similar to the CWCB's historical gage analysis, but using gage data for the drier than average period beginning in 2000 (when the full Dolores project was online) through 3/22/2015 (the last day for which approved, not provisional, USGS gage data was available). I added data together for the USGS gages "San Miguel River at Uravan, CO" (#09177000) and Dolores River near Bedrock (#09171100) to estimate flows at the upper end of the ISF flow reach.

This analysis looked at a short and relatively dry period and is not meant to, and should not be, used in place of the CWCB's analyses which evaluated longer periods of record and a wider range of hydrologic year types. Rather, it provided me with a way to quickly examine a subset of streamflows and water availability at the upper end of the ISF reach without the complexity of modeling. This analysis also shows that even for this short, relatively dry period, water would have been available for the proposed ISF and future water development.

Based on my analysis, for the drier than average 1/1/2000 to 3/22/2015 period, the proposed ISF would be less than or equal to the hydrograph of average daily flows from the combined gages 96% of the time (Figure 2). During this period, the proposed ISF was below the average for 349 days of 365 days. Comparing the ISF to mean values for this drier period is not appropriate because that metric is intended for use with longer periods that include a broader range of year types. However, even during this drier period, the proposed ISF flow would be less than or equal to the hydrograph of median daily values 77% of the time (data not shown).

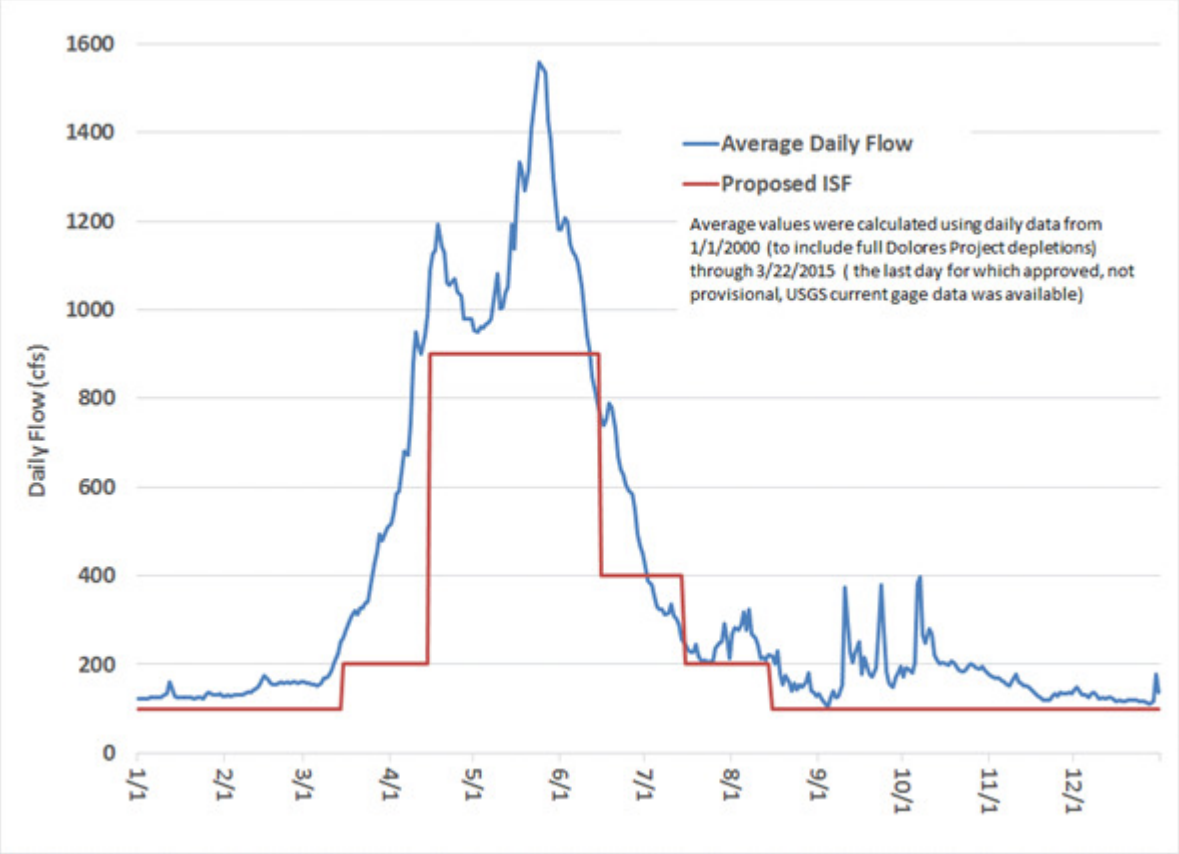


Figure 2: Proposed ISF and Average Daily Flow at Upper End of ISF Reach (USGS gages #09177000 and #09171100 combined) for the Drier than Average 1/1/2000 to 3/22/2015 period

Climate Change

In their PHS, the Southwestern Water Conservation District (SWCD) raised concerns that climate change may result in significantly less water being available in the future than the CWCB's analysis of water availability found. There is no way to know what future flows will be and it is inappropriate to attempt to incorporate climate change predictions, which are extremely variable and wide ranging, into a water rights appropriation. Climate change modeling is important for water managers to help identify vulnerabilities and assess potential risks for use in planning. However predictions are just that, predictions. Climate change models show wide-ranging futures, including decreases *and increases* in flows, with possible outcomes frequently shifting over time as models and data are updated and enhanced.

There is no reliable way to estimate future flows based on climate change models such that those estimates would be meaningful in developing any new water appropriation. Per the Intergovernmental Panel on Climate Change (IPCC) regarding their most recent climate change assessment report "To understand potential impacts of climate change for societies and ecosystems, scientists use scenarios to explore implications of a wide range of possible futures. Scenarios are not predictions of what will happen, but they can be useful tools for researching a wide range of "what if" questions about what the world might be like in the future." (IPCC, 2014)

<u>Water for Future Development</u>

Flows in Excess of the Proposed ISF

Several parties (CRWCD, SWCD and Western Sky) expressed concern over water available for future development. I evaluated water that would have been present in the stream at the upper end of the ISF reach in excess of, or in additional to, the ISF on a daily basis for the relatively dry 1/1/2000 to 12/31/2014 period using the combined flow for USGS gages #09177000 and #09171100. I then summed those daily excesses to annual total volumes. Figure 3 is an exceedance curve which shows the frequency which a volume of annual excess flows would have been met or exceeded during that period. For example, 53% of the time 85,963 acre-feet or more would have been available annually in excess of the proposed ISF and in 87% of years, more than 37,000 acre-feet would have been available. **Even during this drier than average period, significant water, an average of 120,400 acre-feet, would be available for future development annually.**

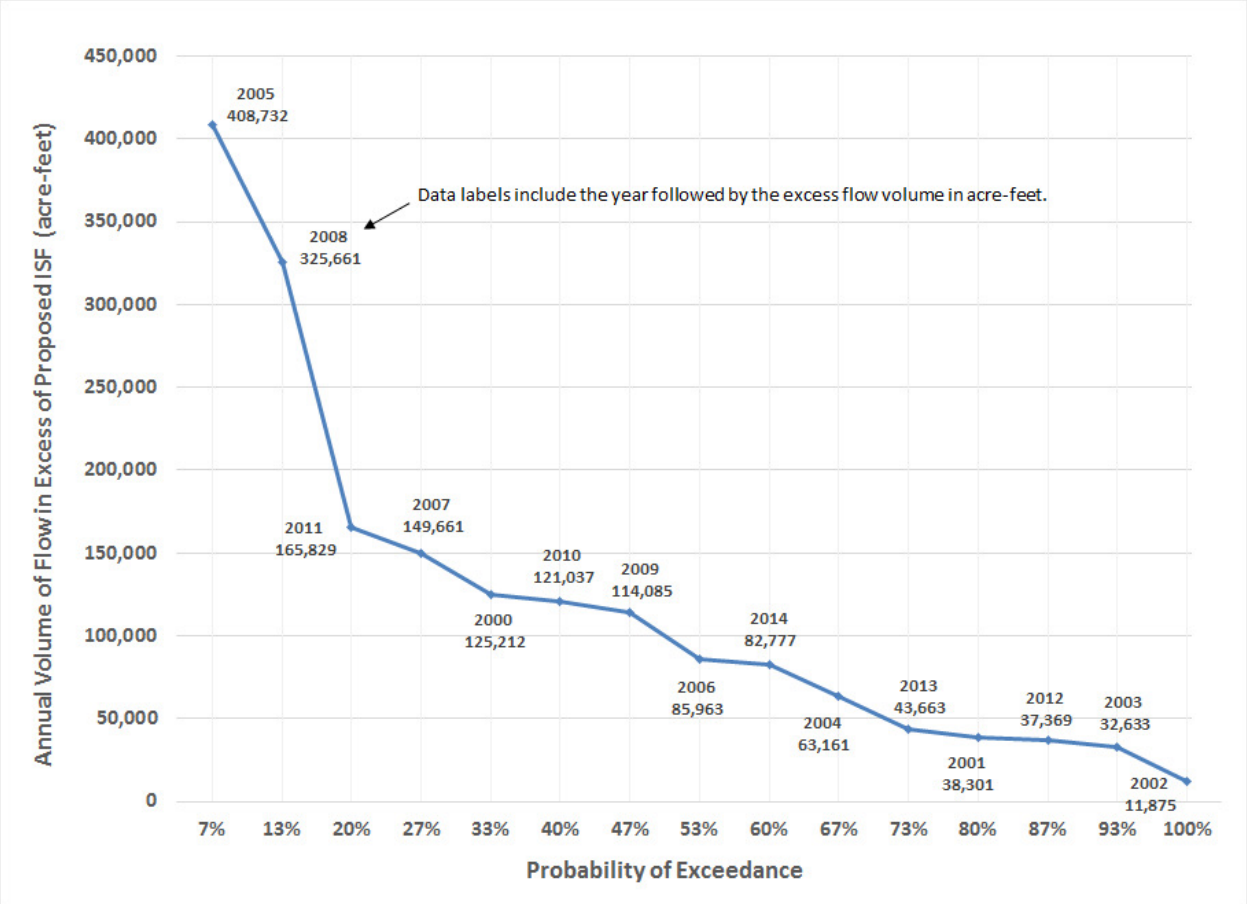


Figure 3: Estimated Annual Water Available in Excess of the Proposed ISF for the Drier than Average 2000 through 2014 Period at Upper End of Proposed ISF Reach (Average Excess = 120,400 AF)

Storage for Future Water Rights

The Colorado River Water Conservation District (CRWCD) raised concerns in their PHS that that large instream flows can call out future uses and impact water rights exchanges and changes. They differentiate between impacts to large and small water users, noting that storage is required to capture unappropriated water during high flow periods, and that most smaller-scale water users don't have the ability to develop such storage. Similarly, in their PHS, the Southwester Water Conservation District (SWCD) stated that there would be periods when a future junior municipal appropriator would be subject to a call and that augmentation sources and storage would be required.

I did not see any specific information provided by either the CRWCD or the SWCD regarding what small-scale or municipal users' future water needs are anticipated to be. However, per the Southwest Basin Roundtable Basin Implementation Plan (Harris Water Engineering, 2015) it appears that users are well positioned to meet future demands, including the use of additional storage. The Southwest Basin Roundtable Basin Implementation Plan (BIP) states that "San Miguel County has a projected demand increase of 2,900 to 6,000 AF per year. This potential gap can be met by growth into existing supplies. Existing providers are investigating means of

providing additional water, firming of existing supplies, and enlargement of distribution systems." For the portion of Montrose County within the Southwest Basin, the BIP describes a new multi-purpose project, the Montrose County Firming Project, "to provide a reliable source of water for municipal and industrial demands over the next 50 years". This project is described as including the construction one or two reservoirs and the enlargement of the Nucla Town Reservoir. Per the BIP "The project will address the 3,200 AF gap between existing water supplies and demands projected to occur by 2060 in the western portion of Montrose County." So according to the BIP, storage is already a recognized necessity in order to develop reliable supplies and does not appear to be contingent on the proposed ISF being appropriated.

Additionally, the BIP notes that "Water critical areas exist throughout the Southwest Basin and its sub-basins (Figure 4). When an area is designated as critical (e.g. over-appropriated) the State Engineer cannot issue a well permit without water being made available for appropriation by means of an approved augmentation plan…" Figure 4 of the BIP maps "critical" areas as well as calls on the river that occurred between November 1, 2000 and October 31, 2013. Per Figure 4 in the BIP, calls occurred on the San Miguel down to Naturita. Figure 4 also identifies the San Miguel watershed above Naturita and the Dolores watershed above the vicinity of Dove Creek [at/near Glade Creek confluence, not shown in figure] as water critical areas.

Significant water is available in excess of the proposed ISF, including for the drier than average 1/1/2000 to 3/22/2015 period (Figure 3). However, given the late date of any new appropriation in the state, upstream of the proposed ISF *or otherwise*, storage may be required in order to develop a reliable supply. While obviously more expensive and time-consuming than direct diversions, the need for storage is something water users of all sizes have long contended with and successfully addressed. And while smaller scale water users may have limited resources, they would also require smaller storage facilities. Additionally, opportunities may exist for them to benefit from sharing storage facilities, including those already planned for, possibly combined with other augmentation sources.

<u>Assumed Gage Error and Instream Flow Administration</u>

The Southwestern Water Conservation District (SWCD, PHS pg. 7) states that "Measurement error, if not accounted for, will enlarge the intended appropriation causing unintentional appropriation of water the Board may intend to leave available for appropriation". **Gage error can both over *and under* estimate flow and likely changes over time between rating curve adjustments. It is just as likely that measurement error will diminish the intended appropriation as it is that it could enlarge it.** Additionally, this concern is applicable to all water rights administered via stream gage and is not unique to the Dolores ISF.

In their PHS, the CRWCD stated that the CWCB has the discretion as part of its appropriation to determine that junior depletions which cannot be accurately measured because of the sensitivity of stream gages do not adversely impact the minimum stream flow necessary to preserve the environment to a reasonable degree. They then note that typical error for a stream gage is 5%. The CRWCD PHS (pg. 4) states "Thus, future depletions within the range of

the gage sensitivity cannot accurately be measured and can be determined as part of the CWCB's appropriation process to have only a de minimis non-injurious impact on the subject ISF." While not completely clear, I believe the CRWCD may be proposing that the ISF not be administered until gage flows are below the proposed ISF minus 5%. As I note above, **gage error may result in readings that are higher *or* lower than actual flows.** All stream gages have error associated with them, and that error may change over time. Yet gages and their readings, which gage managers do their best to keep as accurate as possible, are a key tool we must rely on when administering water rights across the board.

In Table 1 I show the "effective" ISF (the shaded columns) that could result from this proposal in theoretical situations when the gage is reading 100% accurately and when it is already reading 5% low. In the latter case, **the 5% discretion proposed could result in an effective ISF that is 10% lower (812 cfs versus 900 cfs) than what has been determined as being necessary to preserve the natural environment to a reasonable degree by the Board.**

Table 1: Proposed Effective ISF under Theoretical Gage Error Conditions with Proposed Administration Discretion

	Theoretical Gage Is Reading Correctly (no error)			Theoretical Gage is Reading 5% Low		
Proposed ISF (cfs)	Gage Reading (cfs)	Actual Flow (cfs)	Gage Minus 5% (cfs)	Gage Reading (cfs)	Actual Flow (cfs)	Gage Minus 5% (cfs)
100	100	100	95	100	95	90
200	200	200	190	200	190	181
400	400	400	380	400	380	361
900	900	900	855	900	855	812

Conclusions

Based upon my review of prehearing statements and exhibits, and my own analyses, I conclude that water is available for the proposed ISF and that the water availability analyses completed by the CWCB are appropriate. There is significant water available for future water development, even during the drier than average period of record I evaluated, though storage may be necessary depending on supply requirements. Additionally, while it is appropriate and important that water managers and planners consider potential climate change impacts on supplies, historical data, rather than climate change predictions, should be used in developing estimates of water available for new appropriations. Lastly it would be inappropriate to under-administer the proposed ISF to within an assumed gage error as that could significantly undermine flows that have been determined as being necessary to preserve the natural environment to a reasonable degree by the Board.

References

IPCC, 2014: Volume-Wide Frequently Asked Questions Final Draft. Summary for Policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Harris Water Engineering, 2015. Basin Implementation Plan, Southwest Basin Roundtable 4/17/2015.

Laura Belanger, P.E.

Water Resources and Environmental Engineer

Western Resource Advocates ▪ 2260 Baseline Road ▪ Suite 200 ▪ Boulder ▪ Colorado ▪ 80302
office: 720-763-3718 ▪ cell: 303-215-9122 ▪ email: laura@westernresources.org

EDUCATION

M.S. Civil Engineering, Water Resources/Environmental, University of Colorado, 2002
B.A. Social Thought and Political Economy, Minor in Political Science, University of Massachusetts, 1991.
Exchange Program, 1989 - 1990, University of Nairobi, Kenya

PROFESSIONAL LICENSURE AND MEMBERSHIPS

Registered Professional Engineer, State of Colorado
American Water Resources Association, Colorado Section
WateReuse Association, Secretary of Colorado Section
Colorado Lake and Reservoir Management Association

EMPLOYMENT HISTORY

2011 – Present Water Resources Engineer, Western Resource Advocates, CO
Engineer for a regional non-profit environmental law and policy organization with a mission to protect the West's land, air, and water. Complete hydrologic analyses to evaluate proposed water supply projects for environmental and related impacts. Develop alternative supply options to balance human and environmental needs. Provide modeling, technical analyses, testimony, and field work related to instream flow filings, energy development, river flow protection, and other environmental issues.

2008 – 2010 Water Resources Engineer, Headwaters Corporation, CO Engineer for the Platte River Recovery Implementation Program (PRRIP). Evaluated and advanced a variety of water projects to provide flows and improve habitats for four threatened and endangered species. Provided technical support to the PRRIP's Executive Director and Water Advisory Committee. Assisted other clients in developing and implementing comprehensive water conservation plans and compiling drought planning resources.

2002 – 2008 Water Resources and Environmental Engineer, Hydrosphere Resource Consultants, CO (firm acquired by AMEC in 2007) Engineer and project manager for water quality and biological field studies, environmental permitting and regulatory work, RiverWare surface water modeling, water conservation planning, and database development and management.

2000 – 2002 Graduate Research Assistant, Institute of Arctic and Alpine Research, CO. Examined spatial, temporal and ecological impacts of acid rock drainage in collaboration with a local stakeholders group. Planned and implemented water quality and biological monitoring and laboratory analysis of samples.

1999 – 2000 Graduate Research Assistant, Center for Advanced Decision Support in Water and Environmental Systems (CADSWES), CO. Developed engineering object code for RiverWare modeling software in response to client requirements. Documented, tested, debugged and integrated new code. Provided bilingual (English and Spanish) RiverWare user training.

1996 – 1998 Development/Marketing Coordinator, Alexandria Child and Family Network, VA. Secured $900,000 annual budget for non-profit which provides a free fully accredited preschool education to at-risk children and education and job training for parents. Expanded donor base, created agency's first fundraising event, directed board and volunteer committees, and assisted in the preparation of proposals and financial reports.

1993 – 1995 Agricultural Diversification Volunteer, United States Peace Corps, Guatemala. Collaborated with governmental and non-governmental organizations to educate and

encourage women's groups, farmers, families, and school children to improve nutrition while using safe and sustainable agricultural practices.

1991 – 1993 Development Assistant, Big Sister Association of Greater Boston, MA. Member of a two person fundraising team responsible for $500,000 annual budget. Organized annual fundraising events, generated direct mailings, assisted with grant applications, and created public relations materials.

DETAILED SKILLS BY PROJECT

RiverWare Modeling and Decision Support Systems

Flaming Gorge Pipeline Modeling, CO/UT/WY: Utilizing the U.S. Bureau of Reclamation's Colorado River Basin Study RiverWare model, incorporated a proposed pipeline that would divert water from the Flaming Gorge Reservoir to Colorado. Currently evaluating impacts on hydropower, Green River flows, and recreational metrics.

Green River MODSIM Model Development, UT: Member of the Green River Utah Water Acquisitions Team (GRUWAT) technical modeling workgroup. Work closely with the Utah Division of Water Resources, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, and The Nature Conservancy to assist in the development of a model to evaluate the impacts of depletions on recommended flows for endangered fish and to identify flow protection mechanisms.

Pecos River Decision Support System (PRDSS) Development, NM: Implemented numerous enhancements to the Pecos River RiverWare model, rulesets, database, and data analysis components of the PRDSS suite of models. Developed and provided PRDSS user trainings and accompanying documentation and user guides.

Pecos River Adjudication Settlement Negotiations and Litigation Support, NM: Provided technical support to the New Mexico Interstate Stream Commission (NMISC) as part of Adjudication Settlement negotiations and implementation. This included developing rules to represent Settlement Terms in the RiverWare model, scenario development, simulation, and analysis of model results for technical and non-technical stakeholders.

Carlsbad Project Water Operations and Water Supply Conservation EIS, NM: Assisted in the development of a daily rule-based model to simulate reservoir operations for irrigation, flood control, interstate compact deliveries and instream flows for the endangered Pecos Bluntnose Shiner (PBNS). Simulated Environmental Impact Statement (EIS) alternatives, reviewed technical data, developed and managed a processing and results database, participated in work groups, and prepared EIS documentation.

Pecos River Annual Accounting for PBNS Operations, NM: Designed an Excel-based tool to measure water depletions and exchanges resulting from U.S. Bureau of Reclamation operations to meet the constraints of the U.S. Fish and Wildlife Service Biological Opinion on the PBNS.

Simulation of Priority Administration in the Pecos River Basin, NM: Developed and implemented enhancements to the PRDSS to simulate impacts of priority administration on primary and supplemental groundwater pumping in the Carlsbad, NM area and on NM/TX Stateline flows.

Lower Colorado River Authority (LCRA) RiverWare Model Documentation and Training, TX: Developed ruleset documentation and user training materials for the Lower Colorado River RiverWare model and rulesets.

Pecos River Carlsbad Project Operations Long-Term Miscellaneous Purposes EIS, NM: Provided technical services to the NMISC including developing resource indicators for alternatives analysis, generating technical work plans, and reviewing and editing EIS documentation.

Water Supply and Water Rights Analysis

Front Range Colorado Municipal Reuse, CO: Managing project to encourage additional municipal water reuse to meet future demands. Research and compilation of existing and planned reusable supplies, existing reuse and analysis of additional potential reuse. Project will involve selection of prospect municipalities followed by direct outreach to them.

Filling the Gap in the Platte River Basin, WY: Evaluated municipal water supplies for existing, planned and additional reuse opportunities. Developed reuse potential estimate for inclusion in alternative supply portfolio designed to meet projected 2050 municipal and industrial demands.

A Better Future for the Poudre River: Alternative to the Northern Integrated Supply Project (NISP) Report, CO: Completed an in-depth review of demand projections and need for proposed project which would create two new reservoirs and divert critical peak flows from the Poudre and South Platte rivers. Developed alternative supply portfolio that meets needs of 15 towns and water districts while maintaining flows critical to the environment, local communities, and recreation.

Oil and Gas Development Water Requirement Analysis and Report, CO: Developed a range of water use estimates for new oil and gas development in Colorado. Completed analysis of alternative uses water could supply, evaluated localized impacts, and proposed recommendations to balance energy development with protecting water resources, public health, and the environment.

Filling the Gap Arkansas Basin Report, CO: Evaluated water supply portfolios for key water providers in Arkansas River Basin urban counties for existing, planned and additional reuse opportunities. Developed reuse potential estimate for inclusion in alternative supply portfolio designed to meet projected 2050 municipal and industrial demands.

PRRIP Water Action Plan Water Supply and Project Evaluation, NE: Developed operational models to estimate potential water supplies and projects' ability to release/retime return flows during periods of shortages to species target flows. Evaluated a variety of potential water projects including new off-channel reservoirs, leased water, conserved water, and groundwater recharge. Developed technical information for use in project selection, working closely with the PRRIP's Executive Director, Water Advisory Committee, and project workgroups.

Citizens for Dixie, UT: Worked for a citizens group to evaluate the need for a proposed pipeline. Reviewed existing resources for information on current and projected local water supplies, projected population growth, water quality, and per capita water use. Evaluation included converted agricultural and non-potable water supplies. Formulated alternative supply scenarios.

Wolf Creek Ski Area, CO: Evaluated hydrologic data to assess build out demand and supply projections for small ski area. Collected and reviewed water use, skier and snowmaking data. Determined existing and build out monthly and seasonal water use. Calculated available supplies at diversion points using flume, gage, and drainage area data.

AB Lateral Hydropower Facility Conditional Water Rights Evaluation, CO: Evaluated conditional water rights for availability to assess the economic feasibility of a proposed hydropower facility in the Gunnison River Basin. Reviewed technical documentation, historical data, and an Excel-based model to determine probable impacts of hydropower diversions on upstream water rights.

Review of Eldora Enterprises' Proposed Augmentation and Substitute Supply Plan, CO: Reviewed and analyzed methodologies used in the 1986 Colorado Ski Country USA Water Management Research Project Final Report to determine consumptive use during snowmaking. Assessed the reliability of applying Ski Country USA consumptive use values to the 2002 ski season at Eldora Mountain Resort.

Water Conservation and Drought Planning

Sterling Ranch Water Conservation Planning, CO: Worked with project manager to develop an extremely comprehensive and forward thinking water conservation plan for a proposed development in a water-limited area. 100% of new homes and landscaping would be water efficient under the plan, resulting in significantly less water use than traditional developments.

Drought Toolbox Report, CO: Researched, compiled and summarized existing drought planning resources and regulations from across the United States for the Colorado Water Conservation Board for use in develop similar requirements and guidance materials for Colorado.

Eagle River Water and Sanitation District Water Conservation Plan, CO: Initiated the development of a water conservation plan for the Vail area to address unique challenges associated with mountain resort communities.

North Table Mountain Water and Sanitation District Water Conservation Plan, CO: Project manager for an ongoing project to develop and implement a water conservation plan for a medium-sized utility in the

metro Denver area. Though the utility currently has sufficient water to meet demands, the plan will ensure that water supplies are used wisely and are sufficient to meet future demands.

Northglenn Water Conservation Plan, CO: Project manager for the development of the City of Northglenn's water conservation plan. Inventoried water supplies, water and wastewater systems, water use patterns and existing conservation measures. Worked closely with City staff to evaluate and select a variety of conservation measures and programs. Estimated water and financial savings and costs, and developed an implementation plan.

Energy Development and Regulatory/Environmental Processes

NSF Sustainability Research Network Air/Water/Gas Research Project: Member of the External Advisory Committee. Project mission is to provide a logical, science- based framework for evaluating the environmental, economic, and social trade-offs between development of natural gas resources and protection of water and air resources and to convey the results of these evaluations to the public in a way that improves the development of policies and regulations governing natural gas and oil development.

Colorado Water Watch Real-Time Groundwater Monitoring Pilot Project: Member of Technical Committee for real-time ground water monitoring system in proximity to significant hydraulic fracturing and oil and gas development activity in the Denver-Julesburg basin of northeast Colorado.

Colorado Oil and Gas Conservation Commission (COGCC) 2013 Rule 906 Spills and Releases Rulemaking Hearing: Reviewed proposed rules, alternative proposals, and statements from parties. Commented on draft rules, developed technical analysis of spills impacts, and provided written and oral hearing testimony.

Colorado Oil and Gas Conservation Commission (COGCC) 2012 Rule 609 Statewide Groundwater Baseline Sampling and Monitoring Rulemaking Hearing: Reviewed proposed rules, alternative proposals, and statements from parties. Commented on draft rules, worked on alternative proposals, and provided written testimony for the hearing.

Severy Creek Wetland and Ski Creek Restoration Project Environmental Assessment (EA), Pikes Peak National Forest CO: Prepared environmental documentation for the U.S. Forest Service to determine whether to prepare an EIS or a Finding of No Significant Impact for a restoration project. Responsibilities included EA scoping, data collection, biological and hydrologic evaluations, alternative development, and identification of mitigation measures to avoid and/or minimize environmental impacts.

Keystone Ski Area 2003 and 2008 Regulation 33 Rulemaking Hearings, CO: Assessed the scientific basis for, and potential impacts of, proposed changes in water-quality standards for tributary streams located within the Keystone Resort ski area. Developed a Use Attainability Analysis (UAA) for the 2008 process. Worked with the Colorado Water Quality Control Division and other agencies to create consensus on standards proposals.

Keystone Ski Area 2004 and 2008 Regulation 93 303(d) Listing Rulemaking Hearing, CO: Analyzed water quality data and factors influencing pH levels in ski area and other high elevation Colorado streams in response to a proposed listing on Colorado's 303(d) list of impaired water bodies for pH. Prepared hearing documentation summarizing findings on behalf of Keystone Ski Area.

Windy Gap Firming Project EIS, CO: Assembled existing reservoir water quality data from numerous sources, reviewed and formatted data for errors and consistency, and developed a water quality database. Evaluated water quality data against existing and proposed Colorado water quality standards. Prepared data for use in modeling water quality conditions in several reservoirs for possible future alternatives for the Windy Gap Firming Project EIS.

Eagle Mine Superfund Site Surface Water Quality Standards Development, CO: Evaluated hydrologic and water quality data for several stream segments of the Eagle River in Eagle County, Colorado. Assessed temporary and proposed water quality standards for their ability to protect aquatic life. Worked with client and stakeholders to develop standards proposals.

Eagle Park Reservoir Pump Back Operation and Reservoir Enlargement Assessment, CO: Developed a daily Excel-based model to evaluate river flows below the Eagle Park Reservoir for various hydrologic scenarios including a reservoir expansion and a pump back to divert water to the reservoir. Completed 1041 Permit amendment application.

Black Lake No. 1 Second Enlargement 1041 Permit Application, CO: Developed a 1041 Permit amendment application for a second Black Lake No. 1 enlargement to provide additional water to augment domestic, golf course, and snowmaking diversions.

Beard Creek Water Storage Tank 1041 Permit Application, CO: Developed a comprehensive assessment of the impacts of a proposed treated water storage tank to be located in Edwards, Colorado. Assisted the Upper Eagle Regional Water Authority with the preparation of necessary environmental permit applications including a 1041 application.

Vail Wastewater Treatment Plant Expansion and Upgrade, CO: Prepared an Environmental Impact Report for an upgrade and expansion to the Eagle River Water and Sanitation District's Vail wastewater facility and proposed co-located drinking water facility. Potential impacts to riparian areas, instream flows, and water quality were examined.

Vail Resorts Environmental Permitting, CO: Prepared Army Corps of Engineers 404 permit notification for the placement of fill to raise and flatten existing contours in the Golden Peak Terrain Park at Vail Ski Area. Prepared a request to amend an existing Minimal Industrial Discharge (MINDI) permit to include an additional wastewater source at the Vail Shop Yard.

Pueblo Reservoir Water Quality Model, CO: Ran multiple water quality simulations of Pueblo reservoir for a variety of alternatives being considered for an EA using LAKE2K.

Field Sampling and Data Analysis

Utah National Forest Road Impacts Study, UT: Lead on project designed to document road impacts on streams, aquatic life, and water quality standards. Data will be used to inform the Forest Service of roads requiring attention for use in travel system planning processes.

Rushing Rivers Crested Butte Stream gage Location Assessment, CO: Water rights and area assessment to determine location for new stream gage that will be used to monitor stream flow and if future attempts to increase flows to meet instream flow water right are successful.

Clinton Reservoir Baseline Water Quality Study, CO: Provide program oversight and training to consulting firm staff for this project to collect baseline water quality data from a reservoir with the potential to be impacted by renewed mining operations at the Climax molybdenum mine.

Lake DeSmet Baseline Water Quality Study, WY: Planned and managed a baseline water quality field study for a lake located near Buffalo, WY. The lake is a potential source of drinking water supplies and may be impacted by future development and coalbed methane production.

Study of Algal Communities and Water Quality in Gore Creek, CO: Planned and managed a multi-year algae and water quality study in response to concerns about a visible shift in algae species composition and abundance in a high altitude stream with a high recreational value.

Keystone Ski Area Water Quality Monitoring, CO: Responsible for ongoing water quality monitoring and data analysis to assess the impacts of snowmaking, drainage improvements, and other activities on ski area streams.

Vail Resort Water Quality Monitoring, CO: Provided water quality monitoring and data analysis to assess impacts of drainage improvements, snowmaking, and other activities on ski area streams.

Mariano Exchange Ditch System Assessment, CO: Designed and implemented a multi-year field study to assess a reservoir and exchange ditch system that contributes sediment and nutrients to the Big Thompson River. Project involved monitoring, data analysis, and mitigation recommendations.

International

E-Tech International *Aguinda v. ChevronTexaco* Litigation Support, Ecuador: Managed the development of a database for use by Amazon residents in litigation against Chevron for damages relating to a former concession. Gathered and reviewed existing reports and documents, designed and developed a Microsoft Access database to house environmental and related data, and ensured quality control of data. Managed Ecuadorian and U.S. staff.

Jalapa, Nicaragua Engineers Without Borders (EWB) Project, Nicaragua: Volunteer project manager for EWB-USA's Nicaragua program. Led an evaluation team in Nicaragua to assess several potential

projects. Met with community members, local government officials, and non-governmental organizations to gather data and secure community cooperation. Completed site reports and performed initial engineering calculations for projects including a gray water drainage system for 300 homes, two gravity driven potable water systems, and water storage tanks for a hospital and an elementary school.

Foutaka, Mali Engineers Without Borders Water and Sanitation Project, Mali: Member of a team that designed and implemented a rainwater catchment and drip irrigation system for the village of Foutaka Zambougou, Mali.

United States Peace Corps, Santa Lucía Utatlán, Sololá, Guatemala: Served as a Peace Corps volunteer working with governmental and non-governmental organizations, women's groups, farmers, families and school children. Encouraged sustainable agricultural practices and improved nutrition. Planted school and family gardens and small commercial plots. Developed nutrition and health workshops. Created an environmental education and reforestation project.

United Nations Centre for Human Settlements Intern, Nairobi, Kenya: Wrote and edited articles for several monthly shelter-related journals.

PUBLICATIONS AND PRESENTATIONS

Belanger, L. 2015. Colorado's Surface Waters and Sustainability: An Environmental Perspective. Groundwater Institute for Teachers. July 19, 2015. Greeley, CO

Belanger, L. 2014. Reuse as a Preferred Water Supply Option: An Environmental Perspective. One Water Innovations Media Workshop. September 28, 2014. New Orleans, LA

Belanger, L. 2014. The Vital Role of Reuse in Modern Water Management: The Colorado Water Plan Opportunity. WateReuse Workshop, August 14, 2014. Golden, CO

Belanger, L. 2014. Oil, Gas & Water: Addressing Water Quantity and Quality Concerns. Martz Summer Conference, June 5, 2014. Boulder, CO

Belanger, L. 2014. Panelist. Colorado West Slope Produced Water Beneficial Use Stakeholder Meeting. January 7, 2014. Grand Junction, CO

Belanger, L. 2014. Oil & Gas Facilities near Surface Waters: September 2013 Flooding Lessons Learned and Looking Ahead. Colorado Oil and Gas Conservation Commission Lessons Learned Workshop, February 6, 2014. Denver, CO

Belanger, L. 2014. *Oil, Gas and Water:* Colorado Groundwater Association Annual Meeting, August 15, 2013. Denver, CO

Belanger, L. 2013. *Oil, Gas and Water: Addressing Water, Community and Environmental Impacts*. Colorado Foundation for Water Education Energy-Water Tour, November 8, 2013. CO

Belanger, L. 2013. *Oil, Gas and Water: Addressing Water, Community and Groundwater Impacts*. Colorado Groundwater Association Annual Meeting, August 15, 2013. Denver, CO

Belanger, L. 2013. *Oil, Gas and Water: Measuring Water & Community Impacts from Hydraulic Fracturing* Panelist. Big Thompson Watershed Forum, February 28, 2012. Greeley, CO

Belanger, L. 2012. *A Better Future for the Poudre River: Alternative to the Northern Integrated Supply Project (NISP)* Report. December, 2012.

Belanger, L. 2012. *Finding a Way: Oil and Water* Panelist. South Platte Forum, October 26, 2012. Longmont, CO

Belanger, L. 2012. *Oil, Gas and Water: Measuring Water & Community Impacts from Hydraulic Fracturing in Colorado* Presentation. Sustaining Colorado Watersheds Conference, October 10, 2012. Avon, CO

Belanger, L., 2012. *Oil, Gas and Water: Measuring Water & Community Impacts from Hydraulic Fracturing in Colorado* Webinar. Western Interstate Energy Board, September, 21, 2012.

Belanger, L. 2012. *Oil, Gas and Water: Measuring Water & Community Impacts from Hydraulic Fracturing* Presentation. American Water Resources Association Colorado Section, August 28, 2012, Denver, CO

Belanger, L., 2012. *Fracking Our Future: Measuring Water & Community Impacts from Hydraulic Fracturing* Report. June 2012.

Figueroa, J., Gerstle, J., Belanger, L., Luecke, D., 2012. *Filling the Gap: Meeting Future Urban Water Needs in the Arkansas Basin* Report. March, 2012

Courtney, B., Belanger, L., 2010. *Adapting Water Conservation Programs, Examples from Two Different Water Providers: Sterling Ranch & North Table Mountain WSD* Presentation. Colorado Waterwise Annual Meeting, September 24, 2010, Denver, CO

Maest, A., Weaver, B., Belanger, L., 2009. *Elution and Transport of Contaminants from Metal-Rich Artificial Snow in Colorado* Poster. Geological Society of America Annual Meeting, October 18 - 21, 2009, Portland, OR

Barroll, P., Burke, P., Carron, J., Belanger, L., 2003. *Ft. Sumner Irrigation District Return Flow Calculations* Poster. New Mexico Symposium on Hydrologic Modeling, August 12, 2003, Socorro, NM

Boroughs, C., Carron, J., Belanger, L., Liu, B., 2003. *The Fish Rule: Modeling Pecos River Operational Policy to Achieve Target Flows for the Endangered Pecos Bluntnose Shiner*. New Mexico Symposium on Hydrologic Modeling, August 12, 2003, Socorro, NM