BEFORE THE COLORADO WATER CONSERVATION BOARD

STATE OF COLORADO

Prehearing Statement of Staff of the Colorado Water Conservation Board

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IN THE MATTER OF THE CWCB STAFF'S RECOMMENDATION FOR AN INSTREAM FLOW APPROPRIATION ON TROUT CREEK, WATER DIVISION 6

Pursuant to Rule 5n.(2) of the Rules Concerning the Colorado Instream Flow and Natural Lake Level Program, 2 CCR 408-2 ("ISF Rules"), the Staff of the Colorado Water Conservation Board ("Staff") hereby submits its prehearing statement in support of Staff's recommendation for an instream flow ("ISF") appropriation on the subject reach of Trout Creek in the amounts set forth below and in the attached memorandum (attached as **Exhibit 7**):

Waterbody	Watershed	County	Upper Terminus	Lower Terminus	Length (miles)	Flow Rate (cfs)
Trout Creek	Upper Yampa	Routt	confluence unnamed tributary at E: 323578.92 N: 4457645.23	Koll Ditch headgate at E: 329133.88 N: 4464276.41	6.64	2.0 (11/01 - 03/31) 8.0 (04/01 - 07/31) 7.0 (08/01 - 10/31)

A. FACTUAL CLAIMS

1) Based upon field surveys by the Bureau of Land Management ("BLM"), and other data collected or reviewed by Colorado Parks and Wildlife ("CPW") and CWCB Staff, there is a natural environment in the subject reach of Trout Creek, in Routt County.

2) The ISF rates recommended by Staff for the subject reach of Trout Creek:

a) are based upon standard scientific methodology and accurate R2Cross analyses;

b) consider the amount of water available for the ISF appropriation; and

c) will preserve the natural environment to a reasonable degree.

3) For the ISF water rights proposed by Staff:

(a) there is a natural environment in the subject reach of Trout Creek that will be preserved to a reasonable degree with the proposed water rights if granted;

(b) the natural environment will be preserved to a reasonable degree by the water available for the appropriation; and

(c) such environment can exist without material injury to water rights.

4) Staff reserves the right to supplement its factual claims at any time including in its Rebuttal Statement.

B. LEGAL CLAIMS

1) All of the procedural requirements of Rule 5 of the ISF Rules have been met in order for the CWCB to issue a final action on the proposed instream flow rights.

2) ISF Rule 5j.(3) provides that "[i]n a hearing on a contested ISF appropriation, a Party may raise only those issues relevant to the statutory determinations required by section 37-92-102(3)(c), C.R.S., and the required findings in Rule 5i." The required findings are: (1) that there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted; (2) that the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made; and (3) that such environment can exist without material injury to water rights. Staff maintains that the facts support making these determinations.

3) The proposed ISF water rights cannot call out senior water rights within or upstream of the ISF reach, and because the ISF water rights will not consume any water, they will not injure downstream senior water rights. Therefore, the ISF water rights will not materially injure water rights. Additionally, the ISF water rights are subject to present uses or exchanges of water being made by other water users pursuant to appropriation or practices in existence on the date of these ISF appropriations, whether or not previously confirmed by court order or decree. § 37-92-102(3)(b), C.R.S.

Staff reserves the right to supplement its legal claims at any time including in its Rebuttal Statement.

C. EXHIBITS TO BE INTRODUCED AT HEARING

1) March 3, 2018, Notice to the ISF Subscription Mailing List, indicating that a reach of Trout Creek may be considered for an instream flow appropriation at the January 2019 CWCB Board meeting, attached as **Exhibit 1**.

2) March 9, 2018, Memorandum from Jeff Baessler and Rob Viehl to the CWCB, Agenda Item 15, outlining 72 ISF recommendations being noticed and processed by Staff for possible inclusion into the Instream Flow and Natural Lake Level Program in 2019, including the subject reach of Trout Creek, attached as **Exhibit 2**.

3) November 9, 2018, Notice to the ISF Subscription Mailing List, indicating that a reach of Trout Creek may be considered for an ISF appropriation at the January 2019 CWCB Board meeting, attached as **Exhibit 3**.

4) November 14-15, 2018, Memorandum from Rob Viehl to the CWCB, Agenda Item 7, indicating that a reach of Trout Creek may be considered for an ISF appropriation at the January 2019 CWCB Board meeting, attached as **Exhibit 4**.

5) Letter from the BLM dated December 19, 2018, recommending an ISF appropriation on Trout Creek along with supporting field data, photographs, maps, and a preliminary water availability analysis, attached as **Exhibit 5**.

6) Staff executive summary containing the written recommendation for the ISF appropriation on Trout Creek, attached as **Exhibit 6**.

7) January 18, 2019, Memorandum from Linda Bassi and Rob Viehl to the CWCB, Agenda Item 22, containing a tabular list of the geographical locations and associated flow rates for the segment of the proposed Trout Creek ISF and Staff's request that the Board form its intent to appropriate, attached as **Exhibit 7**.

8) February 4, 2019, Notice to the ISF Subscription Mailing List, indicating that the CWCB declared its intent to appropriate an ISF water right on a reach of Trout Creek at the January 2019 CWCB meeting, attached as **Exhibit 8**.

9) April 4, 2019, Notice to the ISF Subscription Mailing List, indicating that a notice to contest the Trout Creek ISF appropriation had been filed, attached as **Exhibit 9**.

10) Colorado Water Conservation Board *Rules Concerning the Colorado Instream Flow and Natural Lake Level Program,* attached as **Exhibit 10**.

11) Gregory D. Espegren, *Development of Instream Flow Recommendations in Colorado Using R2Cross*, January 1996, attached as **Exhibit 11**.

12) Gregory D. Espegren, *Development of Instream Flow Recommendations in Colorado Using R2Cross for Microsoft Excel*, June 2006 attached as **Exhibit12**.

13) Prehearing Statement of Staff of the Colorado Water Conservation Board dated September 3, 2019.

14) Any Rebuttal Statement of Staff.

15) Staff may introduce demonstrative, rebuttal, or other exhibits as allowed by the Hearing Officer, the CWCB, or agreed upon by the Parties.

16) Staff may rely on any exhibits introduced or disclosed by any other party to this hearing.

D. WITNESSES

1) Linda Bassi, Section Chief of the CWCB Stream and Lake Protection Section (resume provided upon request). Ms. Bassi may testify on policies and issues related to the Instream Flow Program.

2) Kathryn Birch, Physical Scientist and Instream Flow Coordinator for the CPW (resume provided upon request). Ms. Birch will testify generally on how the CPW conducts R2Cross analyses as a basis for ISF recommendations, and specifically on the R2Cross analyses and other biological bases for the subject ISF appropriation. Ms. Birch may offer opinion and factual testimony.

3) Jack Landers, Hydrographer for the CWCB Stream and Lake Protection Section (resume provided upon request). Mr. Landers will testify on stream measurements and field investigations on Trout Creek. Mr. Landers may offer opinion and factual testimony.

4) Brandy Logan, Hydrologist for the CWCB (resume provided upon request). Ms. Logan will testify on how she conducted the water availability analysis for the subject ISF recommendation. Ms. Logan may offer opinion and factual testimony.

5) Roy Smith, Water Rights and Instream Flow Coordinator for the BLM (resume provided upon request). Mr. Smith will testify generally on how the BLM conducts R2Cross analyses as a basis for ISF recommendations, and specifically on the R2Cross analyses and other biological bases for the subject ISF appropriation. Mr. Smith may offer opinion and factual testimony.

6) Robert Viehl, Water Resource Specialist for the CWCB Stream and Lake Protection Section (resume provided upon request). Mr. Viehl will testify on how the CWCB staff formulates the basis for its recommendations. Mr. Viehl may offer opinion and factual testimony.

7) Staff may call any witness identified by any other party to this hearing.

E. WRITTEN TESTIMONY

Staff is not submitting written testimony with its prehearing statement, but reserves the right to submit written testimony along with its rebuttal statement.

F. Legal Memoranda

Staff is not submitting legal memoranda with this prehearing statement, but reserves the right to submit legal memoranda along with its rebuttal statement.

Dated this 3rd day of September, 2019

PHIL WEISER
Attorney General

/s/ *Andrew B. Nicewicz*

ANDREW B. NICEWICZ,* # 44903
Assistant Attorney General
Natural Resources and Environment Section
Attorneys for the Staff of the Colorado Water Conservation Board
*Counsel of Record

Certificate of Service

Contested CWCB ISF Appropriation on Trout Creek

I hereby certify that I have duly served the copies of the foregoing **PREHEARING STATEMENT OF THE STAFF OF THE COLORADO WATER CONSERVATION BOARD** upon all parties herein by email, this 3rd day of September 2019, addressed as follows:

Hearing Officer

Amy Beatie Deputy Attorney General Natural Resources & Environment Section Office of the Colorado Attorney General 1300 Broadway, 7th Floor Denver, Colorado 80203 720-508-6296 Amy.Beatie@coag.gov

Party Status

Staff of the Colorado Water Conservation Board Linda Bassi Rob Viehl Colorado Water Conservation Board 1313 Sherman Street, Room 718 Denver, CO 80203 303-866-3441 ext. 3204 linda.bassi@state.co.us rob.viehl@state.co.us	Counsel for Staff of the Colorado Water Conservation Board Jen Mele First Assistant Attorney General Andy Nicewicz Assistant Attorney General Natural Resources & Environment Section Office of the Colorado Attorney General 1300 Broadway, 7th Floor Denver, CO 80203 720-508-6259 jennifer.mele@coag.gov andy.nicewicz@coag.gov
Bureau of Land Management Roy Smith DOI, BLM, Colorado State Office 2850 Youngfield Street Lakewood, CO 80215-7093 303-239-3940 r20smith@blm.gov	Knott Land and Livestock Company, Inc. Kent Holsinger Alyson Meyer Gould Holsinger Law, LLC 1800 Glenarm Place, Suite 500 Denver, CO 80202 kholsinger@holsingerlaw.com agould@holsingerlaw.com

Twentymile Coal, LLC William H. Caile Mark E. Hamilton Holland & Hart, LLP 555 17th Street, Suite 3200 P.O. Box 8749 Denver, CO 80201-8749 whcaile@hollandhart.com mehamilton@hollandhart.com	

/s/Andrew B. Nicewicz

Exhibit 1

COLORADO
Colorado Water
Conservation Board
Department of Natural Resources

1313 Sherman Street, Room 718, Denver, Colorado 80203
Phone: (303) 866-3441 * Fax: (303) 866-4474
www.cwcb.state.co.us

Pursuant to ISF Rule 5c. of the Rules Concerning the Colorado Instream Flow and Natural Lake Level Program, this notice identifies the streams to be considered for instream flow (ISF) appropriations in 2019. At the January meeting of the Colorado Water Conservation Board (CWCB), staff may request that the Board form its intent to appropriate instream flow water rights for the streams listed on the attached Instream Flow Appropriation List. The attached list contains a description of the Instream Flow Recommendations including stream name, watershed, county, length, upper terminus, and lower terminus.

Copies of the Instream Flow Recommendations and Appendices of data submitted into the Official CWCB Record are available for review by the public during regular business hours (8:00 a.m. - 5:00 p.m.) at the Colorado Water Conservation Board's Office, located at 1313 Sherman Street, Room 718, Denver, Colorado, 80203. In addition to the CWCB office, copies of the Instream Flow Recommendations are available online at:

http://cwcb.state.co.us/environment/instream-flow-program/Pages/2019ProposedISFRecommendations.aspx

In addition to the above Instream Flow Recommendations and Appendices, staff may rely on any additional data, exhibits, testimony, or other information submitted by any party as part of the Official CWCB Record to support its Instream Flow and Natural Lake Level Recommendations.

It should also be noted that, pursuant to the ISF Rules:

5d. (3)
(a) The Board may change flow amounts of contested ISF appropriations based on information received during the public notice and comment period.

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

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

(d) Any Notice to Contest must be received at the Board office no later than March 31, 2019, or the first business day thereafter. All Notices of Party status and Contested Hearing Participant status must be received at the Board office no later than April 30, 2019 or the first business day thereafter.

(e) Staff will announce its Final Staff ISF Recommendation concerning contested appropriations at the September 2019 Board meeting and will send notice of the Final Staff Recommendation to all persons on the Contested Hearing Mailing List.

(f) The Board may take final action on any uncontested ISF appropriations at the May 2019 Board meeting.

The schedule set forth in (d), (e), and (f) above will apply to streams on which the CWCB declares its intent to appropriate water rights in January 2019. Should you wish to comment on any proposed Instream Flow Recommendations, you may do so by writing Rob Viehl of the Board's staff at the address given above or by sending your comments by email to rob.viehl@state.co.us. It should be noted that while your appearance at any meeting is welcome, such an appearance is not necessary for your concerns to be recognized. Staff will take your comments into account and, if you so request, will present them to the Board in your absence. If you are not currently on the Board's Instream Flow Subscription Mailing List and you would like to be, please contact the Board's Office at the address given above.

Instream Flow Recommendations 2019

Div	Stream	Watershed	County	Length (miles)	Upper Terminus	Lower Terminus
1	Coal Creek	St. Vrain	Boulder	6.00	Boundary of Open Space	confl Wastewater Outfall
1	Coal Creek	St. Vrain	Boulder	1.72	confl Wastewater Outfall	confl Lafayette PS no. 2
1	Indian Creek	Upper South Platte	Park	2.74	headwaters	confl Willow Gulch
1	McCurdy Creek	Upper South Platte	Park	3.37	headwaters	confl Lost Creek
1	North Fork Little Thompson River	Big Thompson	Larimer	11.9	headwaters	confl Little Thompson River
1	Platte Gulch	South Platte Headwaters	Park	1.54	headwaters	confl MF South Platte River
1	Spring Canyon	Cache La Poudre	Larimer	2.40	headwaters	confl Horsetooth Reservoir
1	Sulzer Gulch	Big Thompson	Larimer	3.73	headwaters	confl Big Thompson River
1	Unnamed Tributary to Duck Creek	Upper South Platte	Clear Creek	1.08	outlet of Lower Square Top Lake	inlet of Duck Lake
2	Baker Creek	Huerfano	Huerfano	2.13	headwaters	Forest Service boundary
2	Beaver Creek	Upper Arkansas	Fremont	8.91	confl East Beaver Creek	confl unnamed tributary
2	Bonnett Creek	Huerfano	Huerfano	4.05	headwaters	confl Cucharas River

Div	Stream	Watershed	County	Length (miles)	Upper Terminus	Lower Terminus
2	Cucharas Creek	Huerfano	Huerfano	0.60	Highway 12 Bridge	confl SF Cucharas Creek
2	Cucharas River	Huerfano	Huerfano	16.0	confl Cucharas Creek & SF Cucharas River	confl Middle Creek
2	Cucharas River	Huerfano	Huerfano	3.71	confl Middle Creek	confl Wahatoya Creek
2	Indian Creek	Huerfano	Huerfano	9.25	headwaters	confl Middle Creek
2	Stout Creek*	Arkansas Headwaters	Fremont	0.69	BLM/USFS Property Boundary	Woods Pasture Ditch hdgt
2	Wahatoya Creek	Huerfano	Huerfano	13.1	headwaters	confl Cucharas River
2	West Beaver Creek	Upper Arkansas	Fremont Teller	7.49	confl Douglas Gulch	confl East Beaver Creek
3	Carnero Creek*	Saguache	Saguache	9.81	confl SF & MF Carnero Creeks	confl Mogotas Arroyo
3	Cave Creek*	Saguache	Saguache	6.32	headwaters	confl SF Carnero Creek
3	Lost Cabin Creek*	Saguache	Saguache	3.00	headwaters	confl MF Carnero Creek
3	Mann Creek*	Saguache	Saguache	3.29	outlet of Mexican Park Lake	confl NF Carnero Creek
3	Middle Fork Carnero Creek*	Saguache	Saguache	9.83	headwaters	confl SF Carnero Creek
3	North Fork Carnero Creek*	Saguache	Saguache	5.23	headwaters	confl Royal Gulch
3	Oso Creek*	Saguache	Saguache	3.55	headwaters	confl SF Carbero Creek
3	Poso Creek*	Saguache	Saguache	2.35	headwaters	confl SF Carnero Creek
3	Sawlog Creek*	Saguache	Saguache	3.44	headwaters	confl NF Carnero Creek
3	South Fork Carnero Creek *(Increase)**	Saguache	Saguache	12.5	headwaters	confl MF Carnero Creek
4	Cold Spring Creek*	Tomichi	Saguache	1.23	Amalla Spring	confl Pauline Creek
4	Cottonwood Creek *(Increase)*	Lower Gunnison	Delta Montrose	23.3	Hawkins Ditch hdgt	confl Roubideau Creek

Div	Stream	Watershed	County	Length (miles)	Upper Terminus	Lower Terminus
4	Cow Creek	Uncompahgre	Ouray	11.8	USFS Property Boundary	confl Uncompahgre River
4	East Fork Little Cimarron River*	Upper Gunnison	Gunnison	6.45	headwaters	confl Little Cimarron River
4	Gold Creek* *(Increase)*	Tomichi	Gunnison	10.3	headwaters	Tarkington Ditch hdgt
4	Gold Creek*	Tomichi	Gunnison	0.45	Tarkington Ditch hdgt	confl Quartz Creek
4	Kelso Creek	Lower Gunnison	Mesa	9.89	headwaters	confl Bear Gulch
4	Little Cimarron River *(Increase)*	Upper Gunnison	Gunnison	2.49	confl Van Boxel Creek	Butte Ditch hdgt
4	Little Cimarron River	Upper Gunnison	Gunnison Montrose	6.56	Butte Ditch hdgt	confl Cimarron River
4	Monitor Creek	Lower Gunnison	Montrose	9.44	USFS Property Boundary	confl Potter Creek
4	Naturita Creek* *(Increase)*	San Miguel	San Miguel	11.0	headwaters	Norwood Road Crossing
4	Naturita Creek*	San Miguel	Montrose San Miguel	16.5	Norwood Road Crossing	confl San Miguel River
4	Potter Creek *(Increase)*	Lower Gunnison	Montrose	9.82	USFS Property Boundary	confl Roubideau Creek
4	Spring Creek	San Miguel	Montrose	12.4	headwaters	confl Tabeguache Creek
6	Marvine Creek	Upper White	Rio Blanco	7.10	outlet of Lower Marvine Lake	confl West Marvine Creek
6	Milk Creek	Lower Yampa	Moffat	4.11	confl Wilson Creek	confl Yampa River
6	Morapos Creek*	Upper Yampa	Moffat Rio Blanco	26.2	headwaters	confl Williams Fork
6	North Fork White River	Upper White	Rio Blanco	8.33	Flat Tops Wilderness Area Boundary	confl Ripple Creek
6	Pagoda Creek*	Upper Yampa	Rio Blanco	10.3	headwaters	confl SF Williams Fork
6	Piceance Creek	Piceance-Yellow	Garfield Rio Blanco	6.93	headwaters	confl. unnamed tributary
6	Piceance Creek	Piceance-Yellow	Rio Blanco	3.83	confl. unnamed tributary	confl. Cow Creek

Div	Stream	Watershed	County	Length (miles)	Upper Terminus	Lower Terminus
6	Rough Creek*	Upper Yampa	Rio Blanco	4.93	headwaters	confl Poose Creek
6	South Fork White River	Upper White	Rio Blanco	8.07	Flat Tops Wilderness Area Boundary	confl Swede Creek
6	South Fork Williams Fork*	Upper Yampa	Rio Blanco	8.06	headwaters	confl Pagoda Creek
6	South Fork Williams Fork*	Upper Yampa	Routt	4.67	confl Beaver Creek	confl Williams Fork
6	Trout Creek* *(Increase)*	Upper Yampa	Rio Blanco	7.45	confl unnamed tributary	confl Little Trout Creek
6	Waddle Creek*	Upper Yampa	Moffat	10.8	headwaters	confl Williams Fork
6	Watson Creek*	Upper Yampa	Routt	5.86	confl Moody Creek	Hardscrabble Ditch hdgt
6	West Marvine Creek	Upper White	Rio Blanco	9.45	headwaters	confl Marvine Creek
6	Williams Fork*	Upper Yampa	Moffat	8.25	confl Morapos Creek	confl Yampa River
7	Burnett Creek*	Upper Dolores	Dolores	3.35	headwaters	confl Dolores River
7	Disappointment Creek	Upper Dolores	Dolores	21.7	confl Morrison Creek	historic USGS
7	Disappointment Creek	Upper Dolores	Dolores San Miguel	37.8	historic USGS	confl Dolores River
7	Grasshopper Creek*	Animas	La Plata	4.48	headwaters	confl Animas River
7	Little Taylor Creek	Upper Dolores	Montezuma	3.92	headwaters	confl Taylor Creek
7	Marguerite Creek*	Upper Dolores	Dolores	2.09	headwaters	confl Dolores River
7	Rincon La Vaca Creek	Upper San Juan	Hinsdale	4.47	headwaters	confl Los Pinos River
7	Rio Lado	Upper Dolores	Montezuma	3.30	headwaters	confl Dolores River
7	Ryman Creek	Upper Dolores	Montezuma	4.31	headwaters	confl Dolores River
7	Tenderfoot Creek	Upper Dolores	Dolores Montezuma	2.99	headwaters	confl Dolores River
7	Vallecito Creek	Upper San Juan	La Plata San Juan	17.2	Natural Outlet of Vallecito Lake	Wilderness boundary
7	Wildcat Creek *(Increase)*	Upper Dolores	Dolores Montezuma	4.86	headwaters	confl Dolores River

*Recommendation received in 2018

Exhibit 2

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

1313 Sherman Street
Denver, CO 80203

P (303) 866-3441
F (303) 866-4474

John Hickenlooper, Governor

Robert Randall, DNR Executive Director

Rebecca Mitchell, CWCB Director

TO: Colorado Water Conservation Board Members

FROM: Rob Viehl, Water Resource Specialist
Jeff Baessler, Deputy Section Chief
Stream and Lake Protection Section

DATE: March 9, 2018

AGENDA ITEM: 15. Notice of Instream Flow Recommendations for 2019

Background and Staff Recommendation

Pursuant to Rule 5c. of the Rules Concerning the Colorado Instream Flow (ISF) and Natural Lake Level Program ("ISF Rules"), Staff is providing notice that the following 72 stream segments have been recommended for instream flow (ISF) appropriations in 2019. At the January 2019 CWCB meeting, Staff may request that the Board form its intent to appropriate ISF water rights on these streams.

Please note that the list below includes 29 new recommendations (identified with an *) and 43 recommendations that Staff received in previous years. Staff has not yet moved the older recommendations forward due to the need for additional scientific data and/or ongoing attempts to address stakeholder issues. In 2019, Staff will recommend that the Board move forward on the recommendations for which Staff is able to reasonably address all outstanding issues. Staff is currently working with the recommending entities to further prioritize this list of recommendations.

Detailed information regarding these stream segments is also available on the CWCB website located at: http://cwcb.state.co.us/environment/instream-flow-program/Pages/2019ProposedISFRecommendations.aspx

This is an informational item with no Board action required.

Div	Stream	Watershed	County	Length (miles)	Upper Terminus	Lower Terminus
1	Coal Creek	St. Vrain	Boulder	6.00	Boundary of Open Space	confl Wastewater Outfall
1	Coal Creek	St. Vrain	Boulder	1.72	confl Wastewater Outfall	confl Lafayette PS no. 2
1	Indian Creek	Upper South Platte	Park	2.74	headwaters	confl Willow Gulch

Div	Stream	Watershed	County	Length (miles)	Upper Terminus	Lower Terminus
1	McCurdy Creek	Upper South Platte	Park	3.37	headwaters	confl Lost Creek
1	North Fork Little Thompson River	Big Thompson	Larimer	11.9	headwaters	confl Little Thompson River
1	Platte Gulch	South Platte Headwaters	Park	1.54	headwaters	confl MF South Platte River
1	Spring Canyon	Cache La Poudre	Larimer	2.40	headwaters	confl Horsetooth Reservoir
1	Sulzer Gulch	Big Thompson	Larimer	3.73	headwaters	confl Big Thompson River
1	Unnamed Tributary to Duck Creek	Upper South Platte	Clear Creek	1.08	outlet of Lower Square Top Lake	inlet of Duck Lake
2	Baker Creek	Huerfano	Huerfano	2.13	headwaters	Forest Service boundary
2	Beaver Creek	Upper Arkansas	Fremont	8.91	confl East Beaver Creek	confl unnamed tributary
2	Bonnett Creek	Huerfano	Huerfano	4.05	headwaters	confl Cucharas River
2	Cucharas Creek	Huerfano	Huerfano	0.60	Highway 12 Bridge	confl SF Cucharas Creek
2	Cucharas River	Huerfano	Huerfano	16.0	confl Cucharas Creek & SF Cucharas River	confl Middle Creek
2	Cucharas River	Huerfano	Huerfano	3.71	confl Middle Creek	confl Wahatoya Creek
2	Indian Creek	Huerfano	Huerfano	9.25	headwaters	confl Middle Creek
2	Stout Creek*	Arkansas Headwaters	Fremont	0.69	BLM/USFS Property Boundary	Woods Pasture Ditch hdgt
2	Wahatoya Creek	Huerfano	Huerfano	13.1	headwaters	confl Cucharas River
2	West Beaver Creek	Upper Arkansas	Fremont Teller	7.49	confl Douglas Gulch	confl East Beaver Creek
3	Carnero Creek*	Saguache	Saguache	9.81	confl SF & MF Carnero Creeks	confl Mogotas Arroyo
3	Cave Creek*	Saguache	Saguache	6.32	headwaters	confl SF Carnero Creek
3	Lost Cabin Creek*	Saguache	Saguache	3.00	headwaters	confl MF Carnero Creek

Div	Stream	Watershed	County	Length (miles)	Upper Terminus	Lower Terminus
3	Mann Creek*	Saguache	Saguache	3.29	outlet of Mexican Park Lake	confl NF Carnero Creek
3	Middle Fork Carnero Creek*	Saguache	Saguache	9.83	headwaters	confl SF Carnero Creek
3	North Fork Carnero Creek*	Saguache	Saguache	5.23	headwaters	confl Royal Gulch
3	Oso Creek*	Saguache	Saguache	3.55	headwaters	confl SF Carbero Creek
3	Poso Creek*	Saguache	Saguache	2.35	headwaters	confl SF Carnero Creek
3	Sawlog Creek*	Saguache	Saguache	3.44	headwaters	confl NF Carnero Creek
3	South Fork Carnero Creek *(Increase)**	Saguache	Saguache	12.5	headwaters	confl MF Carnero Creek
4	Cold Spring Creek*	Tomichi	Saguache	1.23	Amalla Spring	confl Pauline Creek
4	Cottonwood Creek *(Increase)*	Lower Gunnison	Delta Montrose	23.3	Hawkins Ditch hdgt	confl Roubideau Creek
4	Cow Creek	Uncompahgre	Ouray	11.8	USFS Property Boundary	confl Uncompahgre River
4	East Fork Little Cimarron River*	Upper Gunnison	Gunnison	6.45	headwaters	confl Little Cimarron River
4	Gold Creek* *(Increase)*	Tomichi	Gunnison	10.3	headwaters	Tarkington Ditch hdgt
4	Gold Creek*	Tomichi	Gunnison	0.45	Tarkington Ditch hdgt	confl Quartz Creek
4	Kelso Creek	Lower Gunnison	Mesa	9.89	headwaters	confl Bear Gulch
4	Little Cimarron River *(Increase)*	Upper Gunnison	Gunnison	2.49	confl Van Boxel Creek	Butte Ditch hdgt
4	Little Cimarron River	Upper Gunnison	Gunnison Montrose	6.56	Butte Ditch hdgt	confl Cimarron River
4	Monitor Creek	Lower Gunnison	Montrose	9.44	USFS Property Boundary	confl Potter Creek
4	Naturita Creek* *(Increase)*	San Miguel	San Miguel	11.0	headwaters	Norwood Road Crossing
4	Naturita Creek*	San Miguel	Montrose San Miguel	16.5	Norwood Road Crossing	confl San Miguel River

Div	Stream	Watershed	County	Length (miles)	Upper Terminus	Lower Terminus
4	Potter Creek *(Increase)*	Lower Gunnison	Montrose	9.82	USFS Property Boundary	confl Roubideau Creek
4	Spring Creek	San Miguel	Montrose	12.4	headwaters	confl Tabeguache Creek
6	Marvine Creek	Upper White	Rio Blanco	7.10	outlet of Lower Marvine Lake	confl West Marvine Creek
6	Milk Creek	Lower Yampa	Moffat	4.11	confl Wilson Creek	confl Yampa River
6	Morapos Creek*	Upper Yampa	Moffat Rio Blanco	26.2	headwaters	confl Williams Fork
6	North Fork White River	Upper White	Rio Blanco	8.33	Flat Tops Wilderness Area Boundary	confl Ripple Creek
6	Pagoda Creek*	Upper Yampa	Rio Blanco	10.3	headwaters	confl SF Williams Fork
6	Piceance Creek	Piceance-Yellow	Garfield Rio Blanco	6.93	headwaters	confl. unnamed tributary
6	Piceance Creek	Piceance-Yellow	Rio Blanco	3.83	confl. unnamed tributary	confl. Cow Creek
6	Rough Creek*	Upper Yampa	Rio Blanco	4.93	headwaters	confl Poose Creek
6	South Fork White River	Upper White	Rio Blanco	8.07	Flat Tops Wilderness Area Boundary	confl Swede Creek
6	South Fork Williams Fork*	Upper Yampa	Rio Blanco	8.06	headwaters	confl Pagoda Creek
6	South Fork Williams Fork*	Upper Yampa	Routt	4.67	confl Beaver Creek	confl Williams Fork
6	Trout Creek* *(Increase)*	Upper Yampa	Rio Blanco	7.45	confl unnamed tributary	confl Little Trout Creek
6	Waddle Creek*	Upper Yampa	Moffat	10.8	headwaters	confl Williams Fork
6	Watson Creek*	Upper Yampa	Routt	5.86	confl Moody Creek	Hardscrabble Ditch hdgt
6	West Marvine Creek	Upper White	Rio Blanco	9.45	headwaters	confl Marvine Creek
6	Williams Fork*	Upper Yampa	Moffat	8.25	confl Morapos Creek	confl Yampa River
7	Burnett Creek*	Upper Dolores	Dolores	3.35	headwaters	confl Dolores River
7	Disappointment Creek	Upper Dolores	Dolores	21.7	confl Morrison Creek	historic USGS
7	Disappointment Creek	Upper Dolores	Dolores San Miguel	37.8	historic USGS	confl Dolores River

Div	Stream	Watershed	County	Length (miles)	Upper Terminus	Lower Terminus
7	Grasshopper Creek*	Animas	La Plata	4.48	headwaters	confl Animas River
7	Little Taylor Creek	Upper Dolores	Montezuma	3.92	headwaters	confl Taylor Creek
7	Marguerite Creek*	Upper Dolores	Dolores	2.09	headwaters	confl Dolores River
7	Rincon La Vaca Creek	Upper San Juan	Hinsdale	4.47	headwaters	confl Los Pinos River
7	Rio Lado	Upper Dolores	Montezuma	3.30	headwaters	confl Dolores River
7	Ryman Creek	Upper Dolores	Montezuma	4.31	headwaters	confl Dolores River
7	Tenderfoot Creek	Upper Dolores	Dolores Montezuma	2.99	headwaters	confl Dolores River
7	Vallecito Creek	Upper San Juan	La Plata San Juan	17.2	Natural Outlet of Vallecito Lake	Wilderness boundary
7	Wildcat Creek *(Increase)*	Upper Dolores	Dolores Montezuma	4.86	headwaters	confl Dolores River

*Recommendation received in 2018

Exhibit 3

COLORADO
Colorado Water
Conservation Board
Department of Natural Resources

1313 Sherman Street, Room 718, Denver, Colorado 80203
Phone: (303) 866-3441 * Fax: (303) 866-4474
www.cwcb.state.co.us

Pursuant to ISF Rule 5c. of the Rules Concerning the Colorado Instream Flow and Natural Lake Level Program, this notice identifies the streams to be considered for instream flow (ISF) appropriations in 2019. At the January meeting of the Colorado Water Conservation Board (CWCB), staff may request that the Board form its intent to appropriate ISF water rights for the streams listed on the Instream Flow Recommendation List below.

The ISF Recommendations and Appendices of data submitted into the Official CWCB Record are available for review by the public during regular business hours (8:00 a.m. - 5:00 p.m.) at the Colorado Water Conservation Board's office, located at 1313 Sherman Street, Room 718, Denver, Colorado, 80203. This information is also available online at:

http://cwcb.state.co.us/environment/instream-flow-program/Pages/2019ProposedISFRecommendations.aspx

In addition to the ISF Recommendations and Appendices, staff may rely on any additional data, exhibits, testimony, or other information submitted by any party as part of the Official CWCB Record to support the ISF Recommendations.

It should also be noted that, pursuant to the ISF Rules:

5d. (3)
(a) The Board may change flow amounts of contested ISF appropriations based on information received during the public notice and comment period.

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

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

(d) Any Notice to Contest must be received at the Board office no later than March 31, 2019, or the first business day thereafter. All Notices of Party status and Contested Hearing Participant status must be received at the Board office no later than April 30, 2019 or the first business day thereafter.

(e) Staff will announce its Final Staff ISF Recommendation concerning contested appropriations at the September 2019 Board meeting and will send notice of the Final Staff Recommendation to all persons on the Contested Hearing Mailing List.

(f) The Board may take final action on any uncontested ISF appropriations at the May 2019 Board meeting.

The schedule set forth in (d), (e), and (f) above will apply to streams on which the CWCB declares its intent to appropriate water rights in January 2019. Should you wish to comment on any proposed ISF Recommendation, you may do so by writing Rob Viehl of the Board's staff at the address given above or by sending your comments by email to rob.viehl@state.co.us. It should be noted that while your appearance at any meeting is welcome, such an appearance is not necessary for your concerns to be recognized. Staff will take your comments into account and, if you so request, will present them to the Board in your absence. If you are not currently on the Board's ISF Subscription Mailing List and you would like to be, please contact the Board's office at the address given above.

January 2019 Instream Flow Recommendations List

Water Div	Stream	Watershed	County	Length (miles)	Upper Terminus	Lower Terminus
2	Baker Creek	Huerfano	Huerfano	2.13	headwaters	Forest Service boundary
2	Bonnett Creek	Huerfano	Huerfano	4.05	headwaters	confl. Cucharas River
2	Stout Creek	Arkansas Headwaters	Fremont	0.69	BLM/USFS Property Boundary	Woods Pasture Ditch hdgt.
3	Carnero Creek	Saguache	Saguache	9.81	confl. SF & MF Carnero Creeks	confl. Mogotas Arroyo
3	Cave Creek	Saguache	Saguache	6.32	headwaters	confl. SF Carnero Creek
3	Middle Fork Carnero Creek	Saguache	Saguache	4.78	headwaters	confl. Lost Cabin Creek
3	Middle Fork Carnero Creek	Saguache	Saguache	4.46	confl. Lost Cabin Creek	confl. SF Carnero Creek
4	Cold Spring Creek	Tomichi	Saguache	1.23	Amalla Spring	confl. Pauline Creek
4	East Fork Little Cimarron River	Upper Gunnison	Gunnison	6.45	headwaters	confl. Little Cimarron River
4	Gold Creek *(Increase)*	Tomichi	Gunnison	10.32	headwaters	Tarkington Ditch hdgt.
4	Gold Creek	Tomichi	Gunnison	0.45	Tarkington Ditch hdgt	confl. Quartz Creek
6	Marvine Creek	Upper White	Rio Blanco	6.08	outlet of Lower Marvine Lake	confl. East Marvine Creek

6	Marvine Creek	Upper White	Rio Blanco	1.01	confl. East Marvine Creek	confl. West Marvine Creek
6	North Fork White River	Upper White	Garfield	3.99	outlet of Trappers Lake	confl. Big Fish Creek
6	North Fork White River	Upper White	Garfield	3.08	confl. Big Fish Creek	confl. Mirror Creek
6	North Fork White River	Upper White	Rio Blanco	1.30	confl. Mirror Creek	confl. Ripple Creek
6	Trout Creek *(Increase)*	Upper Yampa	Routt	7.45	confl. unnamed tributary	confl. Little Trout Creek
6	Watson Creek	Upper Yampa	Routt	5.86	confl. Moody Creek	Hardscrabble Ditch hdgt.
6	West Marvine Creek	Upper White	Rio Blanco	9.08	headwaters	West Marvine Ditch hdgt.
7	Disappointment Creek	Upper Dolores	Dolores	21.71	confl. Morrison Creek	historic USGS gage
7	Disappointment Creek	Upper Dolores	Dolores San Miguel	37.80	historic USGS gage	confl. Dolores River
7	Himes Creek	Upper San Juan	Mineral	2.00	headwaters	Himes Ditch hdgt.

Exhibit 4

COLORADO
Colorado Water
Conservation Board
Department of Natural Resources

1313 Sherman Street
Denver, CO 80203

P (303) 866-3441
F (303) 866-4474

John Hickenlooper, Governor

Robert Randall, DNR Executive Director

Rebecca Mitchell, CWCB Director

TO: Colorado Water Conservation Board Members

FROM: Rob Viehl, Water Resource Specialist

DATE: November 14-15, 2018 Board Meeting

AGENDA ITEM: 7. Notice of 2019 Instream Flow Recommended Appropriations in Water Divisions 2, 3, 4, 6 and 7

Background:

Pursuant to Instream Flow ("ISF") Rule 5c., the Colorado Water Conservation Board is providing notice that the following 22 stream segments are being considered for ISF appropriations in 2019. At the January 2019 CWCB meeting, Staff may request that the Board form its intent to appropriate ISF water rights on some or all of the streams listed in Table 1. All of these streams were previously noticed at the Board's March 2018 meeting.

Staff recommendation:

This is an informational item that provides notice of recommended stream segments that staff may bring to the Board in January 2019 with a recommendation that the Board form its intent to appropriate ISF water rights. No Board action is required.

Table 1: Instream Flow Recommendations January 2019

Water Div.	Stream Name (Segment Upper/Lower Termini)	Recommending Entity	County	Length (miles)
2	Baker Creek *(headwaters to the USFS property boundary)*	CPW	Huerfano	2.13
2	Bonnett Creek *(headwaters to confluence Cucharas River)*	CPW	Huerfano	4.05
2	Stout Creek *(BLM/USFS property boundary to Woods Pasture Ditch hdgt.)*	BLM	Fremont	0.69
3	Carnero Creek *(confluence South Fork & Middle Fork Carnero Creeks to confluence Mogotas Arroyo)*	CPW	Saguache	9.81
3	Cave Creek *(headwaters to confluence South Fork Carnero Creek)*	CPW	Saguache	6.32
3	Middle Fork Carnero Creek *(headwaters to confluence Lost Cabin Creek)*	CPW	Saguache	4.78
3	Middle Fork Carnero Creek *(confluence Lost Cabin Creek to confluence South Fork Carnero Creek)*	CPW	Saguache	5.04

4	Cold Spring Creek *(Amalla Spring to confluence Pauline Creek)*	BLM	Saguache	1.23
4	East Fork Little Cimarron River *(headwaters to confluence Little Cimarron River)*	BLM	Gunnison	6.45
4	Gold Creek *(Increase)* *(headwaters to Tarkington Ditch hdgt.)*	HCCA	Gunnison	10.32
4	Gold Creek *(Tarkington Ditch hdgt. to confluence Quartz Creek)*	HCCA	Gunnison	0.45
6	Marvine Creek *(outlet of Lower Marvine Lake to confluence East Marvine Creek)*	CPW	Rio Blanco	6.08
6	Marvine Creek *(confluence East Marvine Creek to confluence West Marvine Creek)*	CPW	Rio Blanco	3.95
6	North Fork White River *(outlet of Trappers Lake to confluence Big Fish Creek)*	CPW	Garfield	3.99
6	North Fork White River *(confluence Big Fish Creek to confluence Mirror Creek)*	CPW	Garfield	3.08
6	North Fork White River *(confluence Mirror Creek to confluence Ripple Creek)*	CPW	Rio Blanco	1.30
6	Trout Creek *(Increase)* *(confluence unnamed tributary to confluence Little Trout Creek)*	BLM	Routt	7.45
6	Watson Creek *(confluence Moody Creek to Hardscrabble Ditch hdgt.)*	BLM	Routt	5.86
6	West Marvine Creek *(headwaters to West Marvine Ditch hdgt.)*	CPW	Rio Blanco	9.08
7	Disappointment Creek *(confluence Morrison Creek to historic USGS gage)*	BLM	Dolores	21.71
7	Disappointment Creek *(historic USGS gage to confluence Dolores River)*	BLM	Dolores San Miguel	37.80
7	Himes Creek *(headwaters to Himes Ditch hdgt.)*	USFS	Mineral	2.00

BLM = Bureau of Land Management; CPW = Colorado Parks and Wildlife; HCCA = High Country Conservation Advocates; USFS = U.S. Forest Service

The detailed recommendations and appendices for these streams can be found on the CWCB website at: http://cwcb.state.co.us/environment/instream-flow-program/Pages/2019ProposedISFRecommendations.aspx

Exhibit 5

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Colorado State Office
2850 Youngfield Street
Lakewood, Colorado 80215-7210
www.co.blm.gov

In Reply Refer To:
7250 (CO-932)

Ms. Linda Bassi
Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, Colorado 80203

DEC 19 2018

Dear Ms. Bassi:

The Bureau of Land Management (BLM) is writing this letter to formally communicate its recommendation for an increase to the instream flow water right on Trout Creek, located in Water Division 6.

Location and Land Status. Trout Creek originates in the Flattops Wilderness Area, approximately 11.0 miles southwest of the community of Yampa. Trout Creek flows into the Yampa River at the town of Milner. This recommendation addresses only the portion of Trout Creek that starts at the confluence with an unnamed tributary located in the SW ¼ NW ¼, Section 8, T3N R86W and ending at the headgate of the Koll Ditch, a distance of approximately 7.0 miles. The BLM manages 0.8 miles of this reach, while approximately 6.2 miles are in private ownership.

Existing Instream Flow Water Rights. In 1977, the Colorado Water Conservation Board appropriated an instream flow water right on Trout Creek that begins at the outlet of Sheriff Reservoir and ends at the confluence with Middle Creek. The protected flow rate is 5.0 cfs, year round.

Biological Summary. Trout Creek is a cold water, moderate gradient stream. The reach that is the subject of this recommendation flows through valley that ranges from 1/8 to ½ mile in width. The upper part of the reach flows through agricultural lands used for livestock grazing, while the lower part of the reach flows through a confined canyon that is in largely natural condition. Substrate is generally from medium to large size, ranging from 4-inch cobbles to small boulders. Water quality is good for supporting salmonid fish species, but during July and August, temperatures can approach the maximum temperatures that can be tolerated by trout.

Fish surveys indicate a diverse and self-sustaining fish community. Trout Creek provides habitat for brook trout, brown trout, cutthroat trout, mottled sculpin, speckled dace, and mountain sucker. Spot surveys have indicated abundant populations of stonefly and caddisfly.

The creek also supports a vigorous riparian community comprised of alder, dogwood, and narrowleaf cottonwood. When the creek flows through confined canyons, the riparian community provides good cover and shading for the creek, and contributes substantially to bank stability.

R2Cross Analysis. The BLM collected the following R2Cross data from Trout Creek:

Cross Section Date	Discharge Rate	Top Width	Winter Flow Recommendation (meets 2 of 3 hydraulic criteria)	Summer Flow Recommendation (meets 3 of 3 hydraulic criteria)
08/12/2017 #1	9.43 cfs	39.42 feet	9.27 cfs	13.28 cfs
08/12/2017 #2	8.58 cfs	35.17 feet	5.79 cfs	12.80 cfs
		Averages:	7.53 cfs	13.04 cfs

BLM's analysis of this data, coordinated with Colorado Parks and Wildlife, indicates that the following flows are needed to protect the natural environment to a reasonable degree.

> 13.00 cubic feet per second is recommended during the snowmelt runoff period and early summer, from April 1 to July 31. This recommendation is driven by the average depth criteria. In many locations, the Trout Creek channel is wide with large substrate, so meeting the depth criteria is important for passage between rocks and between pools. Implementing this recommendation would require an increase of 8.0 cfs over the current instream flow water right.
>
> 12.00 cubic feet per second is recommended during late summer and early fall, from August 1 to October 31. This recommendation is driven by limited water availability. This flow rate will maintain sufficient physical habitat in the creek for the fish population to complete important parts of their life cycle before cold temperatures reduce fish activity for the winter. Implementing this recommendation would require an increase of 7.0 cfs over the current instream flow water right.
>
> 7.00 cubic feet per second is recommended during the cold temperature portion of the year, from November 1 through March 31. This recommendation is driven by limited water availability but comes very close to meeting the wetted perimeter criteria and the velocity criteria. This flow rate should prevent complete icing of the numerous pools in this reach, allowing the fish population to overwinter. Implementing this recommendation would require an increase of 2.0 cfs over the current instream flow water right.

Rationale for Instream Flow Increase. BLM believes an instream flow increase for Trout Creek is warranted because of physical habitat characteristics. The R2Cross data summarized above clearly indicates that the current instream flow water right does not provide sufficient physical habitat during the warm weather portions of the year when the fish populations are feeding, growing, and spawning. When the existing instream flow rights are applied to the cross sections that were collected, the stream would exhibit 40 percent to 66 percent wetted perimeter. However, this habitat is not highly usable by the fish population, because 5.0 cfs constrains the habitat to an average depth of 0.22 to 0.26 feet. An average habitat depth of 0.22 to 0.26 feet is not sufficient in a stream that averages 35 to 40 feet in top width. During the warm weather season, the fish populations need to have access to as much of the stream channel as possible for feeding, resting, and spawning if they are to survive the pronounced cold winters in this canyon. The increase in flow rates during winter is warranted because the average depths associated with 5.0 cfs make much of the physical habitat in the stream channel less susceptible to freezing.

Water Availability. The BLM recommends using a variety of data sources to confirm water availability, because BLM is not aware of any historical gage data on this creek. Use of Streamstats can provide an estimate of natural hydrology, but this estimate may have to be modified by adjusting for reservoir storage and for irrigation diversions. Two nearby gages may also provide an estimate of natural hydrology, because they are located on watersheds with similar characteristics. USGS Gage 0923800, on Oak Creek near the community of Oak Creek, is located on a smaller watershed, but appears to be relatively unaffected by diversion and storage operations. USGG Gage 09248500, on the East Fork of the Williams Fork near Willow Creek, is on a larger watershed, but this watershed has very similar altitude and aspect to the Trout Creek watershed. Neither of these gages is currently collecting data, but the period of record should be sufficient to help establish water availability for this recommendation. Finally, if reservoir storage and release records are available for Sheriff Reservoir, located upstream from the recommended reach, those records would assist would evaluating the impact of storage operations on stream flows.

The BLM is aware of the following water rights within the proposed instream flow reach:

Koll Ditch – 13.22 cfs
Alex Ditch – 1.28 cfs

The BLM is aware of the following water upstream from the recommended reach:

Orno Ditch – 8.31 cfs
Slough Ditch – 3.98 cfs
Knott Ditch – 2.00 cfs
Pine Grove Ditch – 3.98 cfs
David Chapman Ditch – 2.41 cfs
Male Move Ditch – 12.62 cfs
Last Chance Ditch – 19.29 cfs
Rich Ditch – 19.32 cfs
Sheriff Reservoir – 986.5 acre feet

Relationship to Land Management Plans. The BLM's management plan calls for improvement and recovery of current and historic fisheries as a means of increasing native fish populations. In addition, the BLM plan calls for making instream flow recommendations to the Colorado Water Conservation Board to meet minimum instream flow requirements to maintain native fisheries. Finally, the plan calls for maintaining and improving the function of riparian areas to achieve advanced ecological stage for the riparian community, and it also calls for protecting riparian and wetland systems from further sources of degradation. Establishing an instream flow water right would assist in meeting these objectives.

Data sheets, R2Cross output, fishery survey information, and photographs of the cross section were included with BLM's draft recommendation in February 2018. We thank both Colorado Parks and Wildlife and the Colorado Water Conservation Board for their cooperation in this effort.

If you have any questions regarding our instream flow recommendation, please contact Roy Smith at 303-239-3940.

Sincerely,

Brian St. George
Deputy State Director
Resources and Fire

Cc: Bruce Sillitoe, Little Snake FO
Eric Scherff, Little Snake FO
Andrew Archuleta, Northwest District Manager

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP0085	ABV CO RD 29	8-Sep-1993	21041	PRESENCE/ABSENCE	MOTTLED SCULPIN	8	70
23533	Trout Creek #2	YP0085	ABV CO RD 29	8-Sep-1993	21041	PRESENCE/ABSENCE	MOTTLED SCULPIN	2	30
23533	Trout Creek #2	YP0085	ABV CO RD 29	8-Sep-1993	21041	PRESENCE/ABSENCE	MOTTLED SCULPIN	2	90
23533	Trout Creek #2	YP0085	ABV CO RD 29	8-Sep-1993	21041	PRESENCE/ABSENCE	BROOK TROUT	1	130
23533	Trout Creek #2	YP0085	ABV CO RD 29	8-Sep-1993	21041	PRESENCE/ABSENCE	BROOK TROUT	1	30
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	121
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	51
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	151
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	51
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	53
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	59
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	59
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	58
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	66
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	52
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	61
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	59
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	152
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	65
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	57
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	59
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	192
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	58
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	62
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	77
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	59
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	55
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	58
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	52
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	49
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	57
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	57
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	51

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	127
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	161
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	55
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	215
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	137
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	161
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	226
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	57
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	269
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	54
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	181
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	129
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	233
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	163
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	61
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	208
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	60
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	54
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	62
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	52
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	49
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	62
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	122
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	62
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	52
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	60
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	59
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	69
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	59
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	61
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	61
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROOK TROUT	1	54

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	LONGNOSE DACE	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	LONGNOSE DACE	1	105
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	LONGNOSE DACE	1	89
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	322
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	404
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	234
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	143
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	344
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	59
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	329
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	62
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	55
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	55
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	61
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	66
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	266
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	170
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	235
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	373
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	265
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	64
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	326
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	55
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	57
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	51
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	122
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	228
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	145
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	134
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	302
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	405
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	219
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	136
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	215
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	131

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	318
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	131
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	169
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	223
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	246
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	BROWN TROUT	1	382
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOUNTAIN SUCKER	1	160
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOUNTAIN SUCKER	1	138
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOUNTAIN SUCKER	1	107
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOUNTAIN SUCKER	1	125
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOUNTAIN SUCKER	1	112
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOUNTAIN SUCKER	1	88
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOUNTAIN SUCKER	1	102
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOUNTAIN SUCKER	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOUNTAIN SUCKER	1	96
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOUNTAIN SUCKER	1	167
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOUNTAIN SUCKER	1	172
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	79
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	54
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	51
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	44
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	52
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	91
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	96
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	41
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	74
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	106
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	48
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	80
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	55
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	68
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	96
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	49
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	101
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	94
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86

WaterCode	**WaterName**	**StationCode**	**StationLocation**	**SampleDate**	**SurveyID**	**Protocol**	**CommonName**	**Numfish**	**FishLength**
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	69
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	96
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	87
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	79
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	82
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	88
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	85
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	89
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	85
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	54
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	55
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	102
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	90
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	64
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	66
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	110
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	89
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	85
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	61
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	92
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	68
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	77
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	74
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	48
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	93
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	83
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	66
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	58
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	74
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	44
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	63
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	51
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	66
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	91
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	105
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	78
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	115
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	106
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	88
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	76
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	94
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	57
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	51
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	87
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	49
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	108
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	64
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	91
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	63
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	70
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	81
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	52
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	53
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	85
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	85
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	51
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	93
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	102
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	41
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	126

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	104
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	95
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	82
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	101
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	98
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	67
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	94
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	53
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	62
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	55
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	81
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	59
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	89
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	81
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	51
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	72
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	77
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	44
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	42
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	112
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	96
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	101
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	109
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	82
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	99
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	74
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	76
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	67
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	74
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	90
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	76
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	87
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	77
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	94
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	49
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	87
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	94
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	66
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	80
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	85
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	108
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	97
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	76
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	82
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	82
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	76
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	70
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	80
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	84
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	74
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	49
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	72
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	78
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	65
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	65
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	82
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	47
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	47
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	55
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	61
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	87
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	92
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	94
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	93
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	87

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	84
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	84
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	67
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	79
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	94
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	64
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	94
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	69
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	63
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	48
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	48
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	78
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	48
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	49
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	76
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	96
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	76
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	94
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	77
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	76
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	74
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	82
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	76
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	81
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	76
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	101
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	69
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	93
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	68
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	68
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	62

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	68
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	103
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	66
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	77
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	44
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	48
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	52
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	55
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	51
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	51
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	61
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	52
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	76
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	44
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	130
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	85
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	87
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	91
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	68
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	95
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	76
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	87
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	81
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	80
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	74
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	68
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	87
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	84
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	67
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	76
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	72
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	87
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	72
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	92

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	77
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	84
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	72
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	85
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	61
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	74
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	54
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	70
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	96
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	99
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	48
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	51
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	108
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	102
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	96
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	88
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	108
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	76
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	94
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	81
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	84
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	73
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	64
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	65
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	49
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	48
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	65
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	90
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	100
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	101
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	99
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	80
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	103
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	67
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	73

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	81
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	73
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	72
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	70
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	49
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	58
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	135
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	125
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	94
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	53
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	89
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	91
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	67
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	64
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	49
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	49
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	51
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	NULL
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	69
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	94
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	66
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	67
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	83
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	105
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	91
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	89
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	83
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	89
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	95

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	95
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	71
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	66
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	66
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	79
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	83
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	69
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	94
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	89
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	78
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	96
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	92
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	66
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	69
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	85
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	66
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	51
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	51
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	83
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	113
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	64
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	87
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	44
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	45
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	117
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	72
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	74
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	67
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	66
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	80
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	77
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	76
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	55
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	47
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	80

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	79
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	44
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	49
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	57
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	58
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	52
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	47
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	90
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	69
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	64
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	53
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	48
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	48
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	42
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	85
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	52
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	55
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	45
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	55
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	98
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	95
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	85
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	80
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	83
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	66
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	58
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	67
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	45
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	84

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	82
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	55
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	82
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	80
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	90
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	96
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	89
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	84
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	69
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	91
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	96
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	80
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	97
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	117
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	77
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	70
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	78
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	94
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	106
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	85
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	47
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	60
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	82
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	85
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	78
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	70
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	72
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	74
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	66
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	50
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	74

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	70
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	67
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	53
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	54
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	48
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	56
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	46
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	44
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	51
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	70
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	88
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	89
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	84
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	136
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	67
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	97
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	62
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	90
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	95
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	64
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	85
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	68
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	MOTTLED SCULPIN	1	75
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	CUTTHROAT TROUT (S.S.U.)	1	412
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	CUTTHROAT TROUT (S.S.U.)	1	80
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	CUTTHROAT TROUT (S.S.U.)	1	196
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	CUTTHROAT TROUT (S.S.U.)	1	208
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	RAINBOW TROUT	1	267
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	RAINBOW TROUT	1	249
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	RAINBOW X CUTTHROAT	1	277
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	SPECKLED DACE	1	83
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	SPECKLED DACE	1	84
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	SPECKLED DACE	1	101
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	SPECKLED DACE	1	86
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	SPECKLED DACE	1	69
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	SPECKLED DACE	1	81
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	SPECKLED DACE	1	67
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	SPECKLED DACE	1	90

WaterCode	WaterName	StationCode	StationLocation	SampleDate	SurveyID	Protocol	CommonName	Numfish	FishLength
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	SPECKLED DACE	1	87
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	SPECKLED DACE	1	74
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	SPECKLED DACE	1	85
23533	Trout Creek #2	YP1965	4.5 Km BLW CO RD 29	19-Jul-2007	23350	THREE-PASS REMOVAL	SPECKLED DACE	1	84

COLORADO WATER CONSERVATION BOARD
INSTREAM FLOW / NATURAL LAKE LEVEL PROGRAM
STREAM CROSS-SECTION AND FLOW ANALYSIS

LOCATION INFORMATION

STREAM NAME:	Trout Creek
XS LOCATION:	0.5 mile upstr fr confl w Little Trout Ck.
XS NUMBER:	1
DATE:	2-Aug-17
OBSERVERS:	R. Smith, E. Scherff
1/4 SEC:	SW NW
SECTION:	23
TWP:	4N
RANGE:	86W
PM:	Sixth
COUNTY:	Routt
WATERSHED:	Yampa River
DIVISION:	6
DOW CODE:	23533
USGS MAP:	0
USFS MAP:	0

SUPPLEMENTAL DATA

*** NOTE ***
Leave TAPE WT and TENSION
at defaults for data collected
with a survey level and rod

TAPE WT:	0.0106
TENSION:	99999

CHANNEL PROFILE DATA

SLOPE: 0.013

INPUT DATA CHECKED BY: ....DATE....................

ASSIGNED TO: …...............………............................DATE....................

STREAM NAME: Trout Creek
XS LOCATION: 0.5 mile upstr fr confl w Little Trout Ck.
XS NUMBER: 1

DATA POINTS= 40

VALUES COMPUTED FROM RAW FIELD DATA

FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
LS	1.30	3.92			0.00		0.00	0.00	0.0%
1 G	3.70	3.83			0.00		0.00	0.00	0.0%
	4.60	4.71			0.00		0.00	0.00	0.0%
W	6.70	5.05	0.00	0.00	0.00		0.00	0.00	0.0%
	8.00	5.25	0.20	0.45	1.32	0.20	0.23	0.10	1.1%
	9.00	5.20	0.15	0.67	1.00	0.15	0.15	0.10	1.1%
	10.00	5.45	0.40	1.22	1.03	0.40	0.30	0.37	3.9%
	10.50	5.40	0.35	1.67	0.50	0.35	0.18	0.29	3.1%
	11.00	5.50	0.45	1.65	0.51	0.45	0.23	0.37	3.9%
	11.50	5.45	0.40	2.20	0.50	0.40	0.20	0.44	4.7%
	12.00	5.45	0.40	1.98	0.50	0.40	0.20	0.40	4.2%
	12.50	5.45	0.40	1.72	0.50	0.40	0.20	0.34	3.6%
	13.00	5.50	0.45	1.95	0.50	0.45	0.23	0.44	4.7%
	13.50	5.50	0.45	1.61	0.50	0.45	0.23	0.36	3.8%
	14.00	5.55	0.50	1.24	0.50	0.50	0.25	0.31	3.3%
	14.50	5.55	0.50	1.48	0.50	0.50	0.25	0.37	3.9%
	15.00	5.45	0.40	1.40	0.51	0.40	0.20	0.28	3.0%
	15.50	5.50	0.45	1.76	0.50	0.45	0.23	0.40	4.2%
	16.00	5.50	0.45	1.61	0.50	0.45	0.23	0.36	3.8%
	16.50	5.55	0.50	2.01	0.50	0.50	0.25	0.50	5.3%
	17.00	5.45	0.40	2.34	0.51	0.40	0.20	0.47	5.0%
	17.50	5.60	0.55	2.05	0.52	0.55	0.28	0.56	6.0%
	18.00	5.65	0.60	1.63	0.50	0.60	0.30	0.49	5.2%
	18.50	5.70	0.65	1.42	0.50	0.65	0.33	0.46	4.9%
	19.00	5.75	0.70	1.84	0.50	0.70	0.53	0.97	10.2%
	20.00	5.55	0.50	0.00	1.02	0.50	0.50	0.00	0.0%
	21.00	5.45	0.40	0.49	1.00	0.40	0.40	0.20	2.1%
	22.00	5.30	0.25	2.07	1.01	0.25	0.25	0.52	5.5%
	23.00	5.35	0.30	1.01	1.00	0.30	0.30	0.30	3.2%
	24.00	5.05	0.00	0.00	1.04		0.00	0.00	0.0%
	25.00	5.15	0.10	0.28	1.00	0.10	0.10	0.03	0.3%
	26.00	5.15	0.10	0.02	1.00	0.10	0.09	0.00	0.0%
W	26.70	5.05	0.00	0.00	0.71		0.00	0.00	0.0%
	29.60	4.90			0.00		0.00	0.00	0.0%
	33.90	4.62			0.00		0.00	0.00	0.0%
	35.60	4.42			0.00		0.00	0.00	0.0%
	39.30	4.68			0.00		0.00	0.00	0.0%
	41.60	4.20			0.00		0.00	0.00	0.0%
	42.60	4.04			0.00		0.00	0.00	0.0%
1 RS & G	43.20	3.80			0.00		0.00	0.00	0.0%
TOTALS ----------------------					20.21	0.7	6.79	9.43	100.0%
						(Max.)			

Manning's n = 0.0589
Hydraulic Radius= 0.33589187

STREAM NAME: Trout Creek
XS LOCATION: 0.5 mile upstr fr confl w Little Trout Ck.
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	6.79	6.79	0.0%
4.80	6.79	12.57	85.1%
4.82	6.79	12.05	77.5%
4.84	6.79	11.55	70.0%
4.86	6.79	11.05	62.7%
4.88	6.79	10.56	55.5%
4.90	6.79	10.08	48.4%
4.92	6.79	9.61	41.5%
4.94	6.79	9.14	34.7%
4.96	6.79	8.69	28.0%
4.98	6.79	8.25	21.5%
5.00	6.79	7.82	15.2%
5.01	6.79	7.61	12.1%
5.02	6.79	7.40	9.0%
5.03	6.79	7.20	6.0%
5.04	6.79	6.99	3.0%
5.05	6.79	6.79	0.0%
5.06	6.79	6.59	-2.9%
5.07	6.79	6.40	-5.8%
5.08	6.79	6.20	-8.7%
5.09	6.79	6.01	-11.5%
5.10	6.79	5.82	-14.2%
5.12	6.79	5.46	-19.7%
5.14	6.79	5.10	-24.9%
5.16	6.79	4.76	-29.9%
5.18	6.79	4.44	-34.6%
5.20	6.79	4.12	-39.3%
5.22	6.79	3.81	-43.9%
5.24	6.79	3.51	-48.2%
5.26	6.79	3.23	-52.4%
5.28	6.79	2.95	-56.5%
5.30	6.79	2.67	-60.6%

WATERLINE AT ZERO
AREA ERROR = 5.050

STREAM NAME: Trout Creek
XS LOCATION: 0.5 mile upstr fr confl w Little Trout Ck.
XS NUMBER: 1

Constant Manning's n

GL = lowest Grassline elevation corrected for sag
STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	3.83	39.42	1.19	1.92	46.80	40.16	100.0%	1.17	148.97	3.18
	4.05	38.61	0.99	1.70	38.11	39.22	97.7%	0.97	107.45	2.82
	4.10	38.25	0.95	1.65	36.19	38.83	96.7%	0.93	99.23	2.74
	4.15	37.89	0.90	1.60	34.28	38.44	95.7%	0.89	91.29	2.66
	4.20	37.52	0.86	1.55	32.40	38.05	94.8%	0.85	83.64	2.58
	4.25	37.23	0.82	1.50	30.53	37.74	94.0%	0.81	76.18	2.50
	4.30	36.94	0.78	1.45	28.67	37.42	93.2%	0.77	69.01	2.41
	4.35	36.65	0.73	1.40	26.83	37.11	92.4%	0.72	62.14	2.32
	4.40	36.36	0.69	1.35	25.01	36.79	91.6%	0.68	55.57	2.22
	4.45	35.39	0.66	1.30	23.21	35.79	89.1%	0.65	49.98	2.15
	4.50	33.96	0.63	1.25	21.48	34.33	85.5%	0.63	45.15	2.10
	4.55	32.53	0.61	1.20	19.81	32.87	81.9%	0.60	40.63	2.05
	4.60	31.10	0.59	1.15	18.22	31.42	78.2%	0.58	36.43	2.00
	4.65	29.47	0.57	1.10	16.71	29.75	74.1%	0.56	32.68	1.96
	4.70	28.08	0.54	1.05	15.27	28.34	70.6%	0.54	29.07	1.90
	4.75	27.06	0.51	1.00	13.89	27.30	68.0%	0.51	25.45	1.83
	4.80	25.98	0.48	0.95	12.57	26.22	65.3%	0.48	22.12	1.76
	4.85	24.90	0.45	0.90	11.30	25.14	62.6%	0.45	19.04	1.69
	4.90	23.83	0.42	0.85	10.08	24.06	59.9%	0.42	16.21	1.61
	4.95	22.55	0.40	0.80	8.92	22.78	56.7%	0.39	13.72	1.54
	5.00	21.28	0.37	0.75	7.82	21.50	53.5%	0.36	11.46	1.46
WL	5.05	20.00	0.34	0.70	6.79	20.21	50.3%	0.34	9.43	1.39
	5.10	18.66	0.31	0.65	5.82	18.86	46.9%	0.31	7.65	1.31
	5.15	16.32	0.30	0.60	4.92	16.50	41.1%	0.30	6.32	1.28
	5.20	15.82	0.26	0.55	4.12	15.99	39.8%	0.26	4.80	1.16
	5.25	14.13	0.24	0.50	3.37	14.28	35.6%	0.24	3.70	1.10
	5.30	13.77	0.19	0.45	2.67	13.90	34.6%	0.19	2.56	0.96
	5.35	12.07	0.17	0.40	2.03	12.19	30.3%	0.17	1.76	0.87
	5.40	11.53	0.12	0.35	1.44	11.64	29.0%	0.12	1.03	0.71
	5.45	9.25	0.10	0.30	0.89	9.34	23.3%	0.10	0.54	0.60
	5.50	5.33	0.09	0.25	0.50	5.39	13.4%	0.09	0.30	0.59
	5.55	2.67	0.11	0.20	0.29	2.70	6.7%	0.11	0.19	0.65
	5.60	2.25	0.08	0.15	0.17	2.27	5.7%	0.07	0.09	0.51
	5.65	1.50	0.05	0.10	0.08	1.51	3.8%	0.05	0.03	0.39
	5.70	0.75	0.03	0.05	0.02	0.76	1.9%	0.02	0.00	0.24
	5.75	0.00	#DIV/0!	0.00	0.00	0.00	0.0%	#DIV/0!	#DIV/0!	#DIV/0!

STREAM NAME: Trout Creek
XS LOCATION: 0.5 mile upstr fr confl w Little Trout Ck.
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	9.43	cfs
CALCULATED FLOW (Qc)=	9.43	cfs
(Qm-Qc)/Qm * 100 =	0.0	%
MEASURED WATERLINE (WLm)=	5.05	ft
CALCULATED WATERLINE (WLc)=	5.05	ft
(WLm-WLc)/WLm * 100 =	0.0	%
MAX MEASURED DEPTH (Dm)=	0.70	ft
MAX CALCULATED DEPTH (Dc)=	0.70	ft
(Dm-Dc)/Dm * 100	0.0	%
MEAN VELOCITY=	1.39	ft/sec
MANNING'S N=	0.059	
SLOPE=	0.013	ft/ft
.4 * Qm =	3.8	cfs
2.5 * Qm=	23.6	cfs

RECOMMENDED INSTREAM FLOW:

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FLOW (CFS)	PERIOD

RATIONALE FOR RECOMMENDATION:

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RECOMMENDATION BY: .... AGENCY.. DATE:..............................

CWCB REVIEW BY: .... DATE:..............................

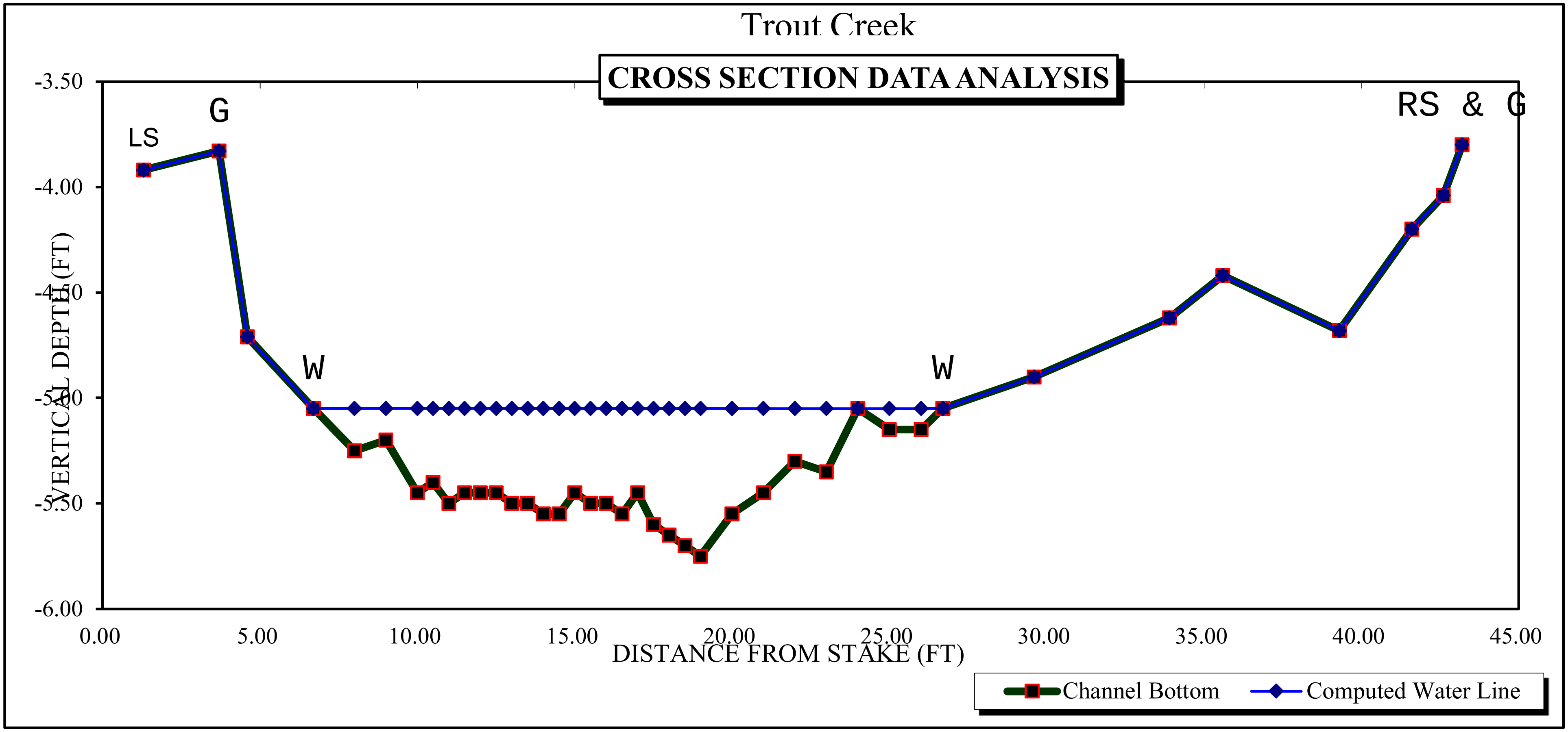
STREAM NAME: Trout Creek
XS LOCATION: 0.5 mile upstr fr confl w Little Trout Ck.
XS NUMBER: 1

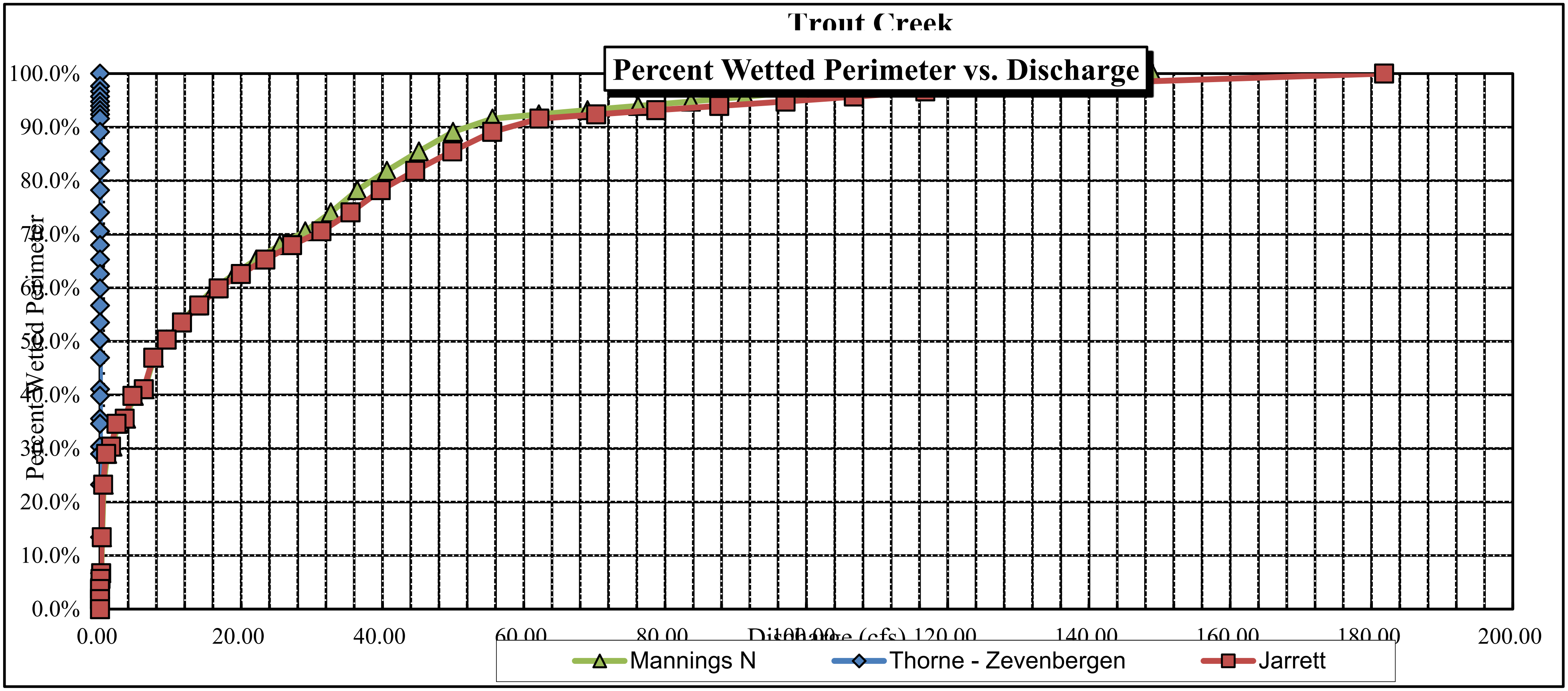
Jarrett Variable Manning's n Correction Applied

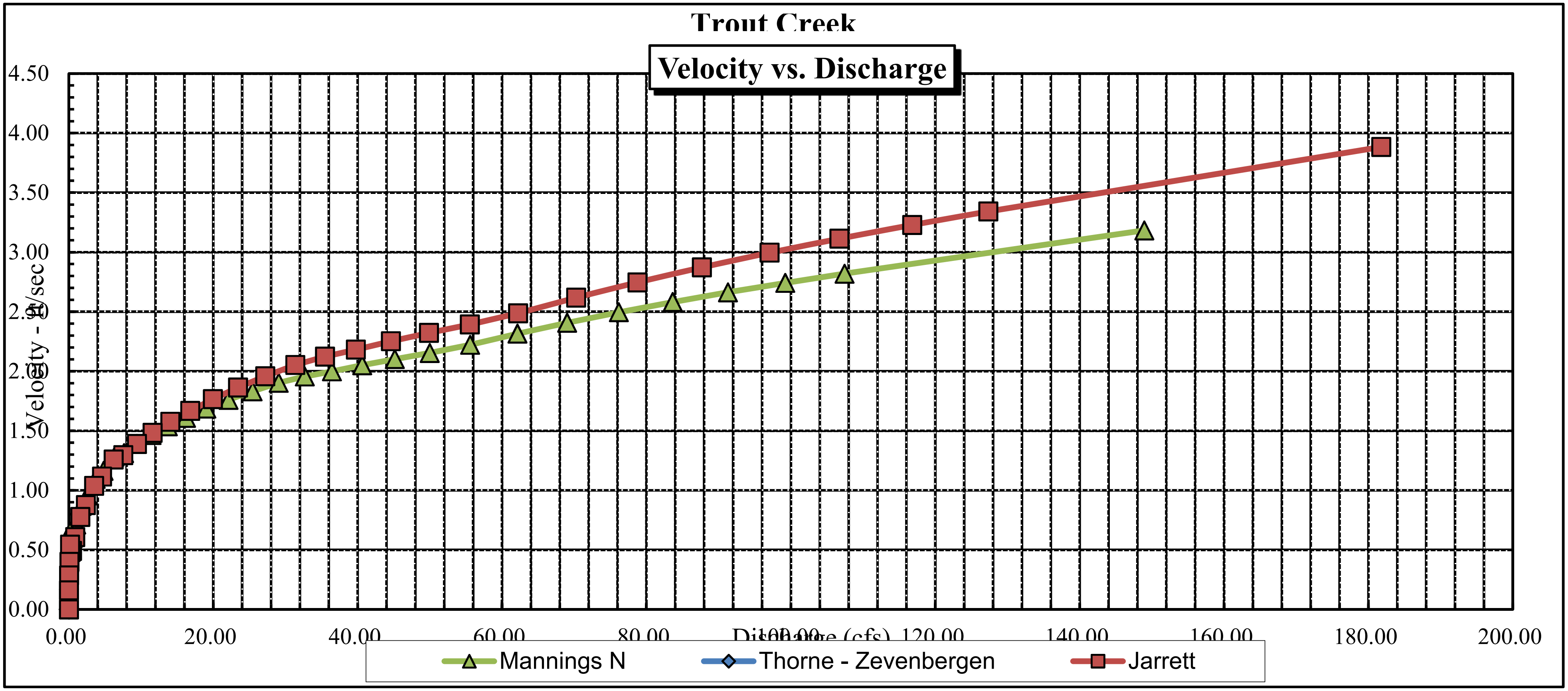
GL = lowest Grassline elevation corrected for sag
WL = Waterline corrected for variations in field measured water surface elevations and sag

STAGING TABLE

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	3.83	39.42	1.19	1.92	46.80	40.16	100.0%	1.17	181.78	3.88
	4.05	38.61	0.99	1.70	38.11	39.22	97.7%	0.97	127.35	3.34
	4.10	38.25	0.95	1.65	36.19	38.83	96.7%	0.93	116.82	3.23
	4.15	37.89	0.90	1.60	34.28	38.44	95.7%	0.89	106.73	3.11
	4.20	37.52	0.86	1.55	32.40	38.05	94.8%	0.85	97.06	3.00
	4.25	37.23	0.82	1.50	30.53	37.74	94.0%	0.81	87.68	2.87
	4.30	36.94	0.78	1.45	28.67	37.42	93.2%	0.77	78.74	2.75
	4.35	36.65	0.73	1.40	26.83	37.11	92.4%	0.72	70.25	2.62
	4.40	36.36	0.69	1.35	25.01	36.79	91.6%	0.68	62.21	2.49
	4.45	35.39	0.66	1.30	23.21	35.79	89.1%	0.65	55.52	2.39
	4.50	33.96	0.63	1.25	21.48	34.33	85.5%	0.63	49.87	2.32
	4.55	32.53	0.61	1.20	19.81	32.87	81.9%	0.60	44.62	2.25
	4.60	31.10	0.59	1.15	18.22	31.42	78.2%	0.58	39.75	2.18
	4.65	29.47	0.57	1.10	16.71	29.75	74.1%	0.56	35.48	2.12
	4.70	28.08	0.54	1.05	15.27	28.34	70.6%	0.54	31.35	2.05
	4.75	27.06	0.51	1.00	13.89	27.30	68.0%	0.51	27.20	1.96
	4.80	25.98	0.48	0.95	12.57	26.22	65.3%	0.48	23.42	1.86
	4.85	24.90	0.45	0.90	11.30	25.14	62.6%	0.45	19.95	1.77
	4.90	23.83	0.42	0.85	10.08	24.06	59.9%	0.42	16.80	1.67
	4.95	22.55	0.40	0.80	8.92	22.78	56.7%	0.39	14.06	1.58
	5.00	21.28	0.37	0.75	7.82	21.50	53.5%	0.36	11.61	1.48
WL	5.05	20.00	0.34	0.70	6.79	20.21	50.3%	0.34	9.43	1.39
	5.10	18.66	0.31	0.65	5.82	18.86	46.9%	0.31	7.55	1.30
	5.15	16.32	0.30	0.60	4.92	16.50	41.1%	0.30	6.20	1.26
	5.20	15.82	0.26	0.55	4.12	15.99	39.8%	0.26	4.60	1.12
	5.25	14.13	0.24	0.50	3.37	14.28	35.6%	0.24	3.50	1.04
	5.30	13.77	0.19	0.45	2.67	13.90	34.6%	0.19	2.34	0.88
	5.35	12.07	0.17	0.40	2.03	12.19	30.3%	0.17	1.58	0.78
	5.40	11.53	0.12	0.35	1.44	11.64	29.0%	0.12	0.87	0.61
	5.45	9.25	0.10	0.30	0.89	9.34	23.3%	0.10	0.44	0.49
	5.50	5.33	0.09	0.25	0.50	5.39	13.4%	0.09	0.24	0.48
	5.55	2.67	0.11	0.20	0.29	2.70	6.7%	0.11	0.16	0.54
	5.60	2.25	0.08	0.15	0.17	2.27	5.7%	0.07	0.07	0.40
	5.65	1.50	0.05	0.10	0.08	1.51	3.8%	0.05	0.02	0.29
	5.70	0.75	0.03	0.05	0.02	0.76	1.9%	0.02	0.00	0.16
	5.75	0.00	#DIV/0!	0.00	0.00	0.00	0.0%	#DIV/0!	#DIV/0!	#DIV/0!

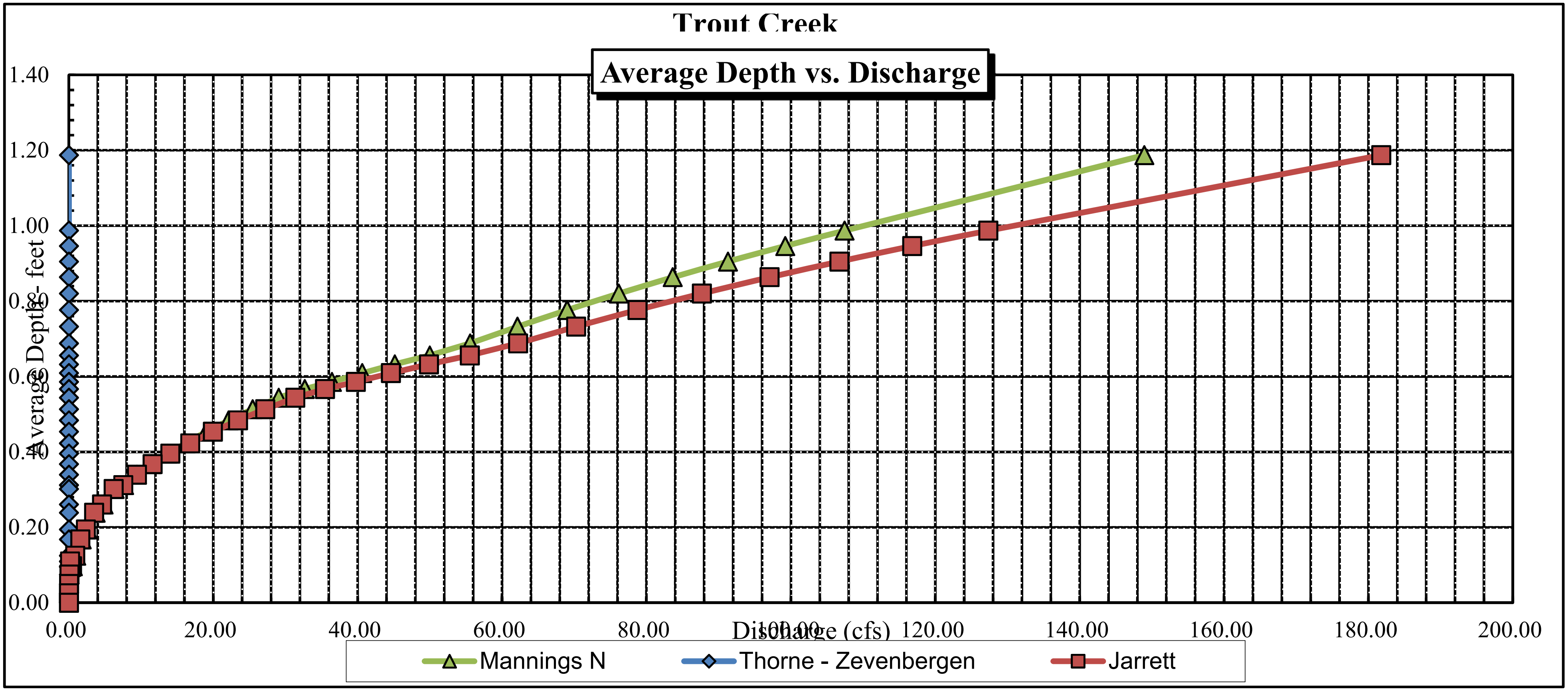

Trout Creek
CROSS SECTION DATA ANALYSIS
-3.50
-4.00
-4.50
-5.00
-5.50
-6.00
VERTICAL DEPTH (FT)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
DISTANCE FROM STAKE (FT)
LS
G
W
W
RS & G
Channel Bottom
Computed Water Line

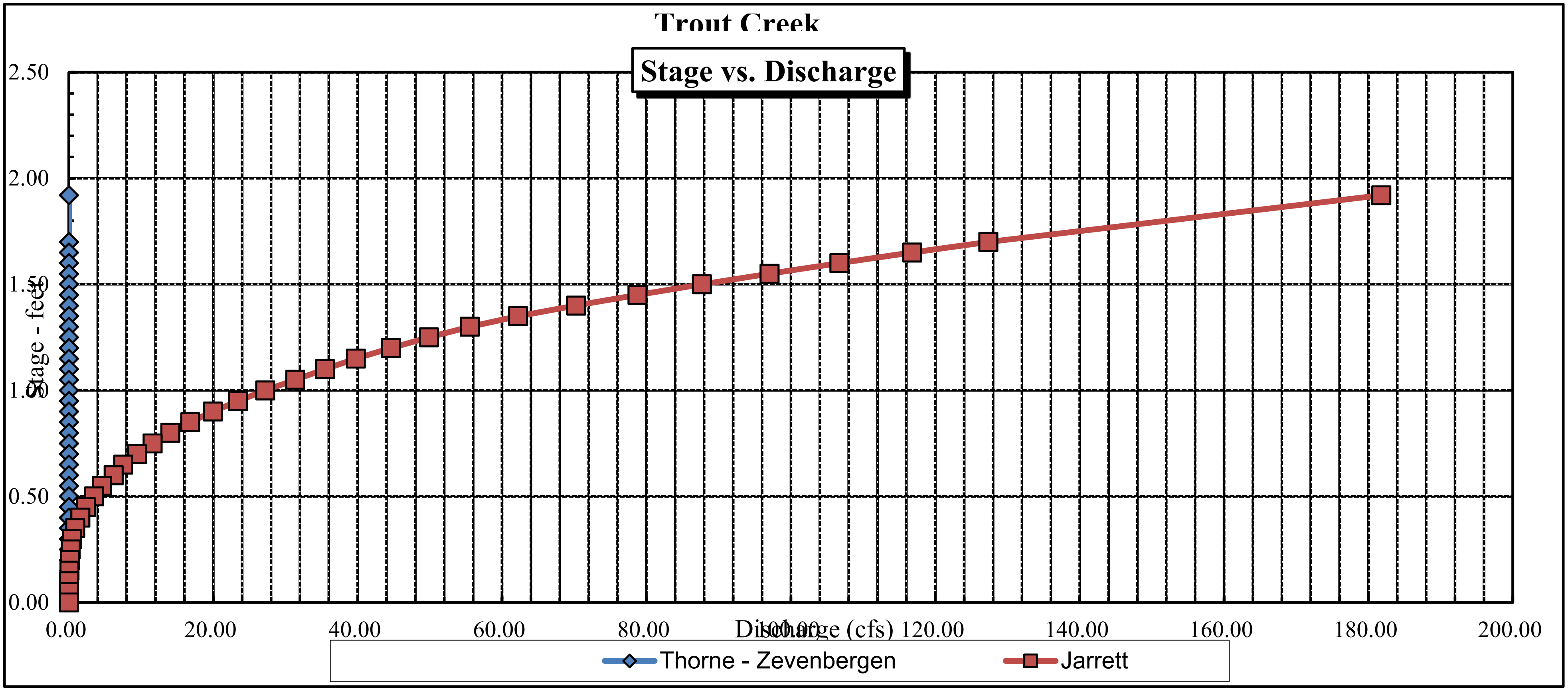

Trout Creek
Percent Wetted Perimeter vs. Discharge
Percent Wetted Perimeter
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett



Trout Creek

Velocity vs. Discharge


Trout Creek
Average Depth vs. Discharge
Average Depth, feet
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Trout Creek
Stage vs. Discharge
Stage - feet
2.50
2.00
1.50
1.00
0.50
0.00
Discharge (cfs)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Thorne - Zevenbergen
Jarrett

Data Input & Proofing

STREAM NAME: Trout Creek
XS LOCATION: 0.5 mile upstr fr confl w Little Trout Ck.
XS NUMBER: 1
DATE: 8/2/2017
OBSERVERS: R. Smith, E. Scherff

1/4 SEC: SW NW
SECTION: 23
TWP: 4N
RANGE: 86W
PM: Sixth

COUNTY: Routt
WATERSHED: Yampa River
DIVISION: 6
DOW CODE: 23533
USGS MAP:
USFS MAP:

Level and Rod Survey ▼

TAPE WT: 0.0106 lbs / ft
TENSION: 99999 lbs

SLOPE: 0.013 ft / ft

CHECKED BY:..........…………………......DATE……………......

ASSIGNED TO: ......………………….......DATE……………......

Total Data Points = 40

GL=1	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	A	Q	Tape to Water
	LS	1.30	3.92			0.00	0.00	0.00
1	G	3.70	3.83			0.00	0.00	0.00
		4.60	4.71			0.00	0.00	0.00
	W	6.70	5.05	0.00	0.00	0.00	0.00	0.00
		8.00	5.25	0.20	0.45	0.23	0.10	5.05
		9.00	5.20	0.15	0.67	0.15	0.10	5.05
		10.00	5.45	0.40	1.22	0.30	0.37	5.05
		10.50	5.40	0.35	1.67	0.18	0.29	5.05
		11.00	5.50	0.45	1.65	0.23	0.37	5.05
		11.50	5.45	0.40	2.20	0.20	0.44	5.05
		12.00	5.45	0.40	1.98	0.20	0.40	5.05
		12.50	5.45	0.40	1.72	0.20	0.34	5.05
		13.00	5.50	0.45	1.95	0.23	0.44	5.05
		13.50	5.50	0.45	1.61	0.23	0.36	5.05
		14.00	5.55	0.50	1.24	0.25	0.31	5.05
		14.50	5.55	0.50	1.48	0.25	0.37	5.05
		15.00	5.45	0.40	1.40	0.20	0.28	5.05
		15.50	5.50	0.45	1.76	0.23	0.40	5.05
		16.00	5.50	0.45	1.61	0.23	0.36	5.05
		16.50	5.55	0.50	2.01	0.25	0.50	5.05
		17.00	5.45	0.40	2.34	0.20	0.47	5.05
		17.50	5.60	0.55	2.05	0.28	0.56	5.05
		18.00	5.65	0.60	1.63	0.30	0.49	5.05
		18.50	5.70	0.65	1.42	0.33	0.46	5.05
		19.00	5.75	0.70	1.84	0.53	0.97	5.05
		20.00	5.55	0.50	0.00	0.50	0.00	5.05
		21.00	5.45	0.40	0.49	0.40	0.20	5.05
		22.00	5.30	0.25	2.07	0.25	0.52	5.05
		23.00	5.35	0.30	1.01	0.30	0.30	5.05
		24.00	5.05	0.00	0.00	0.00	0.00	0.00
		25.00	5.15	0.10	0.28	0.10	0.03	5.05
		26.00	5.15	0.10	0.02	0.09	0.00	5.05
	W	26.70	5.05	0.00	0.00	0.00	0.00	0.00
		29.60	4.90			0.00	0.00	0.00
		33.90	4.62			0.00	0.00	0.00
		35.60	4.42			0.00	0.00	0.00
		39.30	4.68			0.00	0.00	0.00
		41.60	4.20			0.00	0.00	0.00
		42.60	4.04			0.00	0.00	0.00
1	RS & G	43.20	3.80			0.00	0.00	0.00
					Totals	6.79	9.43	

COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

LOCATION INFORMATION

STREAM NAME: Trout Creek

CROSS-SECTION NO.: 2

CROSS-SECTION LOCATION: 0.5 mile upstream from confluence with Little Trout Creek

DATE: 8/2/17

OBSERVERS: Roy Smith, Eric Scherff

LEGAL DESCRIPTION ¼ SECTION: SW NW

SECTION: 23

TOWNSHIP: 4 [✓ N]/S

RANGE: 86 E/W

PM: 6th

COUNTY: Routt

WATERSHED: Yampa R.

WATER DIVISION: 6

DOW WATER CODE: 23533

MAP(S): USGS: Zone 13 4463647 N

USFS: 328647 E

SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: [✓ YES]/ NO

METER TYPE: M-M

METER NUMBER:

DATE RATED:

CALIB/SPIN: ______ sec

TAPE WEIGHT: surveyed lbs/foot

TAPE TENSION: surveyed lbs

CHANNEL BED MATERIAL SIZE RANGE: 4" cobble to 18" boulders

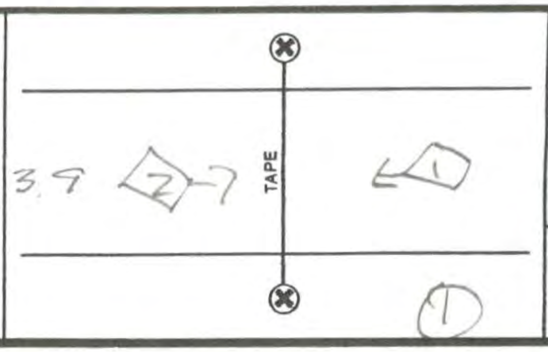
PHOTOGRAPHS TAKEN: [✓ YES]/NO

NUMBER OF PHOTOGRAPHS: 3

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	surveyed
⊗ Tape @ Stake RB	0.0	surveyed
① WS @ Tape LB/RB	0.0 28.9	4.10 / 4.10
② WS Upstream	39.0	3.55
③ WS Downstream	88.8	5.22
SLOPE	1.67 / 127.8 = 0.013	

SKETCH



LEGEND:

Stake ⊗

Station ①

Photo ①→

Direction of Flow ←

AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED: YES/[✓ NO]

DISTANCE ELECTROFISHED: ______ ft

FISH CAUGHT: YES/NO

WATER CHEMISTRY SAMPLED: [✓ YES]/NO

LENGTH - FREQUENCY DISTRIBUTION BY ONE-INCH SIZE GROUPS (1.0-1.9, 2.0-2.9, ETC.)

SPECIES (FILL IN)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>15	TOTAL

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME:

mayfly, caddisfly, stonefly

COMMENTS

DISCHARGE/CROSS SECTION NOTES

TREAM NAME: Trout Creek | CROSS-SECTION NO.: 2 | DATE: 8-2-17 | SHEET 1 OF 2

GINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT | Gage Reading: ____ ft | TIME: 2:40 PM

Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft²)	Discharge (cfs)
RS	1.2		1.38								
	1.6		1.95								
G	1.8		2.38								
	2.4		4.04								
RW	3.9		4.10								
	5.0		4.4	0.30				0.09			
	6.0		4.6	0.50				0.70			
	7.0		4.4	0.30				1.02			
	8.0		4.5	0.40				1.59			
	9.0		4.3	0.20				0.23			
	9.5		4.65	0.55				1.41			
	10.0		4.5	0.40				1.85			
	10.5		4.5	0.40				1.09			
	11.0		4.6	0.50				0.88			
	11.5		4.45	0.35				1.39			
	12.0		4.35	0.25				1.56			
	12.5		4.35	0.25				1.94			
	13.0		4.55	0.45				1.07			
	13.5		4.5	0.40				0.94			
	14.0		4.45	0.35				1.13			
	14.5		4.15	0.05				0.60			
	15.0		4.4	0.30				0.67			
	15.5		4.55	0.45				1.09			
	16.0		4.15	0.05				0.76			
	16.5		4.35	0.25				0.23			
	17.0		4.3	0.20				0.49			
	18.0		4.4	0.30				1.55			
	19.0		4.6	0.50				1.66	23		
	19.5		4.65	0.55				1.56			
	20.0		4.6	0.50				1.44			
	20.5		4.5	0.40				1.99			
	21.0		4.50	0.40				1.26			
	22.0		4.35	0.25				1.67			
	23.0		4.35	0.25				1.63			
	24.0		4.35	0.25				0.71			
		see continuation sheet									
LW	28.9		4.10								
	30.3		4.01								
	31.8		3.42								
	33.0		2.84								
	35.0		2.52								
LS+G	37.0		2.46								
TOTALS:											

End of Measurement | Time: | Gage Reading: ____ ft | CALCULATIONS PERFORMED BY: | CALCULATIONS CHECKED BY:

continued next page →

FIELD DATA
FOR
INSTREAM FLOW DETERMINATIONS

COLORADO WATER
CONSERVATION BOARD

LOCATION INFORMATION

STREAM NAME: Trout Creek - continuation sheet				CROSS-SECTION NO.: 2
CROSS-SECTION LOCATION:				
DATE: 8-2-17	OBSERVERS: R. Smith, E. Scharff			
LEGAL DESCRIPTION	¼ SECTION:	SECTION:	TOWNSHIP: N/S	RANGE: E/W	PM:
COUNTY:	WATERSHED:	WATER DIVISION:	DOW WATER CODE:	
MAP(S):	USGS:			
	USFS:			

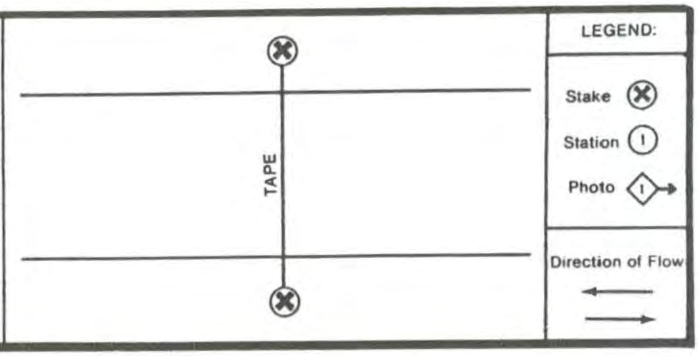
SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES / NO	METER TYPE:			
METER NUMBER:	DATE RATED:	CALIB/SPIN: ______ sec	TAPE WEIGHT: ______ lbs/foot	TAPE TENSION: ______ lbs
CHANNEL BED MATERIAL SIZE RANGE:	PHOTOGRAPHS TAKEN: YES/NO	NUMBER OF PHOTOGRAPHS:		

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	
⊗ Tape @ Stake RB	0.0	
① WS @ Tape LB/RB	0.0	
② WS Upstream		
③ WS Downstream		
SLOPE		

SKETCH



AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED: YES/NO	DISTANCE ELECTROFISHED: ______ ft	FISH CAUGHT: YES/NO	WATER CHEMISTRY SAMPLED: YES/NO

LENGTH - FREQUENCY DISTRIBUTION BY ONE-INCH SIZE GROUPS (1.0-1.9, 2.0-2.9, ETC.)

SPECIES (FILL IN)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>15	TOTAL

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME:

COMMENTS

DISCHARGE/CROSS SECTION NOTES

STREAM NAME: Trout Creek

CROSS-SECTION NO.: 2

DATE: 8/2

SHEET 2 OF 2

BEGINNING OF MEASUREMENT

EDGE OF WATER LOOKING DOWNSTREAM: (0.0 AT STAKE) LEFT / RIGHT

Gage Reading: _____ ft

TIME: continued from previous sheet

Features: Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec)		Area (ft^2)	Discharge (cfs)
								At Point	Mean in Vertical		
	25.0		4.3	0.20				1.15			
	26.0		4.2	0.10				0.76			
	27.0		4.3	0.20				0.92			
	28.0		4.25	0.15				0.69			
TOTALS:											

End of Measurement Time: 3:10 PM Gage Reading: _____ ft

CALCULATIONS PERFORMED BY:

CALCULATIONS CHECKED BY:

COLORADO WATER CONSERVATION BOARD
INSTREAM FLOW / NATURAL LAKE LEVEL PROGRAM
STREAM CROSS-SECTION AND FLOW ANALYSIS

LOCATION INFORMATION

STREAM NAME:	Trout Creek
XS LOCATION:	0.5 mile upst fr conf w Little Trout Ck.
XS NUMBER:	2
DATE:	2-Aug-17
OBSERVERS:	R. Smith, E. Scherff
1/4 SEC:	SW NW
SECTION:	23
TWP:	4N
RANGE:	86W
PM:	Sixth
COUNTY:	Routt
WATERSHED:	Yampa River
DIVISION:	6
DOW CODE:	23533
USGS MAP:	0
USFS MAP:	0

SUPPLEMENTAL DATA

*** NOTE ***
Leave TAPE WT and TENSION
at defaults for data collected
with a survey level and rod

TAPE WT:	0.0106
TENSION:	99999

CHANNEL PROFILE DATA

SLOPE: 0.013

INPUT DATA CHECKED BY: ....DATE....................

ASSIGNED TO: …................………............................DATE...................

STREAM NAME: Trout Creek
XS LOCATION: 0.5 mile upst fr conf w Little Trout Ck.
XS NUMBER: 2

DATA POINTS= 45

VALUES COMPUTED FROM RAW FIELD DATA

FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
RS	1.20	1.38			0.00		0.00	0.00	0.0%
	1.60	1.95			0.00		0.00	0.00	0.0%
1 G	1.80	2.38			0.00		0.00	0.00	0.0%
	2.40	4.04			0.00		0.00	0.00	0.0%
RW	3.90	4.10	0.00	0.00	0.00		0.00	0.00	0.0%
	5.00	4.40	0.30	0.09	1.14	0.30	0.32	0.03	0.3%
	6.00	4.60	0.50	0.70	1.02	0.50	0.50	0.35	4.1%
	7.00	4.40	0.30	1.02	1.02	0.30	0.30	0.31	3.6%
	8.00	4.50	0.40	1.59	1.00	0.40	0.40	0.64	7.4%
	9.00	4.30	0.20	0.23	1.02	0.20	0.15	0.03	0.4%
	9.50	4.65	0.55	1.41	0.61	0.55	0.28	0.39	4.5%
	10.00	4.50	0.40	1.85	0.52	0.40	0.20	0.37	4.3%
	10.50	4.50	0.40	1.09	0.50	0.40	0.20	0.22	2.5%
	11.00	4.60	0.50	0.88	0.51	0.50	0.25	0.22	2.6%
	11.50	4.45	0.35	1.39	0.52	0.35	0.18	0.24	2.8%
	12.00	4.35	0.25	1.56	0.51	0.25	0.13	0.20	2.3%
	12.50	4.35	0.25	1.94	0.50	0.25	0.13	0.24	2.8%
	13.00	4.55	0.45	1.07	0.54	0.45	0.23	0.24	2.8%
	13.50	4.50	0.40	0.94	0.50	0.40	0.20	0.19	2.2%
	14.00	4.45	0.35	1.13	0.50	0.35	0.18	0.20	2.3%
	14.50	4.15	0.05	0.60	0.58	0.05	0.03	0.02	0.2%
	15.00	4.40	0.30	0.67	0.56	0.30	0.15	0.10	1.2%
	15.50	4.55	0.45	1.09	0.52	0.45	0.23	0.25	2.9%
	16.00	4.15	0.05	0.76	0.64	0.05	0.03	0.02	0.2%
	16.50	4.35	0.25	0.23	0.54	0.25	0.13	0.03	0.3%
	17.00	4.30	0.20	0.49	0.50	0.20	0.15	0.07	0.9%
	18.00	4.40	0.30	1.55	1.00	0.30	0.30	0.47	5.4%
	19.00	4.60	0.50	1.66	1.02	0.50	0.38	0.62	7.3%
	19.50	4.65	0.55	1.56	0.50	0.55	0.28	0.43	5.0%
	20.00	4.60	0.50	1.44	0.50	0.50	0.25	0.36	4.2%
	20.50	4.50	0.40	1.99	0.51	0.40	0.20	0.40	4.6%
	21.00	4.50	0.40	1.26	0.50	0.40	0.30	0.38	4.4%
	22.00	4.35	0.25	1.67	1.01	0.25	0.25	0.42	4.9%
	23.00	4.35	0.25	1.63	1.00	0.25	0.25	0.41	4.7%
	24.00	4.35	0.25	0.71	1.00	0.25	0.25	0.18	2.1%
	25.00	4.30	0.20	1.15	1.00	0.20	0.20	0.23	2.7%
	26.00	4.20	0.10	0.76	1.00	0.10	0.10	0.08	0.9%
	27.00	4.30	0.20	0.92	1.00	0.20	0.20	0.18	2.1%
	28.00	4.25	0.15	0.69	1.00	0.15	0.14	0.10	1.1%
LW	28.90	4.10	0.00	0.00	0.91		0.00	0.00	0.0%
	30.30	4.01			0.00		0.00	0.00	0.0%
	31.80	3.42			0.00		0.00	0.00	0.0%
	33.00	2.84			0.00		0.00	0.00	0.0%
	35.00	2.52			0.00		0.00	0.00	0.0%
1 LS & G	37.00	2.46			0.00		0.00	0.00	0.0%
TOTALS ----------------------					25.74	0.55 (Max.)	7.41	8.58	100.0%

Manning's n = 0.0637
Hydraulic Radius= 0.28774312

STREAM NAME: Trout Creek
XS LOCATION: 0.5 mile upst fr conf w Little Trout Ck.
XS NUMBER: 2

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	7.41	7.41	0.0%
3.85	7.41	14.31	93.2%
3.87	7.41	13.75	85.6%
3.89	7.41	13.18	77.9%
3.91	7.41	12.62	70.3%
3.93	7.41	12.05	62.7%
3.95	7.41	11.49	55.1%
3.97	7.41	10.93	47.5%
3.99	7.41	10.37	40.0%
4.01	7.41	9.81	32.4%
4.03	7.41	9.26	25.0%
4.05	7.41	8.71	17.6%
4.06	7.41	8.44	13.9%
4.07	7.41	8.18	10.4%
4.08	7.41	7.92	6.9%
4.09	7.41	7.66	3.4%
4.10	7.41	7.41	0.0%
4.11	7.41	7.16	-3.4%
4.12	7.41	6.91	-6.7%
4.13	7.41	6.66	-10.1%
4.14	7.41	6.42	-13.4%
4.15	7.41	6.17	-16.7%
4.17	7.41	5.68	-23.3%
4.19	7.41	5.20	-29.8%
4.21	7.41	4.73	-36.1%
4.23	7.41	4.27	-42.3%
4.25	7.41	3.83	-48.3%
4.27	7.41	3.40	-54.1%
4.29	7.41	3.00	-59.5%
4.31	7.41	2.61	-64.7%
4.33	7.41	2.25	-69.6%
4.35	7.41	1.91	-74.2%

WATERLINE AT ZERO
AREA ERROR = 4.100

STREAM NAME: Trout Creek
XS LOCATION: 0.5 mile upst fr conf w Little Trout Ck.
XS NUMBER: 2

Constant Manning's n

GL = lowest Grassline elevation corrected for sag

STAGING TABLE *WL* = Waterline corrected for variations in field measured water surface elevations and sag

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	2.46	35.17	1.61	2.19	56.69	37.30	100.0%	1.52	199.26	3.51
	3.10	30.40	1.20	1.55	36.39	31.99	85.8%	1.14	105.41	2.90
	3.15	30.28	1.15	1.50	34.87	31.83	85.3%	1.10	98.53	2.83
	3.20	30.16	1.11	1.45	33.36	31.66	84.9%	1.05	91.84	2.75
	3.25	30.04	1.06	1.40	31.85	31.49	84.4%	1.01	85.34	2.68
	3.30	29.92	1.01	1.35	30.36	31.32	84.0%	0.97	79.04	2.60
	3.35	29.79	0.97	1.30	28.86	31.15	83.5%	0.93	72.93	2.53
	3.40	29.67	0.92	1.25	27.38	30.99	83.1%	0.88	67.02	2.45
	3.45	29.54	0.88	1.20	25.90	30.80	82.6%	0.84	61.32	2.37
	3.50	29.39	0.83	1.15	24.42	30.62	82.1%	0.80	55.85	2.29
	3.55	29.25	0.78	1.10	22.96	30.43	81.6%	0.75	50.58	2.20
	3.60	29.10	0.74	1.05	21.50	30.24	81.1%	0.71	45.53	2.12
	3.65	28.96	0.69	1.00	20.05	30.05	80.6%	0.67	40.69	2.03
	3.70	28.81	0.65	0.95	18.60	29.86	80.0%	0.62	36.08	1.94
	3.75	28.67	0.60	0.90	17.17	29.67	79.5%	0.58	31.69	1.85
	3.80	28.52	0.55	0.85	15.74	29.48	79.0%	0.53	27.53	1.75
	3.85	28.38	0.50	0.80	14.31	29.29	78.5%	0.49	23.61	1.65
	3.90	28.23	0.46	0.75	12.90	29.10	78.0%	0.44	19.94	1.55
	3.95	28.09	0.41	0.70	11.49	28.91	77.5%	0.40	16.51	1.44
	4.00	27.94	0.36	0.65	10.09	28.72	77.0%	0.35	13.36	1.32
	4.05	27.03	0.32	0.60	8.71	27.77	74.5%	0.31	10.68	1.23
WL	4.10	25.00	0.30	0.55	7.41	25.74	69.0%	0.29	8.58	1.16
	4.15	24.52	0.25	0.50	6.17	25.25	67.7%	0.24	6.41	1.04
	4.20	23.66	0.21	0.45	4.97	24.33	65.2%	0.20	4.58	0.92
	4.25	21.81	0.18	0.40	3.83	22.41	60.1%	0.17	3.13	0.82
	4.30	19.25	0.15	0.35	2.80	19.79	53.1%	0.14	2.02	0.72
	4.35	13.88	0.14	0.30	1.91	14.33	38.4%	0.13	1.33	0.69
	4.40	11.92	0.11	0.25	1.27	12.28	32.9%	0.10	0.74	0.58
	4.45	9.33	0.08	0.20	0.73	9.59	25.7%	0.08	0.35	0.48
	4.50	5.40	0.06	0.15	0.34	5.58	15.0%	0.06	0.14	0.41
	4.55	2.89	0.05	0.10	0.13	2.98	8.0%	0.05	0.05	0.34
	4.60	1.24	0.03	0.05	0.03	1.27	3.4%	0.02	0.01	0.22
	4.65	0.00	#DIV/0!	0.00	0.00	0.00	0.0%	#DIV/0!	#DIV/0!	#DIV/0!

STREAM NAME: Trout Creek
XS LOCATION: 0.5 mile upst fr conf w Little Trout Ck.
XS NUMBER: 2

SUMMARY SHEET

MEASURED FLOW (Qm)=	8.58	cfs
CALCULATED FLOW (Qc)=	8.58	cfs
(Qm-Qc)/Qm * 100 =	0.0	%
MEASURED WATERLINE (WLm)=	4.10	ft
CALCULATED WATERLINE (WLc)=	4.10	ft
(WLm-WLc)/WLm * 100 =	0.0	%
MAX MEASURED DEPTH (Dm)=	0.55	ft
MAX CALCULATED DEPTH (Dc)=	0.55	ft
(Dm-Dc)/Dm * 100	0.0	%
MEAN VELOCITY=	1.16	ft/sec
MANNING'S N=	0.064	
SLOPE=	0.013	ft/ft
.4 * Qm =	3.4	cfs
2.5 * Qm=	21.5	cfs

RECOMMENDED INSTREAM FLOW:
============================

FLOW (CFS) ===========	PERIOD ========

RATIONALE FOR RECOMMENDATION:
============================

RECOMMENDATION BY: ……………….………..……............................... AGENCY..……………………......…....…....……...... DATE:......…...….....……………

CWCB REVIEW BY: ..…………………………....………………………………………………..…............. DATE:.................……………...…

STREAM NAME: Trout Creek
XS LOCATION: 0.5 mile upst fr conf w Little Trout Ck.
XS NUMBER: 2

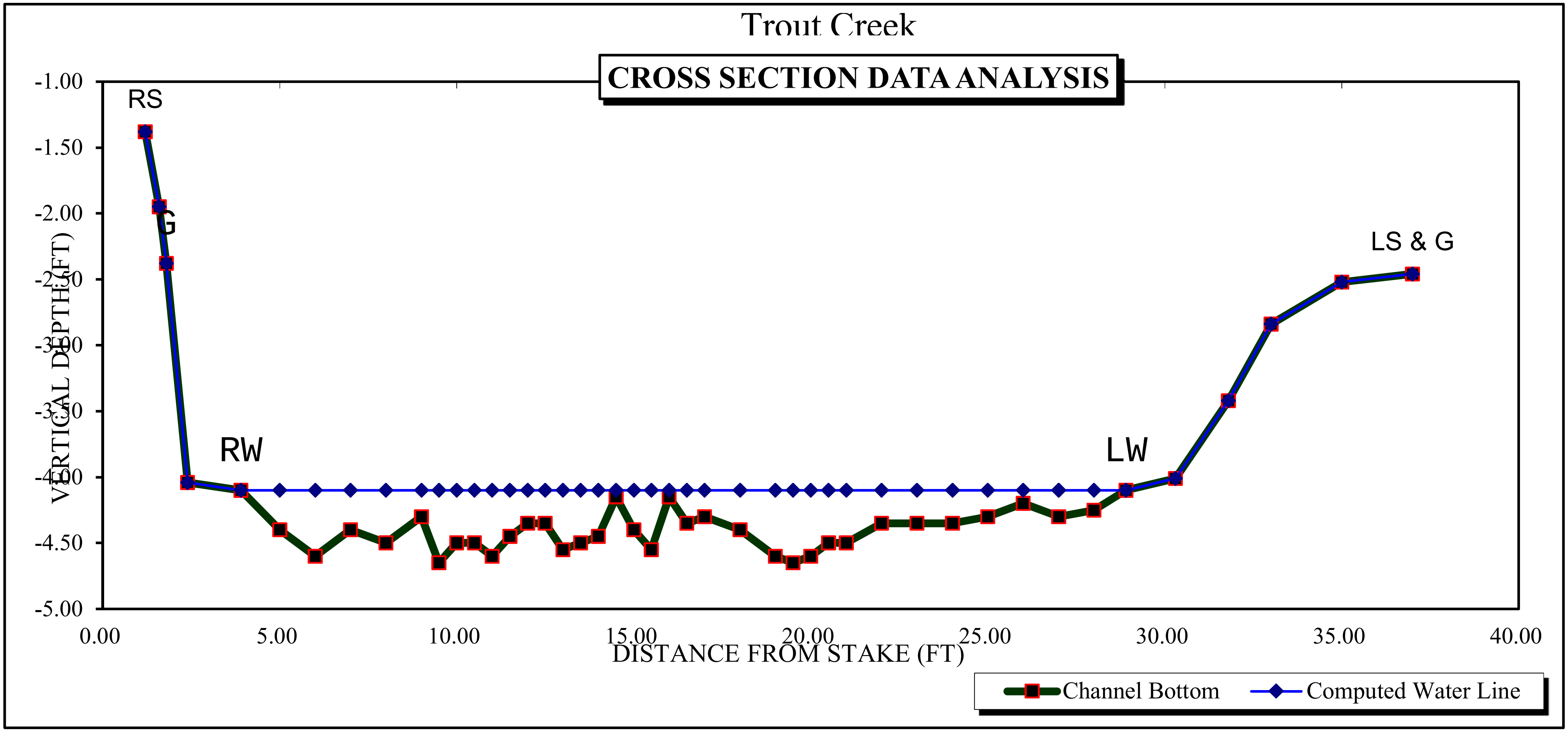
Jarrett Variable Manning's n Correction Applied

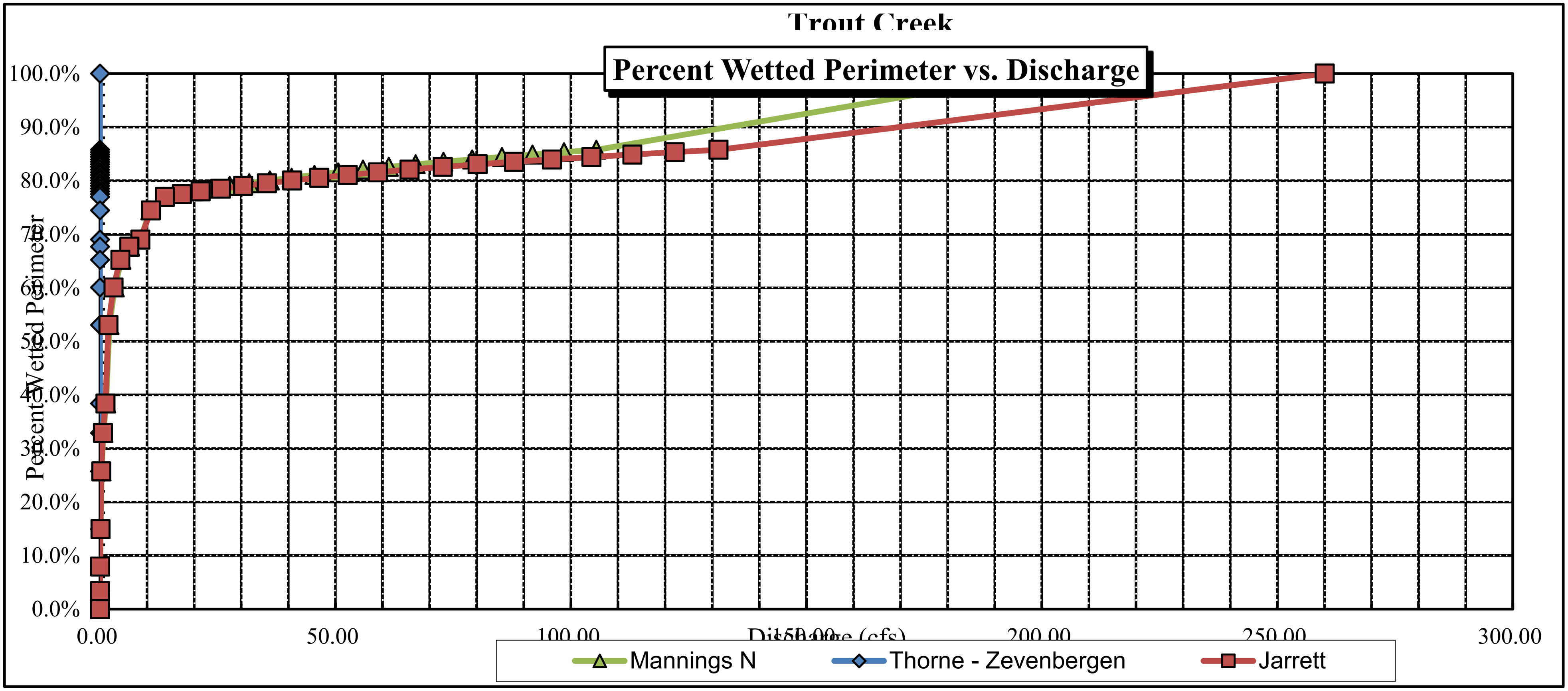
GL = lowest Grassline elevation corrected for sag

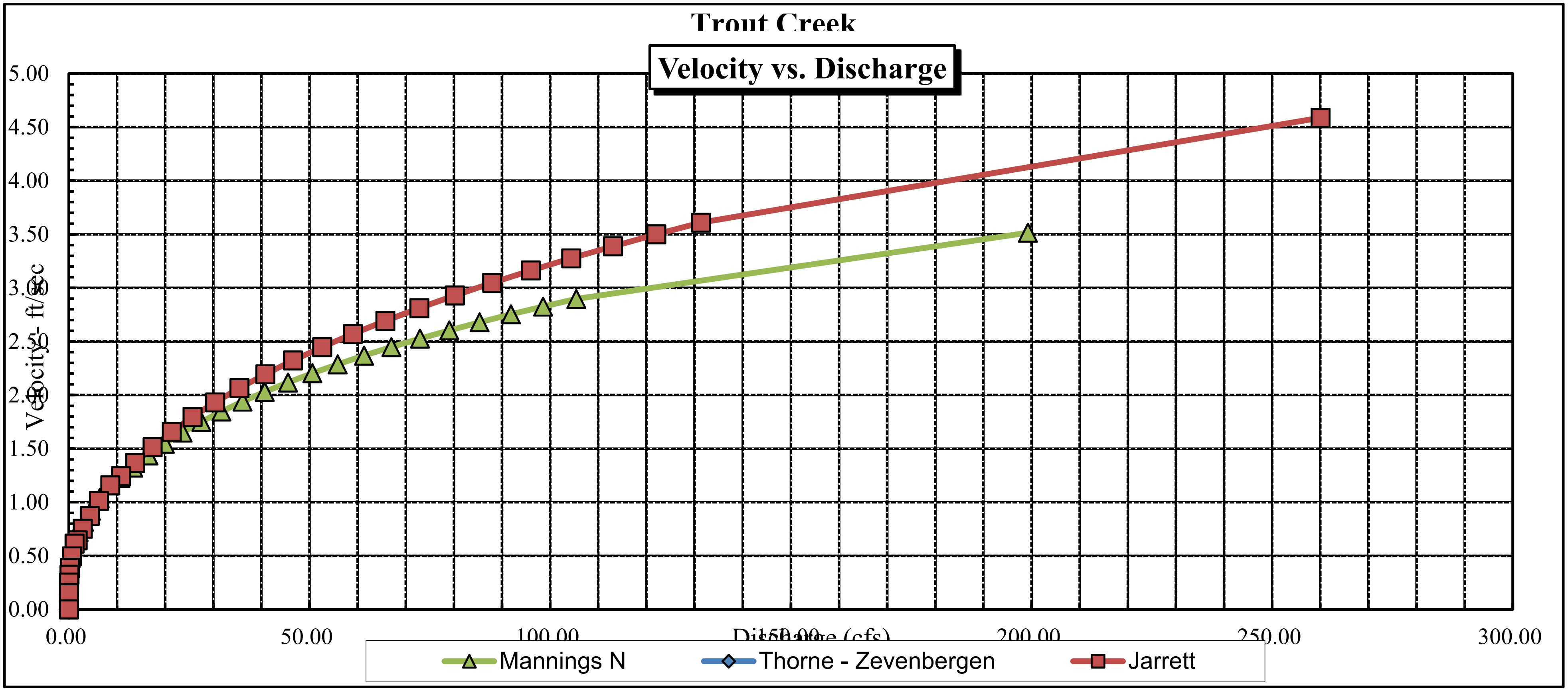
STAGING TABLE

WL = Waterline corrected for variations in field measured water surface elevations and sag

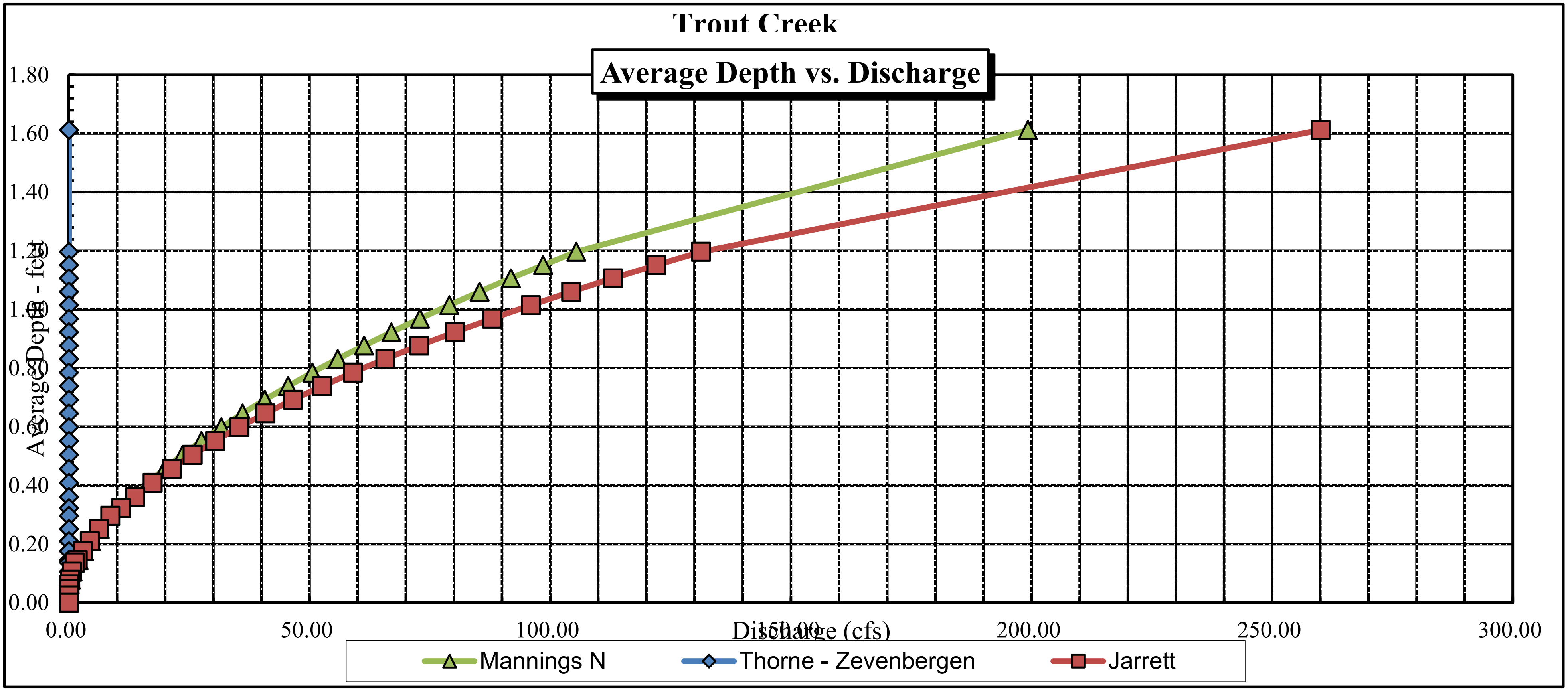
	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	2.46	35.17	1.61	2.19	56.69	37.30	100.0%	1.52	260.06	4.59
	3.10	30.40	1.20	1.55	36.39	31.99	85.8%	1.14	131.33	3.61
	3.15	30.28	1.15	1.50	34.87	31.83	85.3%	1.10	122.03	3.50
	3.20	30.16	1.11	1.45	33.36	31.66	84.9%	1.05	113.04	3.39
	3.25	30.04	1.06	1.40	31.85	31.49	84.4%	1.01	104.36	3.28
	3.30	29.92	1.01	1.35	30.36	31.32	84.0%	0.97	95.99	3.16
	3.35	29.79	0.97	1.30	28.86	31.15	83.5%	0.93	87.93	3.05
	3.40	29.67	0.92	1.25	27.38	30.99	83.1%	0.88	80.19	2.93
	3.45	29.54	0.88	1.20	25.90	30.80	82.6%	0.84	72.80	2.81
	3.50	29.39	0.83	1.15	24.42	30.62	82.1%	0.80	65.75	2.69
	3.55	29.25	0.78	1.10	22.96	30.43	81.6%	0.75	59.02	2.57
	3.60	29.10	0.74	1.05	21.50	30.24	81.1%	0.71	52.62	2.45
	3.65	28.96	0.69	1.00	20.05	30.05	80.6%	0.67	46.56	2.32
	3.70	28.81	0.65	0.95	18.60	29.86	80.0%	0.62	40.83	2.19
	3.75	28.67	0.60	0.90	17.17	29.67	79.5%	0.58	35.44	2.06
	3.80	28.52	0.55	0.85	15.74	29.48	79.0%	0.53	30.39	1.93
	3.85	28.38	0.50	0.80	14.31	29.29	78.5%	0.49	25.70	1.80
	3.90	28.23	0.46	0.75	12.90	29.10	78.0%	0.44	21.36	1.66
	3.95	28.09	0.41	0.70	11.49	28.91	77.5%	0.40	17.39	1.51
	4.00	27.94	0.36	0.65	10.09	28.72	77.0%	0.35	13.79	1.37
	4.05	27.03	0.32	0.60	8.71	27.77	74.5%	0.31	10.83	1.24
WL	4.10	25.00	0.30	0.55	7.41	25.74	69.0%	0.29	8.58	1.16
	4.15	24.52	0.25	0.50	6.17	25.25	67.7%	0.24	6.25	1.01
	4.20	23.66	0.21	0.45	4.97	24.33	65.2%	0.20	4.33	0.87
	4.25	21.81	0.18	0.40	3.83	22.41	60.1%	0.17	2.88	0.75
	4.30	19.25	0.15	0.35	2.80	19.79	53.1%	0.14	1.81	0.64
	4.35	13.88	0.14	0.30	1.91	14.33	38.4%	0.13	1.17	0.61
	4.40	11.92	0.11	0.25	1.27	12.28	32.9%	0.10	0.63	0.50
	4.45	9.33	0.08	0.20	0.73	9.59	25.7%	0.08	0.29	0.39
	4.50	5.40	0.06	0.15	0.34	5.58	15.0%	0.06	0.11	0.32
	4.55	2.89	0.05	0.10	0.13	2.98	8.0%	0.05	0.03	0.25
	4.60	1.24	0.03	0.05	0.03	1.27	3.4%	0.02	0.00	0.15
	4.65	0.00	#DIV/0!	0.00	0.00	0.00	0.0%	#DIV/0!	#DIV/0!	#DIV/0!

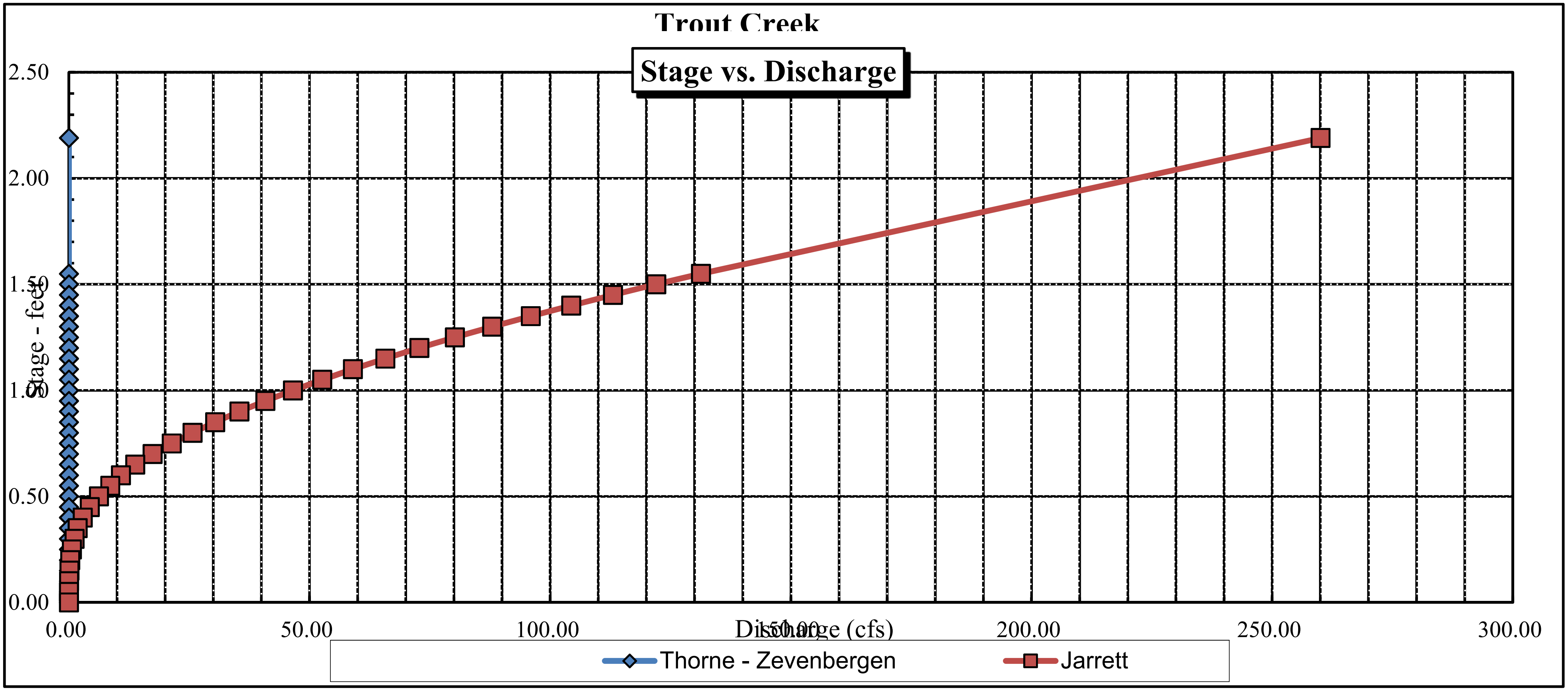

Trout Creek
CROSS SECTION DATA ANALYSIS
RS
G
RW
LW
LS & G
VERTICAL DEPTH (FT)
-1.00
-1.50
-2.00
-2.50
-3.00
-3.50
-4.00
-4.50
-5.00
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
DISTANCE FROM STAKE (FT)
Channel Bottom
Computed Water Line


Trout Creek
Percent Wetted Perimeter vs. Discharge
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Percent Wetted Perimeter
0.00
50.00
100.00
150.00
200.00
250.00
300.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett



Trout Creek
Velocity vs. Discharge
Velocity - ft/sec
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
50.00
100.00
150.00
200.00
250.00
300.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Trout Creek
Average Depth vs. Discharge
Average Depth - feet
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
50.00
100.00
150.00
200.00
250.00
300.00
Discharge (cfs)
Mannings N
Thorne - Zevenbergen
Jarrett


Trout Creek
Stage vs. Discharge
2.50
2.00
1.50
1.00
0.50
0.00
Stage - feet
0.00
50.00
100.00
150.00
200.00
250.00
300.00
Discharge (cfs)
Thorne - Zevenbergen
Jarrett

Data Input & Proofing

STREAM NAME: Trout Creek
XS LOCATION: 0.5 mile upst fr conf w Little Trout Ck.
XS NUMBER: 2
DATE: 8/2/2017
OBSERVERS: R. Smith, E. Scherff

1/4 SEC: SW NW
SECTION: 23
TWP: 4N
RANGE: 86W
PM: Sixth

COUNTY: Routt
WATERSHED: Yampa River
DIVISION: 6
DOW CODE: 23533
USGS MAP:
USFS MAP:
Level and Rod Survey ▼
TAPE WT: 0.0106 lbs / ft
TENSION: 99999 lbs

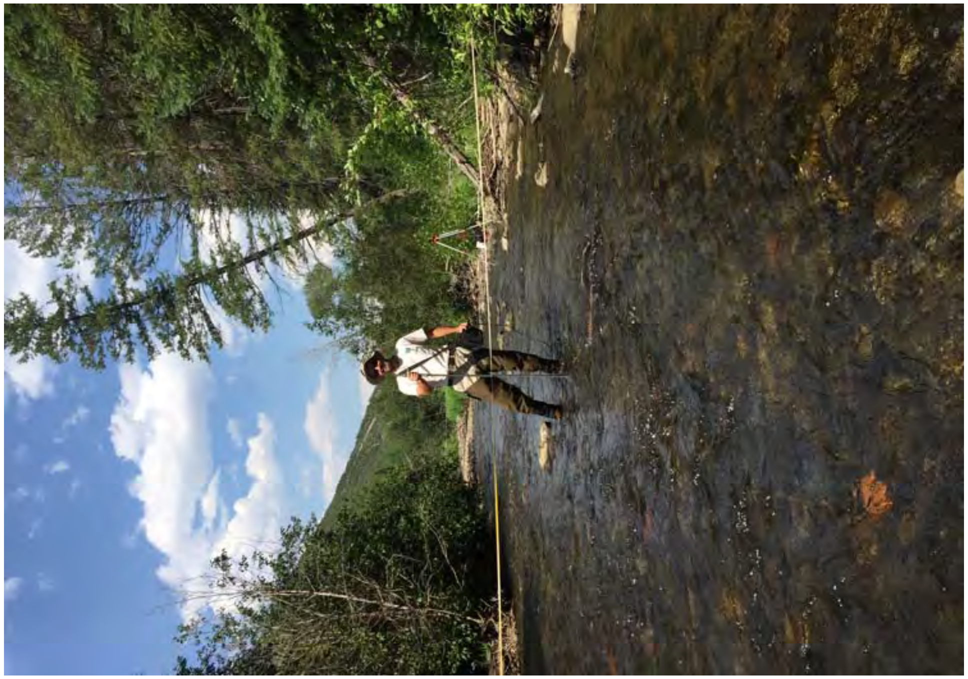
SLOPE: 0.013 ft / ft

CHECKED BY:..........……………………......DATE……………......

ASSIGNED TO: ......…………………….......DATE……………......

Total Data Points = 45

GL=1	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	A	Q	Tape to Water
	RS	1.20	1.38			0.00	0.00	0.00
		1.60	1.95			0.00	0.00	0.00
1	G	1.80	2.38			0.00	0.00	0.00
		2.40	4.04			0.00	0.00	0.00
	RW	3.90	4.10	0.00	0.00	0.00	0.00	0.00
		5.00	4.40	0.30	0.09	0.32	0.03	4.10
		6.00	4.60	0.50	0.70	0.50	0.35	4.10
		7.00	4.40	0.30	1.02	0.30	0.31	4.10
		8.00	4.50	0.40	1.59	0.40	0.64	4.10
		9.00	4.30	0.20	0.23	0.15	0.03	4.10
		9.50	4.65	0.55	1.41	0.28	0.39	4.10
		10.00	4.50	0.40	1.85	0.20	0.37	4.10
		10.50	4.50	0.40	1.09	0.20	0.22	4.10
		11.00	4.60	0.50	0.88	0.25	0.22	4.10
		11.50	4.45	0.35	1.39	0.18	0.24	4.10
		12.00	4.35	0.25	1.56	0.13	0.20	4.10
		12.50	4.35	0.25	1.94	0.13	0.24	4.10
		13.00	4.55	0.45	1.07	0.23	0.24	4.10
		13.50	4.50	0.40	0.94	0.20	0.19	4.10
		14.00	4.45	0.35	1.13	0.18	0.20	4.10
		14.50	4.15	0.05	0.60	0.03	0.02	4.10
		15.00	4.40	0.30	0.67	0.15	0.10	4.10
		15.50	4.55	0.45	1.09	0.23	0.25	4.10
		16.00	4.15	0.05	0.76	0.03	0.02	4.10
		16.50	4.35	0.25	0.23	0.13	0.03	4.10
		17.00	4.30	0.20	0.49	0.15	0.07	4.10
		18.00	4.40	0.30	1.55	0.30	0.47	4.10
		19.00	4.60	0.50	1.66	0.38	0.62	4.10
		19.50	4.65	0.55	1.56	0.28	0.43	4.10
		20.00	4.60	0.50	1.44	0.25	0.36	4.10
		20.50	4.50	0.40	1.99	0.20	0.40	4.10
		21.00	4.50	0.40	1.26	0.30	0.38	4.10
		22.00	4.35	0.25	1.67	0.25	0.42	4.10
		23.00	4.35	0.25	1.63	0.25	0.41	4.10
		24.00	4.35	0.25	0.71	0.25	0.18	4.10
		25.00	4.30	0.20	1.15	0.20	0.23	4.10
		26.00	4.20	0.10	0.76	0.10	0.08	4.10
		27.00	4.30	0.20	0.92	0.20	0.18	4.10
		28.00	4.25	0.15	0.69	0.14	0.10	4.10
	LW	28.90	4.10	0.00	0.00	0.00	0.00	0.00
		30.30	4.01			0.00	0.00	0.00
		31.80	3.42			0.00	0.00	0.00
		33.00	2.84			0.00	0.00	0.00
		35.00	2.52			0.00	0.00	0.00
1	LS & G	37.00	2.46			0.00	0.00	0.00
					Totals	7.41	8.58	



CWCB discharge measurement data
Collected using the ESRI Survey123 app on a Samsung tablet

Stream name	Trout Creek
Location description	Trout Creek - D6
Water division	6
Visit date	5/7/2018
Collected by CWCB staff	Jack Landers
Collected by non-CWCB staff	N/A
Non-CWCB entity	N/A
Measurement method	wadingADV
Equipment	Flowtracker2_sn_2H1747037
Site name	Trout Creek - D6
Measurement number	507
Weather	overcast, no recent precip
Wind	calm
Cross-section description	run, cobble substrate, confined by valley wall to south
Flow conditions	turbulent
Measurement start time	17:53
Flow amount	64.5796
Measurement rating	Good(5%)
Discharge comments:	Lots of beaver ponds and old dams in area, this xsec one of few good spots for measurement.
Location	13N 328640 4463623

COLORADO
Colorado Water
Conservation Board
Department of Natural Resources

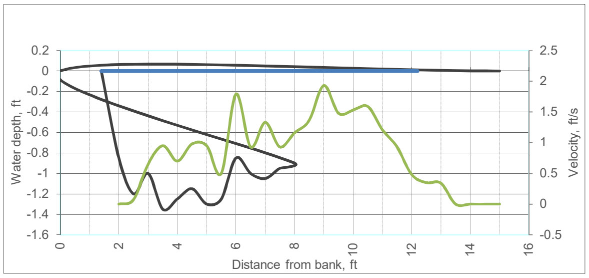
CWCB discharge measurement data
Collected using the ESRI Survey123 app on a Samsung tablet

Stream name	Trout Creek
Location description	Trout Creek and beaver ponds
Water division	6
Visit date	10/10/2018
Collected by CWCB staff	Other, Rob Viehl
Collected by non-CWCB staff	Jay Skinner
Non-CWCB entity	CPW
Measurement method	wadingMMcB
Equipment	Marsh McBirney
Site name	
Measurement number	2
Weather	cold cloudy,misty
Wind	No wind
Cross-section description	
Flow conditions	slightly turbulent
Measurement start time	09:45
Flow amount	9.59
Measurement rating	Good(5%)
Discharge comments:	
Location	13N 328736 4463735

Flow Measurement Calculations

Stream:Trout Creek
Date: 10/9/2018 **Time:945 AM**
Observers: Rob Viehl Jay Skinner
County: Routt
Water Division: 6
Latitude:
Longitude:
Location Description: above LT Beaver Ponds
Comments:
Other:

Station, ft	**Width, ft**	**Depth, ft**	**Velocity, ft/s**	**Area, ft2**	**Discharge, cfs**	**%**
1.4	water line	0	0			
2	0.5	0.85	0	0.425	0	0.0%
2.5	0.5	1.2	0.07	0.6	0.042	0.4%
3	0.5	1	0.65	0.5	0.325	3.4%
3.5	0.5	1.35	0.95	0.675	0.64125	6.7%
4	0.5	1.25	0.7	0.625	0.4375	4.6%
4.5	0.5	1.15	0.98	0.575	0.5635	5.9%
5	0.5	1.3	0.95	0.65	0.6175	6.4%
5.5	0.5	1.25	0.5	0.625	0.3125	3.3%
6	0.5	0.85	1.79	0.425	0.76075	7.9%
6.5	0.5	1	0.93	0.5	0.465	4.8%
7	0.5	1.05	1.33	0.525	0.69825	7.3%
7.5	0.5	0.95	0.93	0.475	0.44175	4.6%
8	0.5	0.9	1.16	0.45	0.522	5.4%
8.5	0.5	0.75	1.36	0.375	0.51	5.3%
9	0.5	0.7	1.93	0.35	0.6755	7.0%
9.5	0.5	0.9	1.48	0.45	0.666	6.9%
10	0.5	0.8	1.53	0.4	0.612	6.4%
10.5	0.5	0.7	1.59	0.35	0.5565	5.8%
11	0.5	0.6	1.21	0.3	0.363	3.8%
11.5	0.5	0.45	0.93	0.225	0.20925	2.2%
12	0.5	0.4	0.48	0.2	0.096	1.0%
12.5	0.5	0.2	0.35	0.1	0.035	0.4%
13	0.5	0.25	0.34	0.125	0.0425	0.4%
13.5	0.5	0.2	0	0.1	0	0.0%
14	0.5	0.1	0	0.05	0	0.0%
14.5	0.5	0.05	0	0.025	0	0.0%
15	water line	0	0	0	0	0.0%
				FLOW =	**9.59**	



Graph Data

Bed elevation

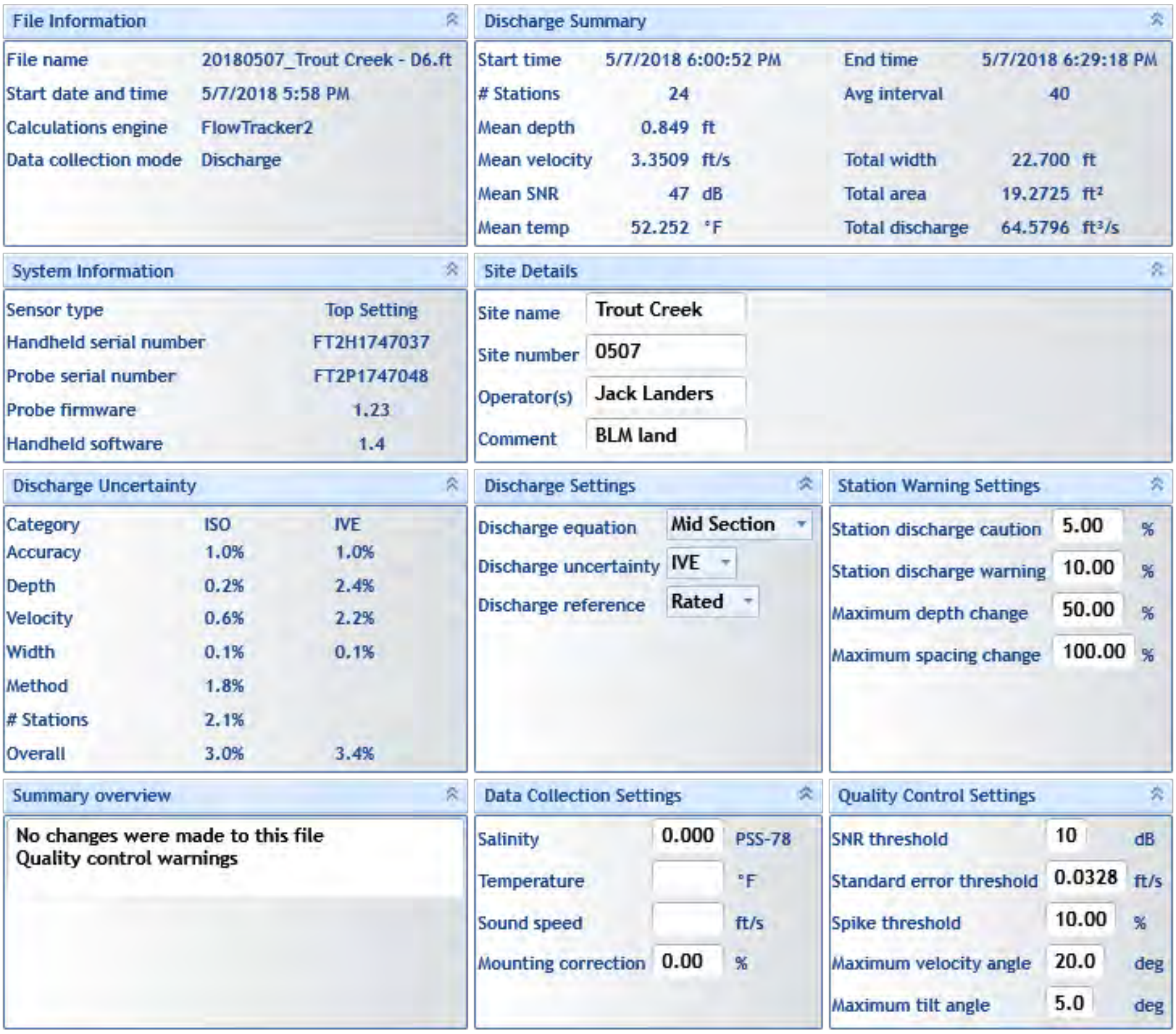
1.4	0
2	-0.85
2.5	-1.2
3	-1
3.5	-1.35
4	-1.25
4.5	-1.15
5	-1.3
5.5	-1.25
6	-0.85
6.5	-1
7	-1.05
7.5	-0.95
8	-0.9
#REF!	#REF!
15	0

Waterline

1.4	0
12.2	0

11/20/2018 12:10:06 PM

Discharge Measurement Summary



File Information

File name	20180507_Trout Creek - D6.ft
Start date and time	5/7/2018 5:58 PM
Calculations engine	FlowTracker2
Data collection mode	Discharge

Discharge Summary

Start time	5/7/2018 6:00:52 PM		End time	5/7/2018 6:29:18 PM	
# Stations	24		Avg interval	40	
Mean depth	0.849	ft			
Mean velocity	3.3509	ft/s	Total width	22.700	ft
Mean SNR	47	dB	Total area	19.2725	ft²
Mean temp	52.252	°F	Total discharge	64.5796	ft³/s

System Information

Sensor type	Top Setting
Handheld serial number	FT2H1747037
Probe serial number	FT2P1747048
Probe firmware	1.23
Handheld software	1.4

Site Details

Site name	Trout Creek
Site number	0507
Operator(s)	Jack Landers
Comment	BLM land

Discharge Uncertainty

Category	ISO	IVE
Accuracy	1.0%	1.0%
Depth	0.2%	2.4%
Velocity	0.6%	2.2%
Width	0.1%	0.1%
Method	1.8%	
# Stations	2.1%	
Overall	3.0%	3.4%

Discharge Settings

Discharge equation	Mid Section
Discharge uncertainty	IVE
Discharge reference	Rated

Station Warning Settings

Station discharge caution	5.00	%
Station discharge warning	10.00	%
Maximum depth change	50.00	%
Maximum spacing change	100.00	%

Summary overview

No changes were made to this file
Quality control warnings

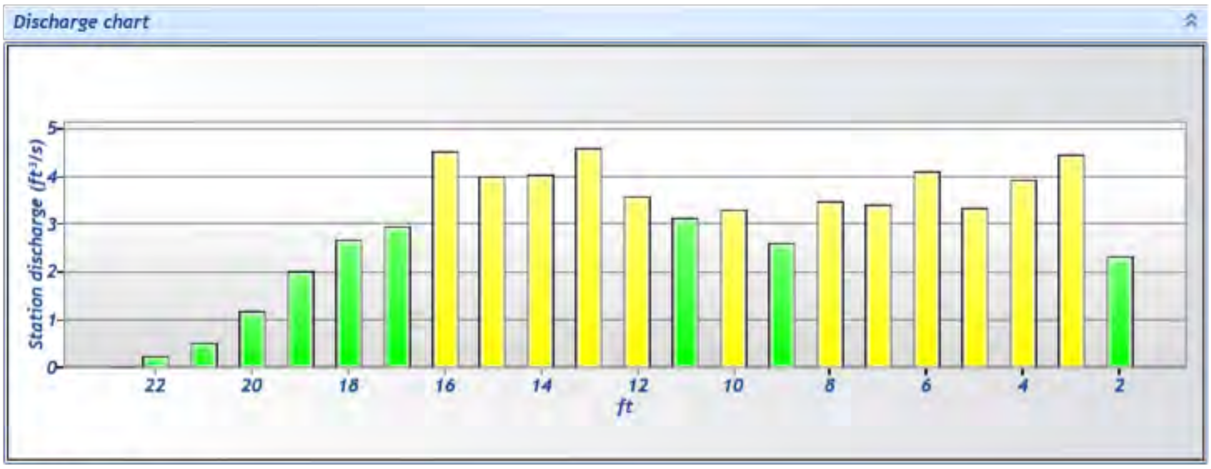
Data Collection Settings

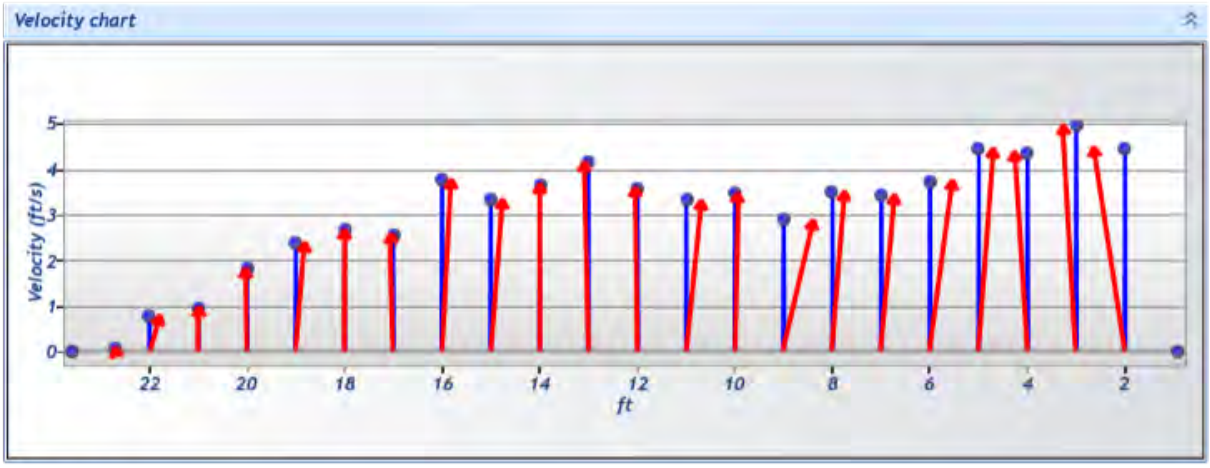
Salinity	0.000	PSS-78
Temperature		°F
Sound speed		ft/s
Mounting correction	0.00	%

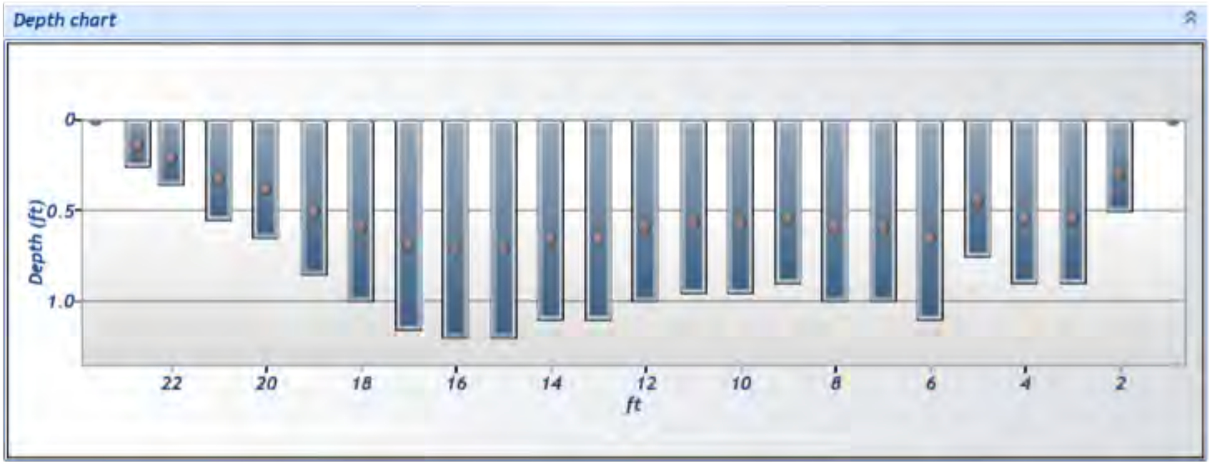
Quality Control Settings

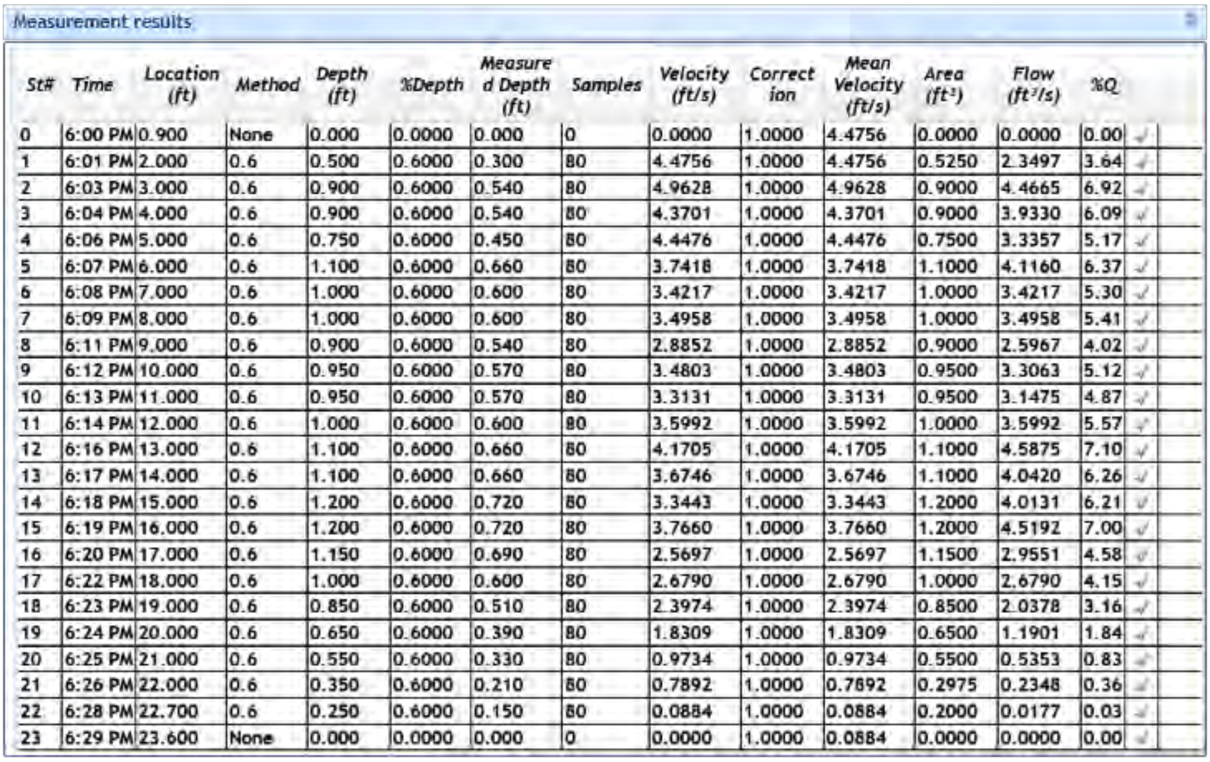
SNR threshold	10	dB
Standard error threshold	0.0328	ft/s
Spike threshold	10.00	%
Maximum velocity angle	20.0	deg
Maximum tilt angle	5.0	deg

11/20/2018 12:10:06 PM



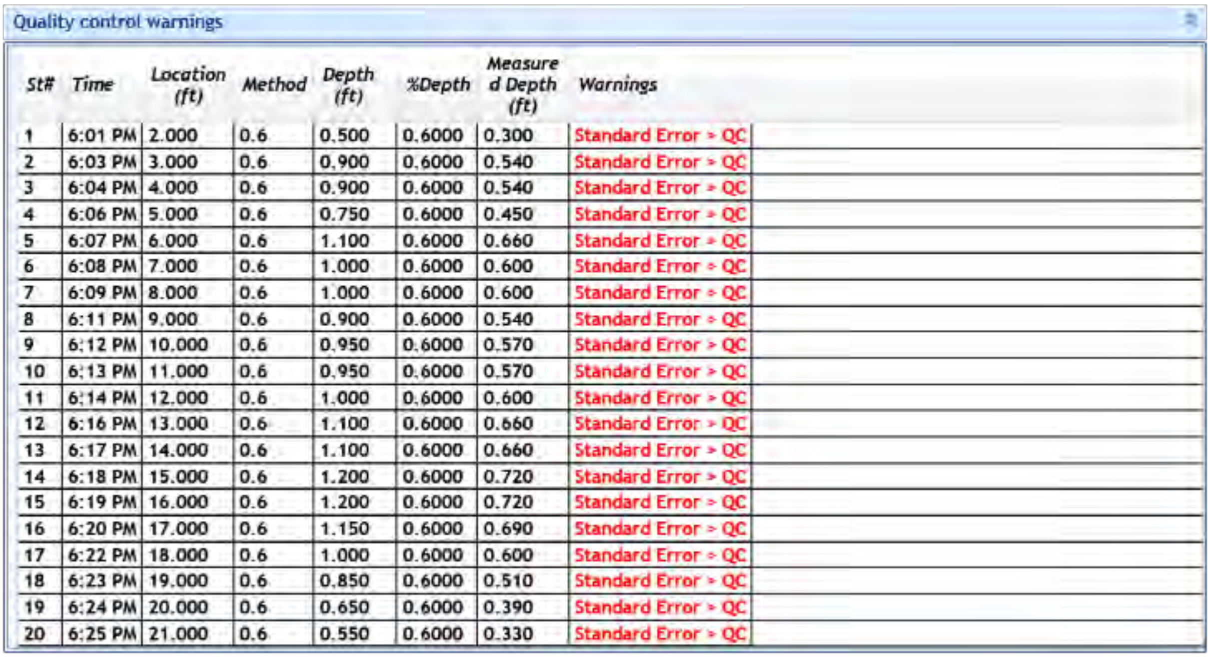






Measurement results

St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Samples	Velocity (ft/s)	Correction	Mean Velocity (ft/s)	Area (ft^2)	Flow (ft^3/s)	%Q	
0	6:00 PM	0.900	None	0.000	0.0000	0.000	0	0.0000	1.0000	4.4756	0.0000	0.0000	0.00	✓
1	6:01 PM	2.000	0.6	0.500	0.6000	0.300	80	4.4756	1.0000	4.4756	0.5250	2.3497	3.64	✓
2	6:03 PM	3.000	0.6	0.900	0.6000	0.540	80	4.9628	1.0000	4.9628	0.9000	4.4665	6.92	✓
3	6:04 PM	4.000	0.6	0.900	0.6000	0.540	80	4.3701	1.0000	4.3701	0.9000	3.9330	6.09	✓
4	6:06 PM	5.000	0.6	0.750	0.6000	0.450	80	4.4476	1.0000	4.4476	0.7500	3.3357	5.17	✓
5	6:07 PM	6.000	0.6	1.100	0.6000	0.660	80	3.7418	1.0000	3.7418	1.1000	4.1160	6.37	✓
6	6:08 PM	7.000	0.6	1.000	0.6000	0.600	80	3.4217	1.0000	3.4217	1.0000	3.4217	5.30	✓
7	6:09 PM	8.000	0.6	1.000	0.6000	0.600	80	3.4958	1.0000	3.4958	1.0000	3.4958	5.41	✓
8	6:11 PM	9.000	0.6	0.900	0.6000	0.540	80	2.8852	1.0000	2.8852	0.9000	2.5967	4.02	✓
9	6:12 PM	10.000	0.6	0.950	0.6000	0.570	80	3.4803	1.0000	3.4803	0.9500	3.3063	5.12	✓
10	6:13 PM	11.000	0.6	0.950	0.6000	0.570	80	3.3131	1.0000	3.3131	0.9500	3.1475	4.87	✓
11	6:14 PM	12.000	0.6	1.000	0.6000	0.600	80	3.5992	1.0000	3.5992	1.0000	3.5992	5.57	✓
12	6:16 PM	13.000	0.6	1.100	0.6000	0.660	80	4.1705	1.0000	4.1705	1.1000	4.5875	7.10	✓
13	6:17 PM	14.000	0.6	1.100	0.6000	0.660	80	3.6746	1.0000	3.6746	1.1000	4.0420	6.26	✓
14	6:18 PM	15.000	0.6	1.200	0.6000	0.720	80	3.3443	1.0000	3.3443	1.2000	4.0131	6.21	✓
15	6:19 PM	16.000	0.6	1.200	0.6000	0.720	80	3.7660	1.0000	3.7660	1.2000	4.5192	7.00	✓
16	6:20 PM	17.000	0.6	1.150	0.6000	0.690	80	2.5697	1.0000	2.5697	1.1500	2.9551	4.58	✓
17	6:22 PM	18.000	0.6	1.000	0.6000	0.600	80	2.6790	1.0000	2.6790	1.0000	2.6790	4.15	✓
18	6:23 PM	19.000	0.6	0.850	0.6000	0.510	80	2.3974	1.0000	2.3974	0.8500	2.0378	3.16	✓
19	6:24 PM	20.000	0.6	0.650	0.6000	0.390	80	1.8309	1.0000	1.8309	0.6500	1.1901	1.84	✓
20	6:25 PM	21.000	0.6	0.550	0.6000	0.330	80	0.9734	1.0000	0.9734	0.5500	0.5353	0.83	✓
21	6:26 PM	22.000	0.6	0.350	0.6000	0.210	80	0.7892	1.0000	0.7892	0.2975	0.2348	0.36	✓
22	6:28 PM	22.700	0.6	0.250	0.6000	0.150	80	0.0884	1.0000	0.0884	0.2000	0.0177	0.03	✓
23	6:29 PM	23.600	None	0.000	0.0000	0.000	0	0.0000	1.0000	0.0884	0.0000	0.0000	0.00	✓



Quality control warnings

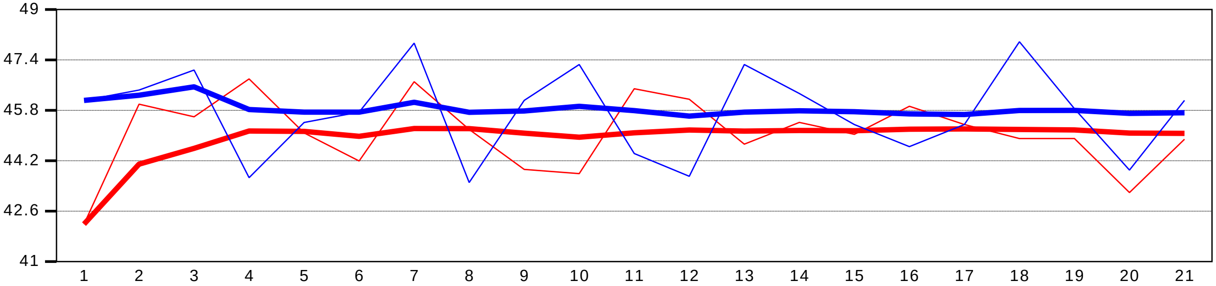
St#	Time	Location (ft)	Method	Depth (ft)	%Depth	Measured Depth (ft)	Warnings
1	6:01 PM	2.000	0.6	0.500	0.6000	0.300	Standard Error > QC
2	6:03 PM	3.000	0.6	0.900	0.6000	0.540	Standard Error > QC
3	6:04 PM	4.000	0.6	0.900	0.6000	0.540	Standard Error > QC
4	6:06 PM	5.000	0.6	0.750	0.6000	0.450	Standard Error > QC
5	6:07 PM	6.000	0.6	1.100	0.6000	0.660	Standard Error > QC
6	6:08 PM	7.000	0.6	1.000	0.6000	0.600	Standard Error > QC
7	6:09 PM	8.000	0.6	1.000	0.6000	0.600	Standard Error > QC
8	6:11 PM	9.000	0.6	0.900	0.6000	0.540	Standard Error > QC
9	6:12 PM	10.000	0.6	0.950	0.6000	0.570	Standard Error > QC
10	6:13 PM	11.000	0.6	0.950	0.6000	0.570	Standard Error > QC
11	6:14 PM	12.000	0.6	1.000	0.6000	0.600	Standard Error > QC
12	6:16 PM	13.000	0.6	1.100	0.6000	0.660	Standard Error > QC
13	6:17 PM	14.000	0.6	1.100	0.6000	0.660	Standard Error > QC
14	6:18 PM	15.000	0.6	1.200	0.6000	0.720	Standard Error > QC
15	6:19 PM	16.000	0.6	1.200	0.6000	0.720	Standard Error > QC
16	6:20 PM	17.000	0.6	1.150	0.6000	0.690	Standard Error > QC
17	6:22 PM	18.000	0.6	1.000	0.6000	0.600	Standard Error > QC
18	6:23 PM	19.000	0.6	0.850	0.6000	0.510	Standard Error > QC
19	6:24 PM	20.000	0.6	0.650	0.6000	0.390	Standard Error > QC
20	6:25 PM	21.000	0.6	0.550	0.6000	0.330	Standard Error > QC

11/20/2018 12:10:06 PM

Automated beam check Start time 5/7/2018 6:00:09 PM

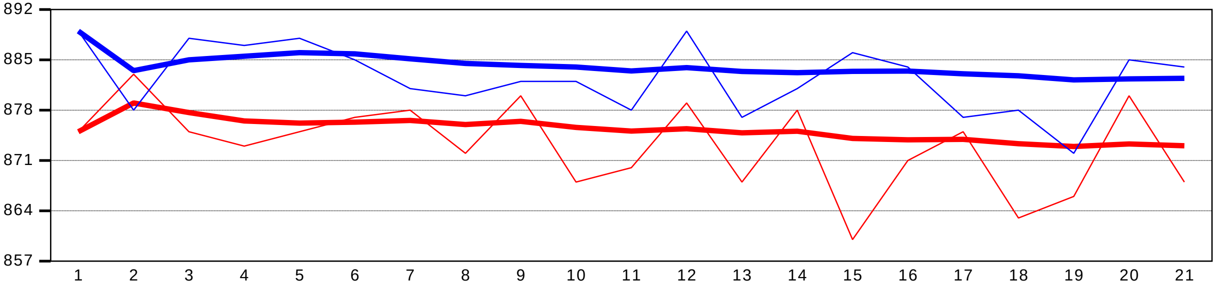
Automated beam check SNR(dB)

PASS



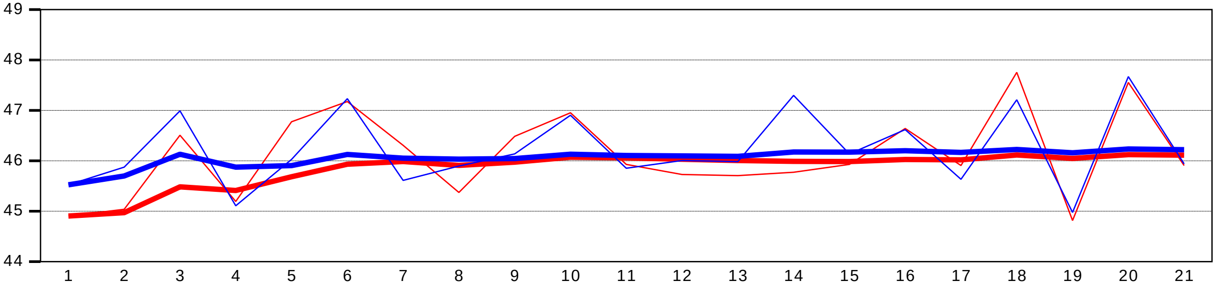
Automated beam check Noise level(cnts)

PASS



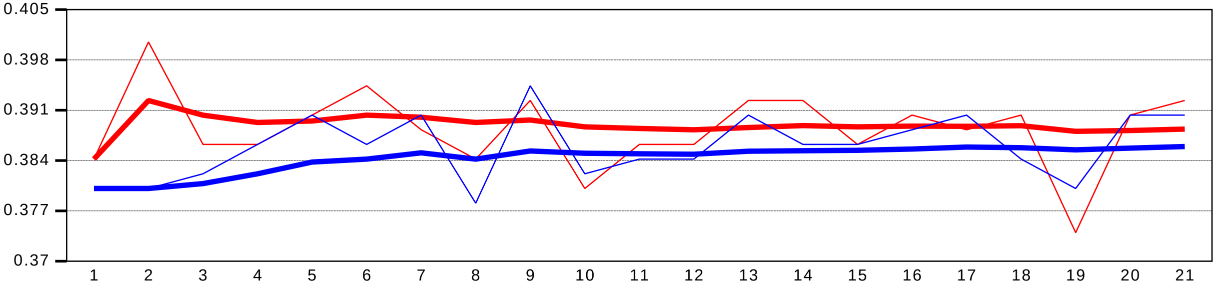
Automated beam check Peak level(dB)

PASS



Automated beam check Peak position(ft)

PASS



Automated beam check Quality control warnings

No quality control warnings

WWCENGINEERING
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February 18, 2010

Permit C-1980-001
Annual Hydrology Report

RECEIVED
FEB 19 2010
Division of Reclamation,
Mining and Safety

Mr. Jason Musick
Colorado Division of Reclamation, Mining and Safety
1313 Sherman Street
Room 215
Denver, Colorado 80203-2273

RE: Edna Mine 2009 Annual Hydrology Report

Dear Mr. Musick:

Enclosed is the 2009 Annual Hydrology Report for the Edna Mine. Should the Colorado Division of Reclamation, Mining and Safety have any comments or concerns regarding this submittal, please contact me at your convenience.

Sincerely,

Troy Summers
Project Manager

TNS
Enclosures
File: 99-144

cc: Chevron (Leach)
Permit (Weinman)

2009 ANNUAL HYDROLOGY REPORT

EDNA MINE
PERMIT CO-80-001
ROUTT COUNTY, CO

FEBRUARY 2010

Prepared For: Chevron Mining Inc.
116 Inverness Drive East, Suite 207
Englewood, CO 80112

Submitted To: Colorado Division of Reclamation Mining & Safety
1313 Sherman Street, Room 215
Denver, Colorado 80203-2273

Prepared By: WWC Engineering
611 Skyline Road
Laramie, Wyoming 82070

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1.0 INTRODUCTION

A water quality monitoring program was initiated at the Edna Mine to monitor specific chemical characteristics of Trout Creek and the alluvium associated with Trout Creek which may be affected by mining and reclamation operations. This program is detailed enough to describe seasonal variations in concentration levels of the parameters monitored, as well as indicate if mining activities and/or reclamation activities are impacting the natural seasonal fluctuations.

The purpose of this report is to provide updated information pertaining to the on-going hydrologic monitoring program developed for the Edna Mine and discuss trends in surface and ground water quality. The previous report, dated February 2009, reported monitoring activities up through the end of 2008. This report provides a discussion on each of the parameters monitored which have been collected through 2009.

The report is divided into several sections including: Hydrologic Monitoring Network; Surface Water; Ground Water; Surface Water and Ground Water Interactions; Quality Assurance; Spring and Seep Survey; and Moffat Stability Monuments.

2.0 HYDROLOGIC MONITORING NETWORK

The present monitoring network is a modification of the network used during baseline monitoring. Continuous streamflow records are made for Trout Creek above the mine (TR-a) from May through October (periods of freezing sometimes necessitate the records to be of shorter duration). Instantaneous streamflow was recorded on Trout Creek below the Moffat mining area at TR-b prior to July 1994. During June 1994, a continuous streamflow recorder was installed at TR-b. Therefore, monitoring data after June 1994 has been collected on the same schedule as at TR-a. Surface water samples are collected above and below the mine at TR-A and TR-D, respectively. Additional surface water sampling sites along Trout Creek are TR-B (located adjacent to the East Ridge area) and TR-C (located adjacent to the Moffat area).

Ground water levels and samples are collected from four wells. Three wells are completed in the alluvium along Trout Creek (TR-1.5, TR-3 and TR-4) and one well is completed in the spoils (WR-1) located at the base of the West Ridge area. An additional water quality well is completed in the Trout Creek Sandstone (TCS-1) monitored downdip of mining activity. Water monitoring locations are shown on Plate 1.

The samples are analyzed for the parameters listed in Table 4.6-54, Section 4.6.8.4 of the permit. Sampling frequency at the various sites is also listed in Table 4.6-54. Parameters measured in the field include: pH, temperature, and specific conductivity. All other parameters measured are analytically derived at an independent laboratory.

The monitoring program has been altered via Technical Revisions 47 and 48. Monitoring wells 215W, 215L, 218W, 218L, M892S and M892L were discontinued September 21, 2007 in accordance with TR-47. Monitoring wells TR-1.5, TR-3, TR-4, WR-1 and TCS-1, surface water flow monitoring sites TR-a and TR-b and surface water quality monitoring sites TR-A, TR-B, TR-C and TR-D were discontinued September 2, 2009 in accordance with TR-48.

3.0 SURFACE WATER

As previously mentioned, Trout Creek is monitored for water quality at sites TR-A, TR-B, TR-C and TR-D and for flow at sites TR-a and TR-b. The following section discusses quantity and quality of surface water at the Edna Mine.

3.1 Gauging Stations

Chart 1 shows the continuous streamflow records for Trout Creek at TR-a and TR-b. The flow measurements along Trout Creek indicate that the monitoring program is being placed on-line early enough in the year to record flow prior to the peak runoff period for each year. The individual data points show the monthly average flows and give some indication of the variability between mild winters (winters of less snow accumulation) and harsh winters (winters of greater snow accumulation). The streamflow during 2009 is elevated compared with previous years with a slight decline from 2008. The chart indicates that 2009 was an average/harsh winter for the past two decades.

The flow record for 2009 shows a peak flow to have occurred in May. The peak flow historically occurs in either May or June. The runoff from the mine site was higher in 2009 than the majority of previous years probably due to more snowpack on the mine site and the on-set of warmer temperatures occurring later in the spring.

The flow data presented in Chart 1 consists only of information derived from continuous flow records. Instantaneous flow measurements obtained between 1989 and June 1994 for TR-b are provided in Table 1. Prior to 1994, instability of the stream channel caused by a 1984 flood precluded the installation of any type of monitoring station in the vicinity of TR-b. The Stevens chart recorders were replaced with electronic streamflow recorders in April 2003.

The bridge located immediately downstream of TR-a was replaced in the fall of 2001 potentially altering the stage rating curve. Therefore, the decision was made to update the stage/discharge curves for TR-a and TR-b. Over the 2001 season, a total of nine cross-sections and associated velocities were measured at each cross section location. This data was used to compute a stage rating curve at each location.

The stage rating curve for TR-a was developed from flows ranging from 11 cfs to 145 cfs. The curve equation and r^2 for the curve are as follows: $y = 44.469x^{3.2806}$, where y = flow in cfs and x = depth of flow; $r^2 = 0.98$. Flows for 2009 are in accordance with the range used to develop the rating curve; therefore, the calculated flow is considered accurate.

The stage rating curve for TR-b was developed from flows ranging from 13 cfs to 144 cfs. The curve equation and r^2 for the curve are as follows: $y = 65.049x^{2.431}$, where y = flow in cfs and x = depth of flow; $r^2 = 0.99$. Flows for May of 2009 were above the 144 cfs used to develop the rating curve; therefore, this calculated flow may to be high. The stream flow data appears to indicate a good correlation between the upstream and downstream flows along Trout Creek.

To ensure the accuracy of the stream flow data, channel cross-sections at Site TR-a and TR-b are surveyed annually to verify streambed stability. Figure 1 shows channel cross-sections that were developed as part of an annual survey. These results confirm that the streambed configuration has remained fairly constant and therefore verify streambed stability.

Irrigation ditch flow observations (flowing/not flowing and approximate flow) were made monthly from April through September of 2009 at Site TR-A. Flow was observed in the irrigation ditch at site TR-A during June of 2009. Instantaneous flow observations are provided in Table 2.

3.2 NPDES Monitoring

Monitoring of point discharges from sedimentation impoundments is accomplished under Colorado Department of Public Health and Environment Colorado Permit Discharge System Permit CO-0032638. Copies of required Discharge Monitoring Reports are provided to the Colorado Division of Reclamation, Mining and Safety under separate cover, and are included in this report by reference.

3.3 Surface Water Quality

Surface water sampling is performed in accordance with EPA approved methods and instrumentation. As previously mentioned, the water quality along Trout Creek is monitored via the parameters listed on Table 4.6-54, Section 4.6.8.4 of the permit. Tabular analyses results for monitoring sites TR-A, TR-B, TR-C and TR-D are found in Tables 3, 4, 5 and 6. Results of the analyses are discussed below.

3.3.1 Surface Water Temperature

Chart 2 shows temperature values for monitoring sites TR-A, TR-B, TR-C and TR-D for the period of record. Temperature exhibited the same trends in 2009 as found during baseline studies and previous years monitoring. Specifically, patterns in temperature are seasonal, warming until July or August and than cooling throughout the remaining sampling season. Surface water temperature for 2009 was colder than average for the period of record due to a harsh winter and cool ambient temperatures. The lowest temperature in 2009 was recorded at monitoring site TR-A in April with a reading of 4.8 °C and the high was recorded at monitoring site TR-B in August with a reading of 17.0 °C.

3.3.2 Surface Water pH

Chart 3 shows pH concentrations for monitoring sites TR-A, TR-B, TR-C and TR-D for the period of record. Values of pH during 2009 were consistent with baseline studies and previous monitoring. There is no apparent trend regarding pH although only slight variations occur during the monitoring season. Overall, Trout Creek has remained slightly alkaline throughout the period of record. The lowest pH value in 2009 was recorded at monitoring site TR-D in April with a reading of 7.05 standard units and the high was recorded at monitoring site TR-A in August with a reading of 8.65 standard units.

3.3.3 Surface Water Total Suspended Solids

Chart 4 shows total suspended solids (TSS) concentrations for monitoring sites TR-A, TR-B, TR-C and TR-D for the period of record. Since 1989, TSS concentrations have remained relatively constant. The relatively constant TSS values observed over much of the period appear to be the result of two conditions. First, the stream channel, significantly altered during a 1984 flood, has stabilized and the stream banks have reestablished vegetation. Second, the section of the creek between TR-A and TR-B has become an inundated marsh as result of a continuous string of beaver ponds. Additionally, several long stretches of the creek between TR-B and TR-D have also become marshes due to numerous beaver dams.

Periodically, this general pattern is interrupted, as occurred in 1991, 1993, 1995, 2003, 2005 and 2006. The "spikes" in TSS levels during these years appear to be related to peak flow conditions along Trout Creek. TSS concentrations during the 2009 sampling season closely resemble the general pattern, decreasing as the season lengthens. The TSS concentrations remained fairly static in 2009 and consistent with previous sampling. The lowest TSS concentration in 2009 was <5 mg/L at numerous monitoring sites during numerous events, the high was recorded at monitoring site TR-D in April with a reading of 11 mg/L.

3.3.4 Surface Water Specific Conductivity

Chart 5 shows specific conductivity concentrations for monitoring sites TR-A, TR-B, TR-C and TR-D for the period of record. Specific conductivity from September 1992 through the end of the report period was similar to values obtained prior to October 1990. Data taken between October 1990 and August 1992 are believed to be invalid due to instrument errors. TDS values obtained during these same periods do not reflect the increases; therefore it is believed that the data excursions can be attributed to errors with the instrumentation rather than a reflection of actual field conditions.

New field equipment has been used since September 1992 along with laboratory verification. The values shown in past reports from 1992 through 1994 are the laboratory values. Since the field values and laboratory values have been in close agreement since 1994, values provided beginning in 1995 are field values. Specific conductivity has exhibited the same trends in 2009 as found during baseline studies and previous years monitoring. The lowest specific conductivity concentration in 2009 was recorded at monitoring site TR-A in June with a reading of 100 umhos/cm @ 25 °C and the high was recorded at monitoring site TR-C in April with a reading of 1010 umhos/cm @ 25 °C.

3.3.5 Surface Water Total Dissolved Solids

Chart 6 shows total dissolved solids (TDS) concentrations for monitoring sites TR-A, TR-B, TR-C and TR-D for the period of record. TDS concentrations in Trout Creek exhibit an expected pattern. As stream flow passes the mine, TDS levels increase while adjacent to the mined areas and then begin to decline downstream due to inflow from undisturbed lands below the active mine. Peak TDS levels in Trout Creek adjacent to the mine occur in early spring prior to the period of peak flow. This is caused by the spring runoff from the portion of the watershed in which the Edna Mine is located. Although TDS concentrations in the mine runoff may be quite high when compared to concentrations occurring above the mine, generally the mine runoff is small relative to Trout Creek's total flow. Therefore, a significant increase in Trout Creek TDS levels is observed only during the initial stages of spring runoff. A comparison of the TDS and flow data indicate that TDS concentrations appear to be directly related to flow volume.

The dilution of TDS concentrations in downstream flow for the past decade has not been as pronounced as in the previous decade. Beginning in 1990, mining and reclamation occurred in close proximity to TR-C. As such, dilution of TDS concentrations probably occurs farther downstream of TR-D as runoff from undisturbed areas enters into Trout Creek. Although elevated TDS concentrations have moved downstream in conjunction with mining and reclamation activities, all values for TDS are consistent with the probable hydrologic consequences projections. TDS concentrations seem to have peaked during the 1996 sampling season and have been steadily decreasing to the current year of sampling. TDS concentrations exhibited the same trends in 2009 as found during previous years monitoring. The lowest TDS concentration in 2009 was recorded at monitoring site TR-A in June with a value of 80 mg/L and the high was recorded at monitoring site TR-C in April with a value of 740 mg/L.

3.3.6 Surface Water Calcium, Magnesium and Sodium

Charts 7, 8 and 9 show calcium, magnesium and sodium concentrations for monitoring sites TR-A, TR-B, TR-C and TR-D for the period of record. Calcium is the dominant cation in Trout Creek with magnesium and sodium occurring in lesser concentrations. While the relative proportions of these parameters change slightly between the sampling points, all show peak concentrations coinciding with spring runoff, as would be expected. As with TDS, all three cations show general increases in concentration as the water passes the mine area. Additionally, the relative proportion of each constituent remains constant to the other constituents. While trends in their subsequent dilution downstream have yet to form a consistent pattern, little or no dilution in any of the concentrations have occurred between sampling points TR-C and TR-D since 1989. For the last decade, it is believed that this was due in part to the Moffat area mining and reclamation activities and, as such, the pattern is anticipated to continue. However, since this occurrence existed prior to the initiation of Moffat mining activity, the trend may also suggest that inflow from undisturbed areas upstream and downstream of TR-C contains approximately the same concentrations of these parameters as runoff from the mine.

Calcium, magnesium and sodium concentrations exhibited similar trends in 2009 as found during baseline studies and previous years monitoring. All three parameters show a slight increase in concentration from the 2008 sampling season and an overall decreasing trend since the 1996 sampling season in agreement with the TDS trend. The lowest calcium concentration in 2009 was recorded at monitoring site TR-A in April with a value of 27 mg/L and the high was recorded at monitoring sites TR-C and TR-D in April with a value of 100.0 mg/L. The lowest magnesium concentration in 2009 was recorded at monitoring site TR-A in April a value of 10.0 mg/L and the high was recorded at monitoring site TR-C in April with a value of 71.0 mg/L. The lowest sodium concentration in 2009 was recorded at monitoring site TR-A in August with a value of 3.0 mg/L and the high was recorded at monitoring sites TR-C and TR-D in April with a value of 16.0 mg/L.

3.3.7 Surface Water Bicarbonate and Sulfate

Charts 10, 11 and 12 show bicarbonate and sulfate concentrations and the sulfate/bicarbonate ratio for monitoring sites TR-A, TR-B, TR-C and TR-D for the period of record. As noted in previous annual hydrology reports, upstream of the mine on Trout Creek, bicarbonate is the major anion with sulfate concentrations increasing rapidly along the mine area to become predominating downstream. The sulfate level increase is most markedly noticed prior to the peak flow period of Trout Creek and adjacent to where mining activity took place, as are TDS levels in general. This increase is probably caused by early runoff at the mine site leaching pyritic and organic sulfur as flow passes over and through the spoils. Since the flow of Trout Creek is low at that time, the amount of sulfur is sufficient to cause an ionic shift from a bicarbonate type water to a sulfate type. During periods of higher flow and late in the season when runoff from the mine is small relative to total Trout Creek flow, the sulfate component is less able to shift the anion balance to a sulfate type with concentrations of bicarbonate and sulfate being approximately equal downstream.

The 2009 data is similar to previous monitoring data indicating a trend that shows a topological change occurring generally at TR-B. This is believed to be the result of the spoil spring, which has developed at the base of the West Ridge mining area. As reclamation of West Ridge matures, the high levels of sulfur exhibited in the spring are anticipated to decrease. The recent trend showing peak sulfate levels at TR-C and TR-D are expected to continue for some time as spoil springs in the Moffat area have developed after the completion of mining in that area. Like the West Ridge area the sulfate sources within the Moffat area are anticipated to diminish as vegetation establishes and matures. An overall trend indicates a decrease in sulfate since the 1996 sampling season.

While peak levels of individual constituents may be shifting as flow proceeds past the mine, they do not seem to be increasing overall. It is believed that an equalization in the sulfate-bicarbonate balance or a reversal (similar to the balance at TR-A) occurs downstream as the source of available sulfate (mining areas) is unavailable and dilution by runoff from undisturbed areas is introduced. The lowest bicarbonate concentration in 2009 was recorded at monitoring site TR-A in April with a value of 105 mg/L and the high was recorded at monitoring site TR-C in August with a value of 134 mg/L. The lowest sulfate concentration in 2009 was recorded at monitoring site TR-A in August with a value of 8 mg/L and the high was recorded at monitoring site TR-C in April with a value of 420 mg/L. The lowest sulfate/bicarbonate ratio in 2009 was recorded at monitoring site TR-A in August with a value of 0.10 SO4 (meq)/HCO3 (meq) and the high was recorded at monitoring site TR-C in April with a value of 5.21 SO4 (meq)/HCO3 (meq).

3.3.8 Surface Water Manganese

Chart 13 shows manganese concentrations for monitoring sites TR-A, TR-B, TR-C and TR-D for the period of record. Manganese shows fairly consistent values since 1989. Most of the manganese values observed are consistent with baseline values. Manganese values appear to be developing a trend, which may be directly related to flow in Trout Creek as are the TDS concentrations. Sampling in October of 2005, at site TR-D, produced an inconsistent spike of manganese up to 0.248 mg/L. Manganese remained within historical levels at all other sites along Trout Creek in October 2005. The October water quality data was re-analyzed and the original values were confirmed. There is no apparent reason for this sudden rise in value.

Site TR-D normalized over the last few years, regarding the October 2005 spike, and concentrations on average for all sites are low in comparison with the past decade. The concentration trend seemed to have reversed during 2006 with higher concentrations resulting during low flow in Trout Creek, however the 2007 to 2009 values fall back to the expected trend of decreasing concentrations according to flow. The lowest manganese concentration in 2009 was recorded at monitoring site TR-A in April with a value of 0.02 mg/L and the high was recorded at monitoring site TR-D in April with a value of 0.08 mg/L.

3.3.9 Surface Water Aluminum

Chart 14 shows aluminum concentrations for monitoring sites TR-A, TR-B, TR-C and TR-D for the period of record. Aluminum concentrations have been low with most being below detection limits throughout the duration of monitoring. The apparent elevated aluminum levels shown in 1995 were due to the laboratory lower detection limit being set at 0.2 ppm instead of 0.05 ppm. Aluminum was elevated at TR-C during the April 2002 sampling period. However, concentrations downstream of TR-C are consistent with previous sampling results. Therefore, either sample contamination or laboratory error is suspected. Aluminum was slightly elevated during the 2004 and 2005 sampling periods. The 2009 sampling period shows consistent sampling results with the past decade. The lowest and highest aluminum concentration in 2009 was the lower detection limit of <0.03 mg/L at all sites for all events.

3.3.10 Surface Water Unionized Ammonia

Chart 15 shows unionized ammonia concentrations for monitoring sites TR-A, TR-B, TR-C and TR-D for the period of record. Unionized ammonia concentrations have been consistently below detection limits. The unionized ammonia concentration appeared to drop for the 1997 through 1999 monitoring periods due to the laboratory lowering the detection limit from 0.05 ppm to 0.01 ppm. In 2000, the laboratory raised the detection limit for unionized ammonia back to 0.05 ppm, then lowered the detection back to 0.01 ppm in 2001. The 2009 sampling period shows detections in April at monitoring sites TR-B, TR-C and TR-D. The high was recorded at monitoring site TR-C in April with a value of 0.06 mg/L. Unionized ammonia concentrations were below the detection limit of <0.02 mg/L at all sites for the August 2009 sampling date.

3.3.11 Surface Water Nitrite

Chart 16 shows nitrite concentrations for monitoring sites TR-A, TR-B, TR-C and TR-D for the period of record. Nitrite concentrations have been consistently below detection limits with few exceptions. Nitrite was elevated at site TR-D with a value 0.32 mg/L in April 1999. This value is not consistent with historical data or the other monitoring sites during the April 1999 monitoring event. The April 1999 TR-D value is considered to be a sampling/laboratory error.

The nitrite concentration upstream of the mine at TR-A was 0.06 ppm in the July 2001 sample. The concentration decreased as it passed by the mine site as a result of dilution. Samples collected in May and October 2001 show nitrite levels at TR-A below the detection limit. The 2009 sampling period shows consistent sampling results compared to all previous events. Nitrite concentrations were below the detection limit of <0.01 mg/L at all sites for all sampling dates of 2009.

3.3.12 Surface Water Orthophosphate

Chart 17 shows orthophosphate concentrations for monitoring sites TR-A, TR-B, TR-C and TR-D for the period of record. Values obtained for orthophosphate have been low with most being below detection limits throughout the duration of monitoring. Orthophosphate showed some perturbation during the 2001 sampling period at TR-B. However, concentrations downstream of TR-B are consistent with previous sampling results. Therefore, either sample contamination or laboratory error is suspected. The 2009 sampling period shows slightly elevated sampling results compared to the period of record. The lowest orthophosphate concentration in 2009 was the lower detection limit of <0.01 mg/L recorded at all sites in April and the high was recorded at all monitoring site TR-C in August with a value of 0.04 mg/L.

3.3.13 Surface Water Chloride, Potassium and Iron

Charts 18, 19 and 20 show chloride, potassium and iron concentrations for monitoring sites TR-

A, TR-B, TR-C and TR-D for the period of record. Chloride and potassium were added to the monitoring program in 1993 while iron was added in 1994. The concentrations of all of these parameters in Trout Creek water are generally low. The 2009 sampling period shows consistent sampling results to the previous monitoring events regarding these constituents. Chloride and potassium have shown a trend decrease and stabilization over the past decade. Iron levels during the past few monitoring periods slightly decreased relative to those since 2004 showing a general relation to flow in Trout Creek. The lowest chloride concentration in 2009 was <1.0 mg/L at monitoring site TR-A in April and TR-A and TR-B in August and the high was recorded at monitoring sites TR-B, TR-C and TR-D in April and TR-C and TR-D in August with a value of 2.0 mg/L. The lowest potassium concentration in 2009 was recorded at monitoring site TR-A in August with a value of 1.0 mg/L and the high was recorded at monitoring sites TR-C and TR-D in April with a value of 2.6 mg/L. The lowest iron concentration in 2009 was recorded at monitoring site TR-D in August with a value of 0.07 mg/L and the high was recorded at monitoring site TR-D in April with a value of 0.42 mg/L.

4.0 GROUND WATER

As previously mentioned, ground water is monitored for water quality and static water level elevations at monitoring wells TR-1.5, TR-3, TR-4, WR-1 and TCS-1. The following section discusses quality and static water level elevations of ground water at the Edna Mine.

4.1 Ground Water Elevations

Water levels in the alluvial wells at the Edna Mine have remained constant over the period of record with minor fluctuations occurring seasonally. Elevations of the static water level in the alluvial wells (TR-1.5, TR-3 and TR-4) and the West Ridge spoils well (WR-1) are shown in Chart 21. In reviewing the data, it is apparent that WR-1 has reached steady state and exhibits consistent seasonal fluctuations. The seasonal fluctuations result from spring snowmelt causing a mounding of water in the perched aquifer which drains over the summer via discharge from a spring on the lower portion of West Ridge near the elevation of Trout Creek. Monitoring Well TR-4 was broken off and plugged by livestock in July 2002, preventing monitoring for the remainder of 2002. The well was repaired in the spring of 2003.

Ground water wells TR-1.5, TR-3, TR-4 and WR-1 all maintained levels and trends, a slight decrease of water level during the annual sampling season, similar to historical data during 2009. Ground water well elevations are provided in tabular format in Table 7.

4.2 Ground Water Quality

Comparisons of water quality data gathered from the alluvial wells at the Edna Mine must be exercised with caution due to the differing stratigraphic units intersected along Trout Creek adjacent to the various wells. The alluvium in the vicinity of Well TR-1.5 intersects stratigraphy above the Wadge coal seam while the alluvium in the vicinity of TR-3 intersects stratigraphy below the Wadge coal seam. Alluvium in the vicinity of TR-4 intersects even lower stratigraphic units than those at TR-3. The influence from contact with the differing lithology can not be quantified; therefore, differences between the wells may not be responses to mining related activities.

As previously mentioned, TR-4 was repaired in 2003. Groundwater samples from TR-4 show an increase in several parameters directly after repair, some of which have begun to stabilize and decrease to historical levels. Prior to 2003, parameters at the well had stabilized. Therefore, it is assumed that this increase is due to the well repairs.

Monitoring of Well TCS-1 was initiated in 1995 to ensure the absence of mining impacts on the Trout Creek Sandstone aquifer. To date, no impacts from mining activity are evident in Well TCS-1. TCS-1 was not sampled in 2004 due to equipment problems. The demolition of an adjacent house removed power from the site. During demolition the well sustained damage.

Sampling was attempted using a generator but the well was deemed not functional. TCS-1 was refurbished in the fall of 2005 and sampled thereafter.

Ground water sampling is performed in accordance with EPA approved methods and instrumentation. The ground water quality at the Edna Mine is monitored via the parameters, locations and frequency listed in Table 4.6-54, Section 4.6.8.4 of the permit. Analyses results for monitoring wells TR-1.5, TR-3, TR-4, WR-1 and TCS-1 are found in Tables 8, 9, 10, 11 and 12. Results of the analyses are discussed below.

4.2.1 Ground Water Temperature

Chart 22 shows temperature values for monitoring wells TR-1.5, TR-3, TR-4, WR-1 and TCS-1 for the period of record. Temperature exhibited the same trends in 2009 as found during baseline studies and previous years monitoring. Specifically, patterns in temperature are seasonal, warming until July or August and than cooling throughout the remaining sampling season. The amount of temperature fluctuation in Well TR-4 has been historically somewhat greater than expected suggesting the flow to the perched aquifer, although subsurface, is very shallow. The lowest temperature in 2009 was recorded at monitoring well TR-3 in May with a reading of 7.1 °C and the high was recorded at monitoring site TR-1.5 in July with a reading of 15.2 °C.

4.2.2 Ground Water pH

Chart 23 shows pH concentrations for monitoring wells TR-1.5, TR-3, TR-4, WR-1 and TCS-1 for the period of record. Values of pH during 2009 remained relatively constant over the monitoring period. There is no apparent trend regarding pH. Overall, the groundwater has tended to be alkaline throughout the period of record. The lowest pH value in 2009 was recorded at monitoring well TR-1.5 in August with a reading of 6.75 standard units and the high was recorded at monitoring well TCS-1 in August with a reading of 8.42 standard units.

4.2.3 Ground Water Specific Conductivity and Total Dissolved Solids

Charts 24 and 25 show specific conductivity and TDS concentrations for monitoring wells TR-1.5, TR-3, TR-4, WR-1 and TCS-1 for the period of record. Specific conductivity and TDS values for the three alluvial wells have remained fairly constant over the majority of the period of record. While specific conductivity and TDS values at sites TR-3 and TR-4 are consistent with values obtained during the baseline studies, these parameters and several others have elevated rapidly and remained elevated at TR-1.5 since 1995. The source of the elevated values is not readily identifiable. A few factors which may have contributed to the elevated values were mentioned in the 1996 Report (i.e., inundation of the area in late spring of 1995 and the laying of telephone cable immediately upstream of the area during the summer of 1995). If the elevated values resulted from those activities, the values should have returned to more historic levels during the past decade. However, the values have remained elevated. It appears that the alluvium in this area is reflecting upstream alluvial water containing high levels of TDS, possibly from an old abandoned underground mine up the Little Trout Creek drainage. This conclusion is based partially on the similarity of the water quality between TR-1.5 and WR-1. The location of the underground mine is shown on Exhibit 3.1-1 of the permit.

Specific conductivity and TDS in Well WR-1 have tended to progress from an elevated state each spring to a lower state in the fall for the majority of the period of record. This phenomenon was caused by infiltration of snowmelt water leaching various minerals within the unsaturated zone of reclaimed spoil. As the enriched flow was released over the course of the summer, the conductivity values lessened to that of the stagnant saturated zone. The mounded aquifer exhibits a more diluted state each spring with a return to steady-state as the summer progresses.

Specific conductivity and TDS concentrations exhibited the same trends in 2009 as found during previous years of monitoring. Well TR-1.5 was low for both parameters when compared with the past decade. All concentrations were within the historical range. The lowest specific conductivity value in 2009 was recorded at monitoring well TR-3 in September with a reading of 680 umhos/cm @ 25 °C and the high was recorded at monitoring well WR-1 in May with a reading of 3950 umhos/cm @ 25 °C. The lowest TDS concentration in 2009 was recorded at monitoring well TR-3 in September with a value of 470 mg/L and the high was recorded at monitoring well WR-1 in May with a value of 4210 mg/L.

4.2.4 Ground Water Calcium, Magnesium and Sodium

Charts 26, 27 and 28 show calcium, magnesium and sodium concentrations for monitoring wells TR-1.5, TR-3, TR-4, WR-1 and TCS-1 for the period of record. Calcium is the major cation found in all of the wells, except TCS-1 which is sodium rich, with concentrations of sodium and magnesium occurring in lesser quantities. The sodium concentration at TR-1.5 in May 2001 was 179 ppm. This value is inconsistent with the historical sodium concentrations and the levels after May 2001. Therefore, either sample contamination or laboratory error is suspected. TR-1.5 generally contained the lowest concentrations of cations with a slight increase occurring downstream at TR-3 and TR-4 for the majority of the record. However, elevated levels of these parameters at TR-1.5 began to occur in 1995 consistent with the elevated specific conductivity and TDS levels previously mentioned. Elevated levels of sodium concentration occurred at TR-4 during the 2004 and 2005 sampling period compared with those of the last decade. However, the sodium concentration levels remain within historical levels found in Trout Creek.

Calcium, magnesium and sodium concentrations exhibited the same trends in 2009 as found during previous years of monitoring. The lowest calcium concentration in 2009 was recorded at monitoring well TCS-1 in May with a value of 39 mg/L and the high was recorded at monitoring well WR-1 in May with a value of 488 mg/L. The lowest magnesium concentration in 2009 was recorded at monitoring well TCS-1 in May with a value of 14.4 mg/L and the high was recorded at monitoring well WR-1 in May with a value of 445 mg/L. The lowest sodium concentration in 2009 was recorded at monitoring well TR-3 in May with a value of 12 mg/L and the high was recorded at monitoring well TCS-1 in August with a value of 293 mg/L.

4.2.5 Ground Water Bicarbonate and Sulfate

Charts 29, 30 and 31 show bicarbonate, sulfate and sodium concentrations and the sulfate/bicarbonate ratio for monitoring wells TR-1.5, TR-3, TR-4, WR-1 and TCS-1 for the period of record. Bicarbonate and sulfate concentrations show a consistent topological trend over the last 5 years. The sulfate/bicarbonate ratio during much of the previous decade showed the alluvial waters at TR-1.5, TR-3 and TR-4 and the backfill water at WR-1 to be sulfate type. Waters at TR-1.5 WR-1 and TR-3 have become slightly more sulfate over the period of record. The sulfate/bicarbonate ratio at TR-4 has resulted in a bicarbonate type over the last 5 years, differing from the period of record. During the last decade the sulfate/bicarbonate ratio at TR-1.5 was very similar to that found in WR-1 providing further evidence that the source of sulfate may be from a sulfur rich source such as leakage from an old abandoned underground mine.

Bicarbonate levels in TR-4 rose from 2003 to 2005 driving the sulfate/bicarbonate ratio lower, and shifting the water from a sulfate type to a bicarbonate type. This may be due to the well repairs performed in the spring of 2003. The bicarbonate concentrations at TR-4 seem to have peaked in 2004 and look as if they have stabilized and/or decreased in the past few years. Sulfate concentrations exhibited the same trends in 2009 as found during previous years of monitoring. The lowest bicarbonate concentration in 2009 was recorded at monitoring well TR-3 in May with a value of 111 mg/L and the high was recorded at monitoring well TR-4 in August with a value of 571 mg/L. The lowest sulfate concentration in 2009 was recorded at monitoring well TCS-1 in May with a value of 91 mg/L and the high was recorded at monitoring sites TR-1.5 and WR-1 in May with a value of 2700 mg/L. The lowest sulfate/bicarbonate ratio in 2009 was calculated for monitoring well TR-4 in May with a value of 0.25 SO4 (meq)/HCO3 (meq) and the high was calculated for monitoring well WR-1 in May with a value of 15.13 SO4 (meq)/HCO3 (meq).

4.2.6 Ground Water Dissolved Iron and Manganese

Charts 32 and 33 show dissolved iron and manganese concentrations for monitoring wells TR-1.5, TR-3, TR-4, WR-1 and TCS-1 for the period of record. Overall, dissolved iron and manganese levels for the three alluvial wells TR-1.5, TR-3 and TR-4, and backfill well WR-1 remained low during 2009 as in previous years. Monitoring wells TR-1.5 and TR-3 showed spikes in May of 2009 that are uncharacteristic of the sites. The reason for these outliers is unknown. However, both sites returned to historic levels in August of 2009. Manganese concentrations in TR-4 have risen from 2003 to the 2009 sampling season. Once again, this may be due to the well repairs conducted in the spring of 2003. The lowest dissolved iron concentration in 2009 was recorded at monitoring wells WR-1 in August with a value of 0.02 mg/L and the high was recorded at monitoring well TR-1.5 in May with a value of 30.7 mg/L. The lowest manganese concentration in 2009 was recorded at monitoring well TCS-1 in August with a value of 0.015 mg/L and the high was recorded at monitoring well TR-4 in August with a value of 2.86 mg/L.

4.2.7 Ground Water Orthophosphate and Nitrite

Charts 34 and 35 show orthophosphate and nitrite concentrations for the monitoring wells TR-1.5, TR-3, TR-4, WR-1 and TCS-1 for the period of record. Historically, orthophosphate and nitrite values obtained over the period of record have been low with most being below detection limits. Elevated orthophosphate readings occurred in the summers of 1998 through 2000, at up-gradient well TR-1.5, possibly due to nearby agricultural activity. In 2001, concentrations of orthophosphate returned to historically low levels. Site TR-4 had a slight rise in orthophosphate concentration during the 2005 monitoring period, but decreased to levels similar to previous sampling events during the past few years. Nitrite concentrations were again elevated at TR-1.5 in May 2000 and May 2001 and at WR-1 in May 2001, but decreased to historical levels as the year progressed. Nitrite levels remained at historical levels in the 2009 monitoring period. The lowest orthophosphate concentration in 2009 was recorded at monitoring well WR-1 with a value 0.01 mg/L and the high was recorded at monitoring well TR-4 in August with a value of 0.07 mg/L. The lowest nitrite concentration in 2009 was recorded at numerous monitoring wells during numerous events with a value of <0.01 mg/L and the high was recorded at monitoring well TR-4 in August with a value of 0.13 mg/L.

4.2.8 Ground Water Chloride and Potassium

Charts 36 and 37 show chloride and potassium concentrations for the monitoring wells TR-1.5, TR-3, TR-4, WR-1 and TCS-1 for the period of record. Chloride and Potassium were added to the parameters list in 1994. Potassium levels increased in TR-4 over the course of 2003, but have leveled off over the last few years. Chloride at TR-4 spiked in both October 2004 and May 2005, however concentrations returned to historical levels over the past few monitoring periods. Chloride has risen over the past 5 monitoring seasons at TCS-1. The lowest chloride concentration in 2009 was recorded at monitoring wells TR-3 and WR-1 in May with a value of 2 mg/L and the high was recorded at monitoring well TCS-1 in May with a value of 70 mg/L. The lowest potassium concentration in 2009 was recorded at monitoring well TR-3 in May with a value of 1.1 mg/L and the high was recorded at monitoring well WR-1 in May with a value of 11.3 mg/L.

5.0 SURFACE WATER AND GROUND WATER INTERACTIONS

The interrelationship in concentrations of chemical parameters between the surface waters and alluvial waters at the Edna Mine can only be suggested in very general terms. The primary reasons for this are the relative location of a given well to the creek, the source from which an alluvial well's water originates and the dynamics of alluvial flow.

Prior to 1995, a general trend evident in TDS and the major ions was that as one progressed downstream along the mine an increase in these parameters occurred in both the surface water and alluvial water. Beginning in 1995, the levels of all constituents in TR-1.5 increased dramatically. While the influence of this increase in upstream alluvial water is not clearly expressed in either surface or alluvial water downstream for the majority of the year, the elevated concentrations of surface water constituents observed in the early portion of the year are more pronounced than previously. This is probably a reflection of the co-mingling of alluvial water in the vicinity of TR-1.5 with creek water upstream of TR-B.

The independent nature of the observations and trends occurring within the creek water and alluvial water suggests the two water bodies have limited influence upon each other. The lack of influence is probably due to the slow exchange rate of water between the two bodies during most of the year.

6.0 QUALITY ASSURANCE

The quality assurance program is designed to check the precision and accuracy of the analytical results received from the laboratory providing the water quality analyses. During the collection of samples for analysis a duplicate sample from either a ground water or surface water monitoring site will be collected and analyzed. The duplicate sample analysis is compared with its paired sample for similarity.

Two duplicate samples were collected during 2009 for laboratory quality assurance purposes. The duplicate samples were taken at surface water monitoring sites TR-A in April and TR-B in August. Results of the duplicate analyses were favorable for most of the parameters tested.

The April duplicate for TR-A verified 10 of the 15 laboratory parameters to be within 5% of the original values obtained. The duplicate sample value for aluminum was 133% of the original value (0.03 mg/L-original vs. 0.04 mg/L-duplicate). The duplicate sample value for iron was 92% of the original value (0.25 mg/L-original vs. 0.23 mg/L-duplicate). The duplicate sample value for sodium was 139% of the original value (4.4 mg/L-original vs. 6.1 mg/L-duplicate). The duplicate sample value for chloride was 200% of the original value (1 mg/L-original vs. 2 mg/L-duplicate). The duplicate sample value for TSS was 120% of the original value (5 mg/L-original vs. 6 mg/L-duplicate).

The August duplicate for TR-B verified 13 of the 15 parameters to be within 5% of the original value obtained. The duplicate value for iron was 43% of the original value (0.21 mg/l-original vs. 0.09 mg/l-duplicate). The duplicate value for total suspended solids was 120% of the original value (5 mg/l-original vs. 6 mg/l-duplicate).

7.0 SPRING AND SEEP SURVEY

A spring and seep survey is performed annually in May, or as soon as practical after snowmelt, covering the base of reclaimed areas along Trout Creek. Flow from springs or seeps that exceed approximately 20 gpm are measured while flow from smaller expressions are visually estimated. Additionally, a sample will be taken annually from larger, exceeding 20 gpm, springs and seeps. The complete list of parameters used for surface water monitoring sites, except for TSS, is analyzed to characterize the type of flow.

A survey was conducted May 5, 2009 to May 6, 2009 to evaluate springs and seeps which existed during past surveys at the base of the ridge along Trout Creek from the northern Moffat boundary to the base of West Ridge. A total of 15 spring locations were surveyed. Of these 15 spring locations, 12 were either damp or had flowing water during the 2009 survey. A total of 21 seep locations were surveyed. Of these 21 seep locations, 5 were either damp or had flowing water during the 2009 survey. Table 13 contains a listing of the springs and seeps observed from 1993 through 2009. Spring and seep locations are shown on Plate 2.

Twelve of the 12 springs either damp or flowing exhibited sufficient discharge for flow to be estimated or calculated and field parameters measured during the 2009 monitoring period. Five of the 5 seeps either damp or flowing also exhibited sufficient discharge for flow to be estimated and field parameters measured. Several of the springs and seeps were sampled as single units due to their close proximity to each other and their apparent common origin. Flow estimates and field parameters for these springs and seeps are provided in Table 14.

Springs SPR-1, SPR-3, SPR-5 and SPR-11 and seep SE-23 had sufficient flow, singularly or in combination with other springs or seeps, to require additional laboratory water quality sampling in accordance with the mine's permit. Results of these analyses are provided in Table 15.

8.0 MOFFAT STABILITY MONUMENTS

A system of three control points and six monuments were established in the final Moffat pit area during the fourth quarter of 1997. The purpose of the monuments is to monitor the hillslope for long-term stability. The three control points were placed to form a large triangle. The reference control point was established along the top of the hillside in undisturbed ground above the final Moffat pit. The two additional control points (back-sites) were established in undisturbed ground northwest and south of the reference point. The back-sites were established to verify the location of the reference point. The monuments were installed in pairs with the first pair, SM-1 and SM-2, established in the lower third of the final pit area. SM-1 was placed approximately 130 feet south of the final pit highwall and SM-2 was placed approximately 340 feet south of the final pit highwall. The second pair, SM-3 and SM-4, were installed approximately mid-way along the pit. SM-3 was placed approximately 110 feet south of the highwall and SM-4 was placed approximately 325 feet south of the highwall. The last pair, SM-5 and SM-6 was installed in the upper third of final pit area. SM-5 was placed approximately 150 south of the highwall and SM-6 was placed approximately 350 feet south of the highwall. The monuments consist of 7' to 8' sections of 2-1/2" diameter drill steel driven 5-1/2' to 6-1/2' into the pit backfill material. Locations of the stability monuments are displayed on Plate 3.

The monuments were surveyed quarterly the first year and annually thereafter. In 2003, a level loop was surveyed providing elevation information. However, due to an equipment malfunction, x and y coordinates were lost. The 2009 stability monument survey was performed August 12, 2009. The coordinates of the initial monument survey and subsequent surveys are provided in Table 16.

CHARTS

Chart 1. Surface Water Flow

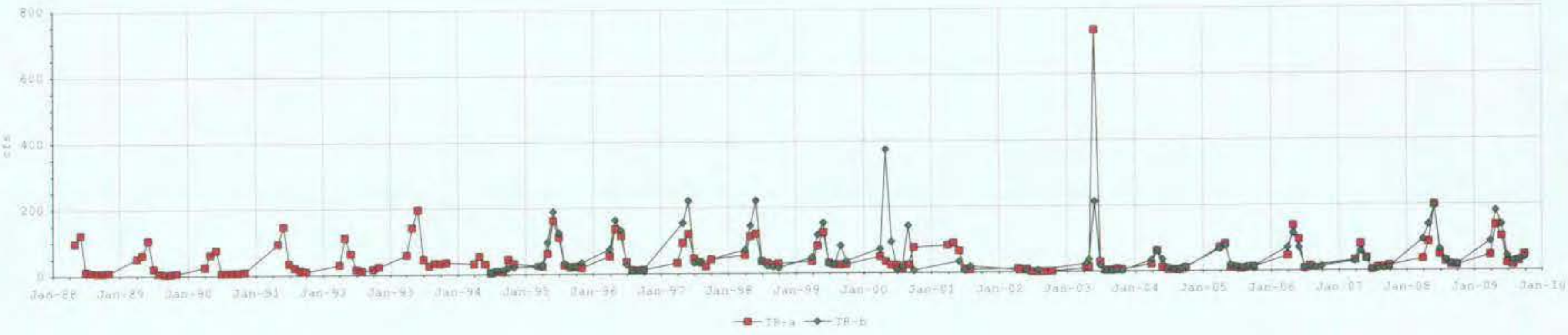


Chart 2. Surface Water Temperature

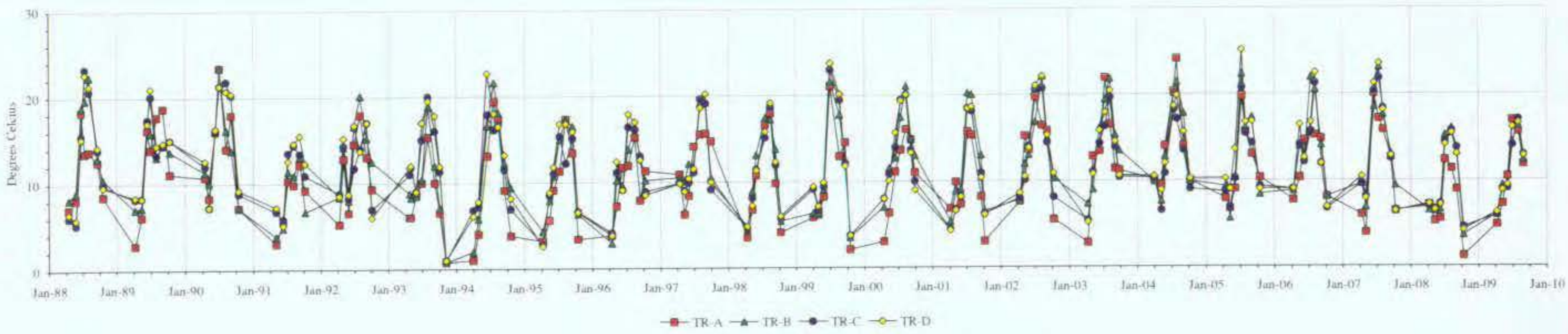


Chart 3. Surface Water pH

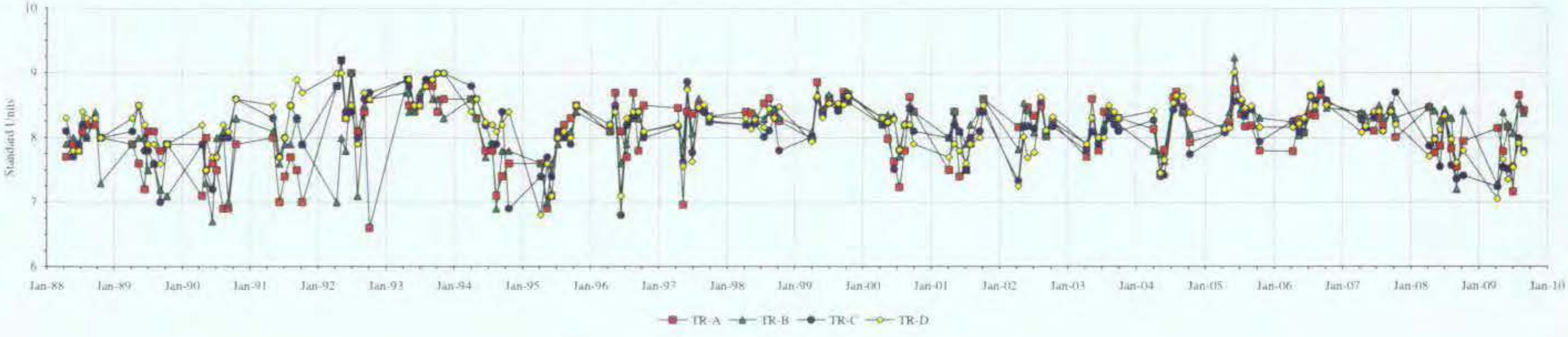


Chart 4. Surface Water Total Suspended Solids

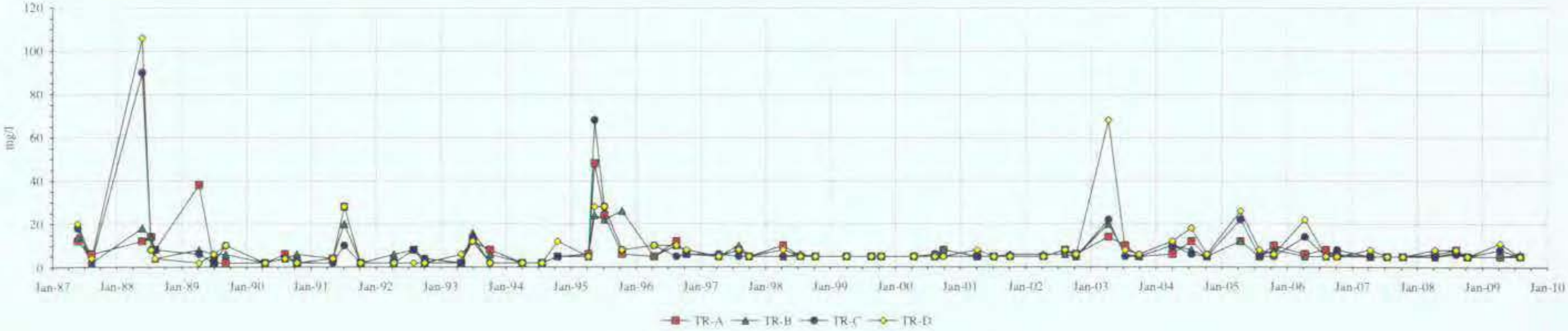


Chart 5. Surface Water Specific Conductivity

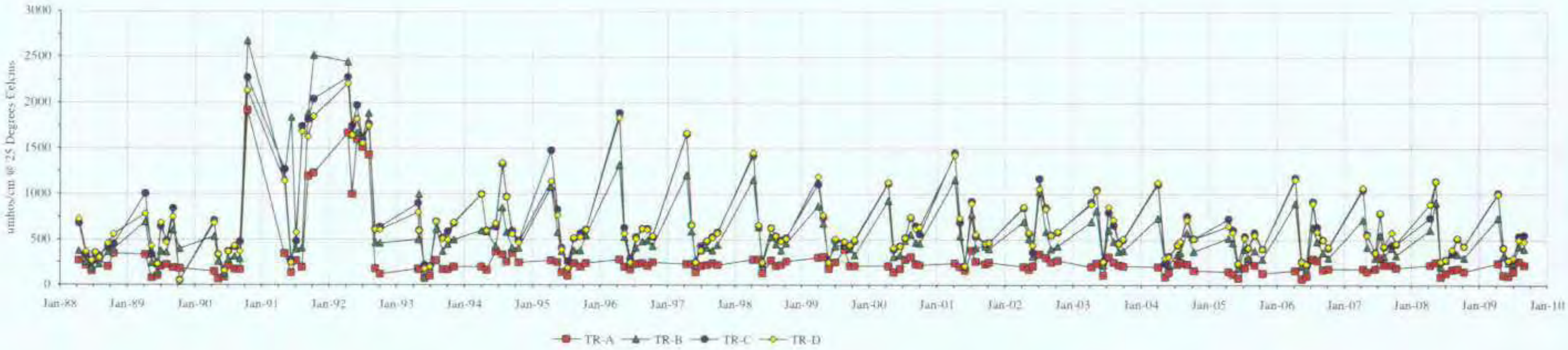


Chart 6. Surface Water Total Dissolved Solids

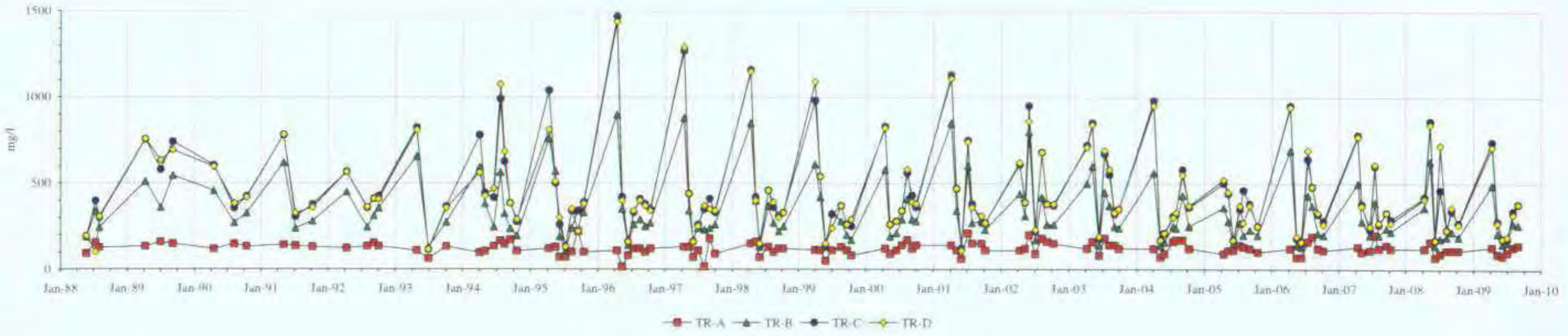


Chart 7. Surface Water Calcium

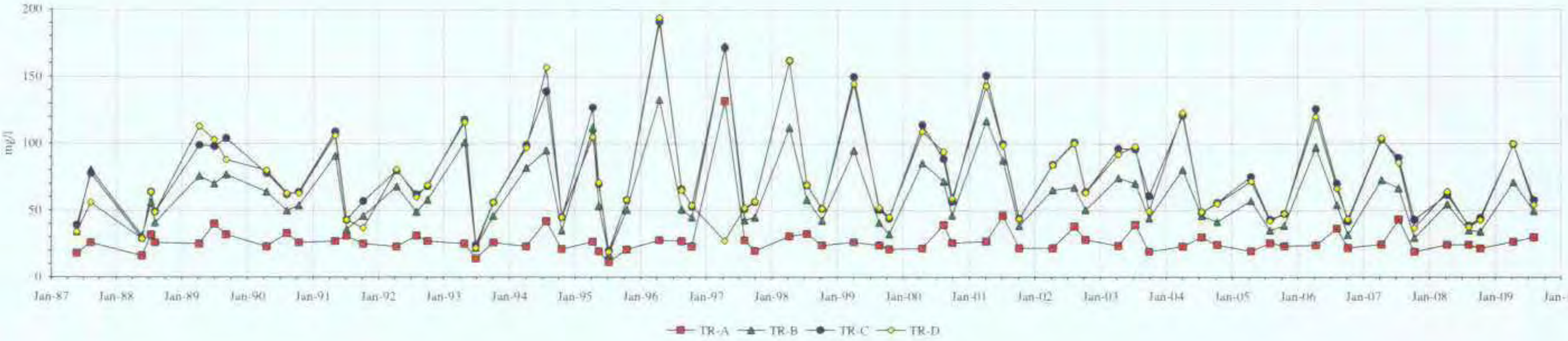


Chart 8. Surface Water Magnesium

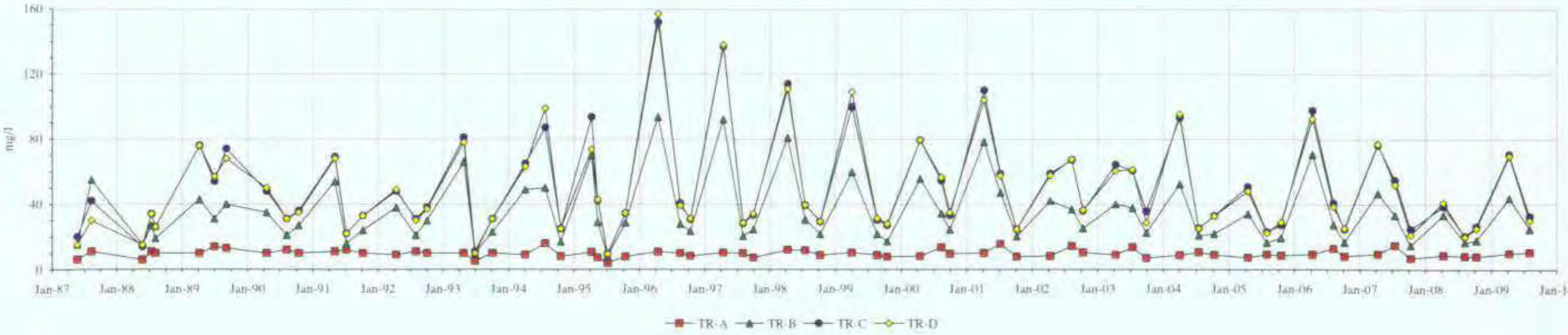


Chart 9. Surface Water Sodium

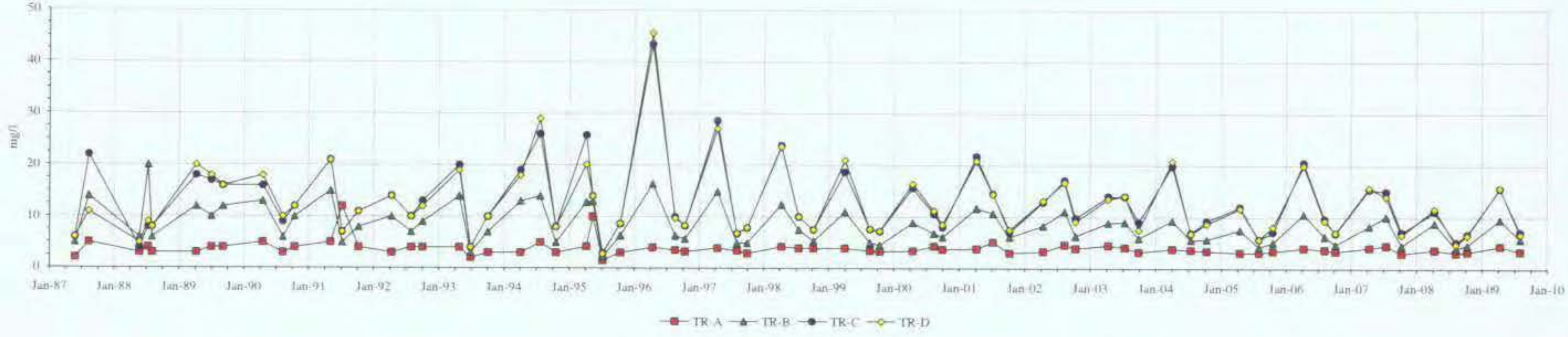


Chart 10. Surface Water Bicarbonate

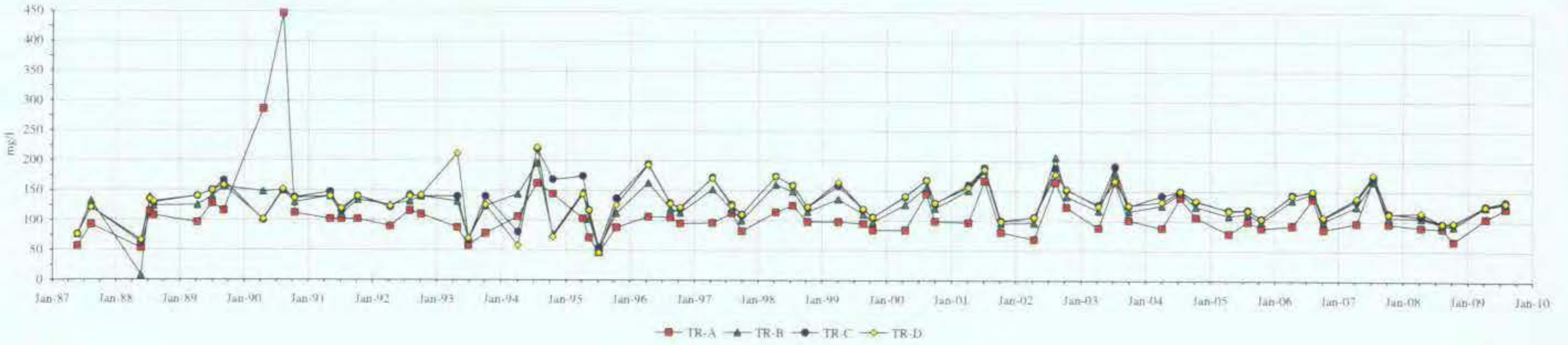


Chart 11. Surface Water Sulfate

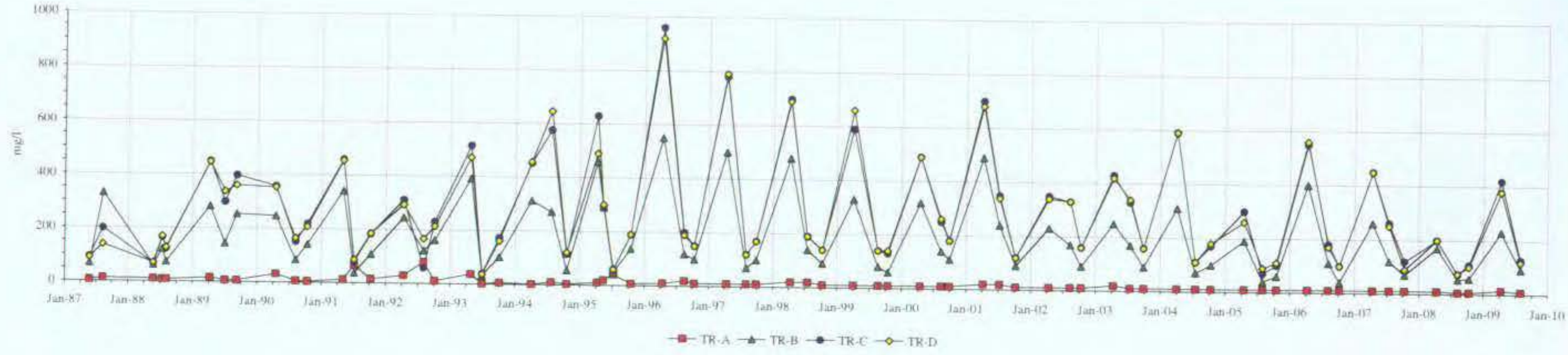
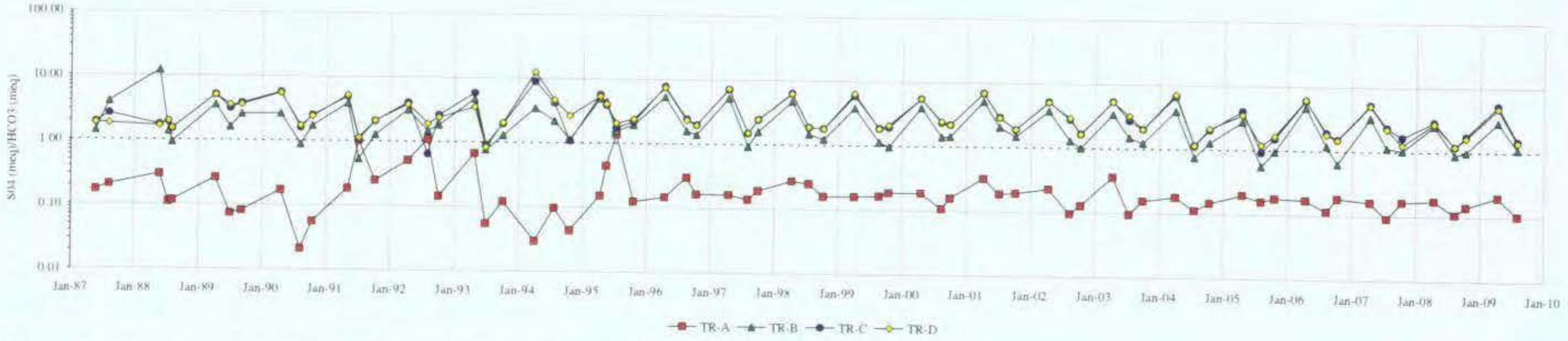


Chart 12. Surface Water Sulfate/Bicarbonate Ratio



(SO4 = HCO3 for y = 1.0 (---); SO4 > HCO3 for y > 1.0; SO4 < HCO3 for y < 1.0)

Chart 13. Surface Water Manganese

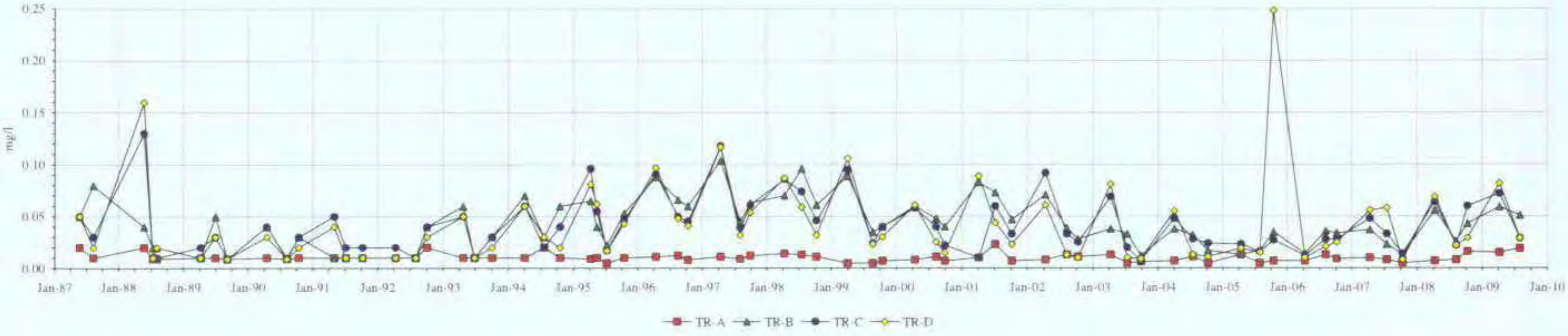


Chart 14. Surface Water Dissolved Aluminum

Chart 15. Surface Water Unionized Ammonia

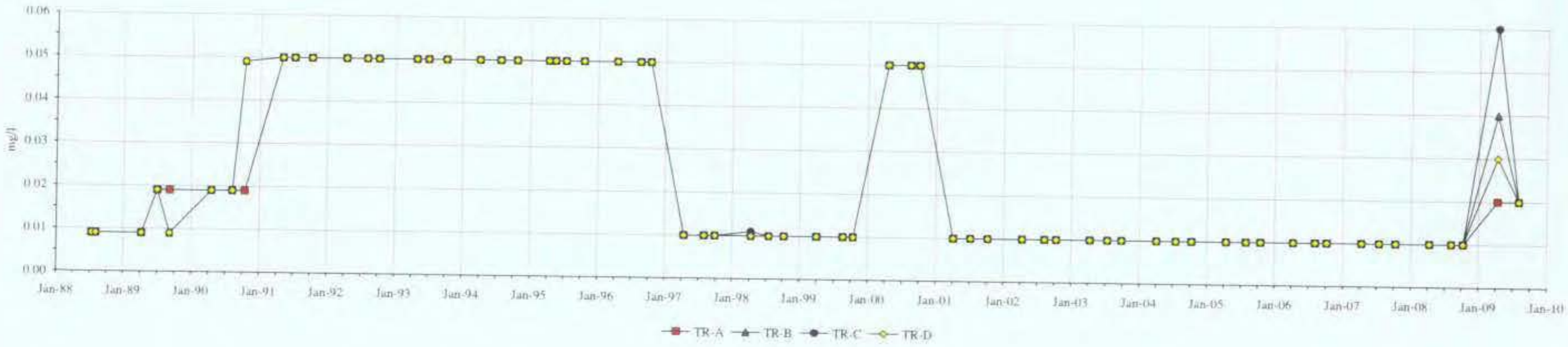


Chart 16. Surface Water Nitrite

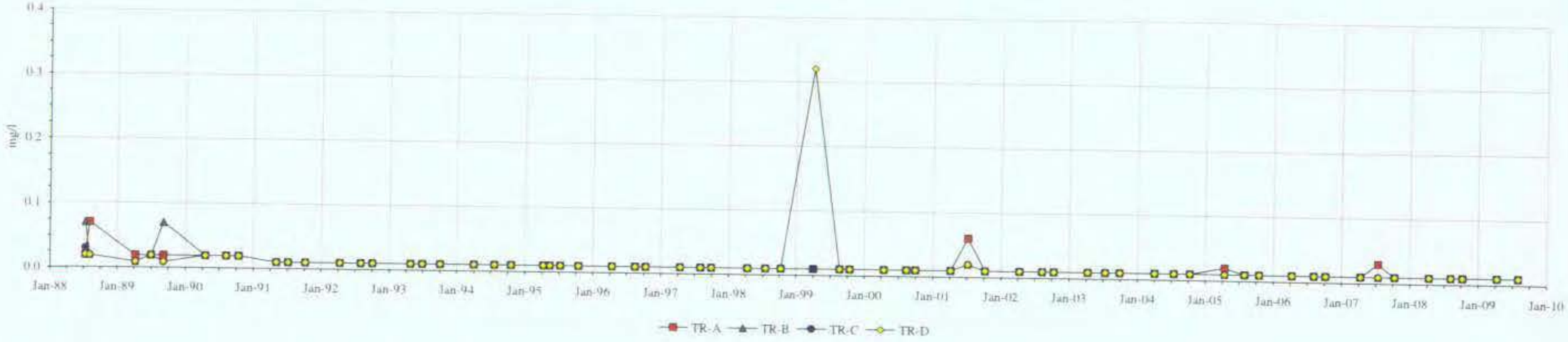


Chart 17. Surface Water Orthophosphate

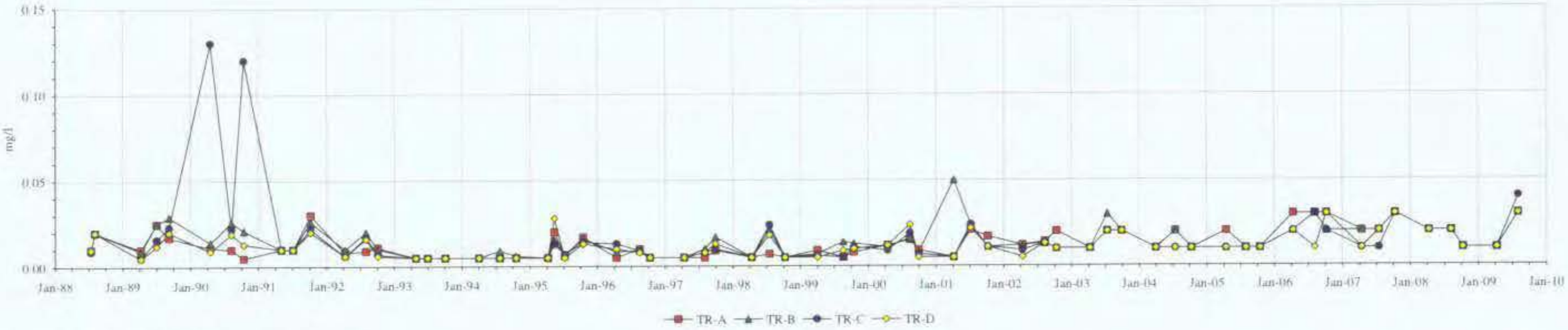


Chart 18. Surface Water Chloride

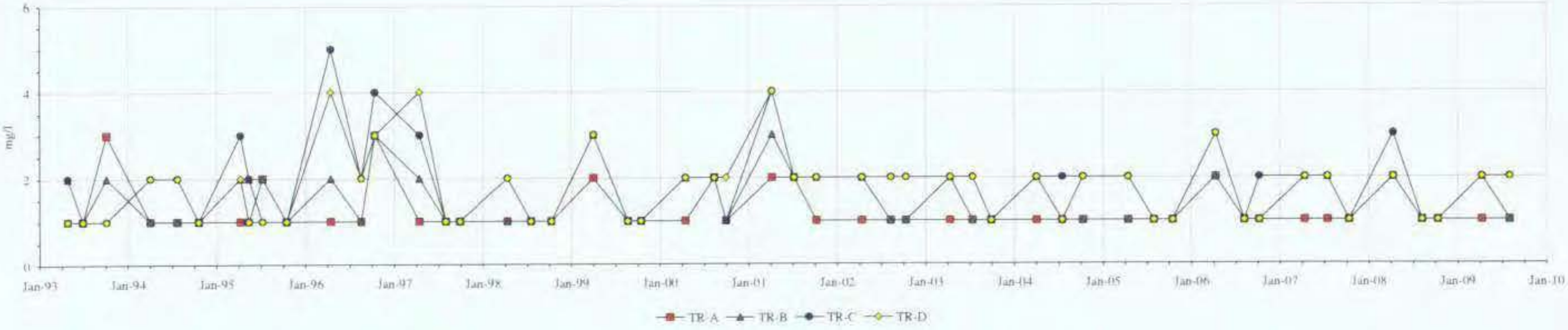


Chart 19. Surface Water Potassium

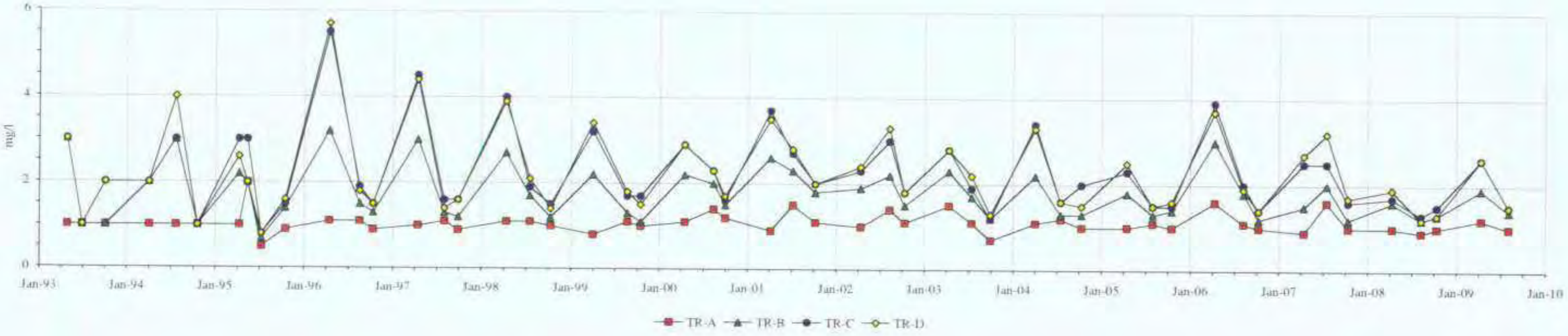


Chart 20. Surface Water Iron

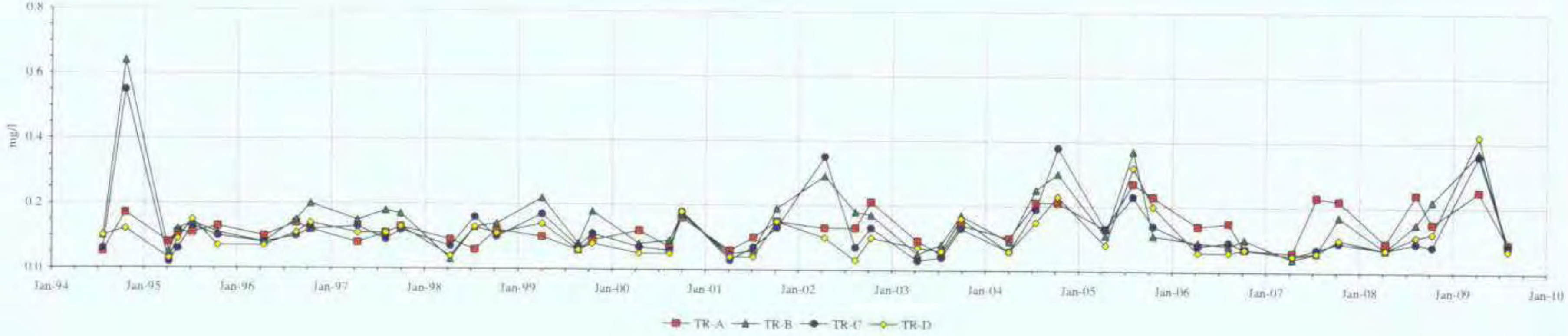


Chart 21. Ground Water Elevation

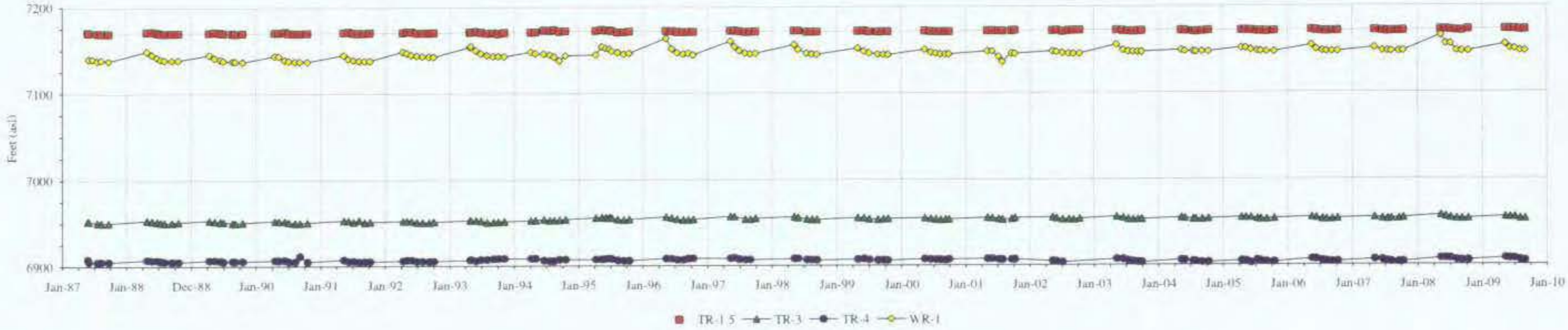


Chart 22. Ground Water Temperature

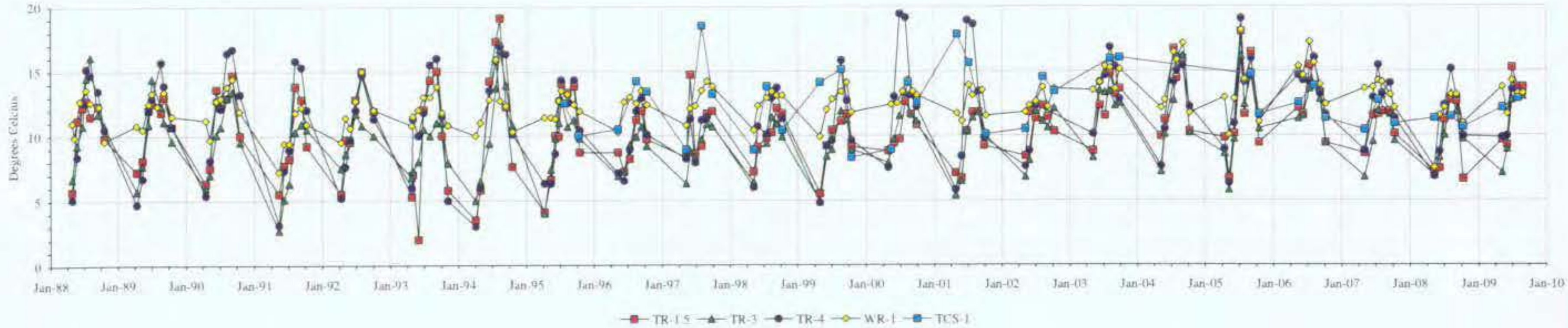


Chart 23. Ground Water pH

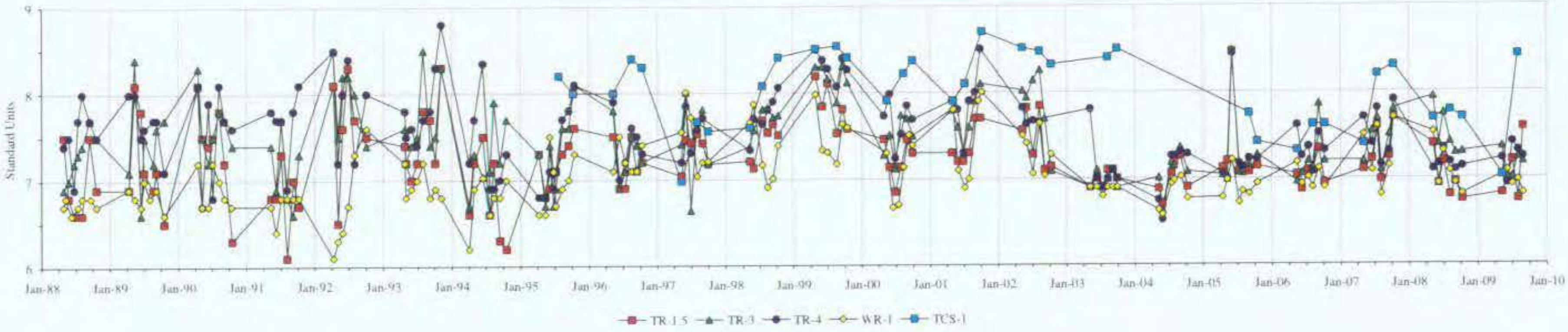


Chart 24. Ground Water Specific Conductivity

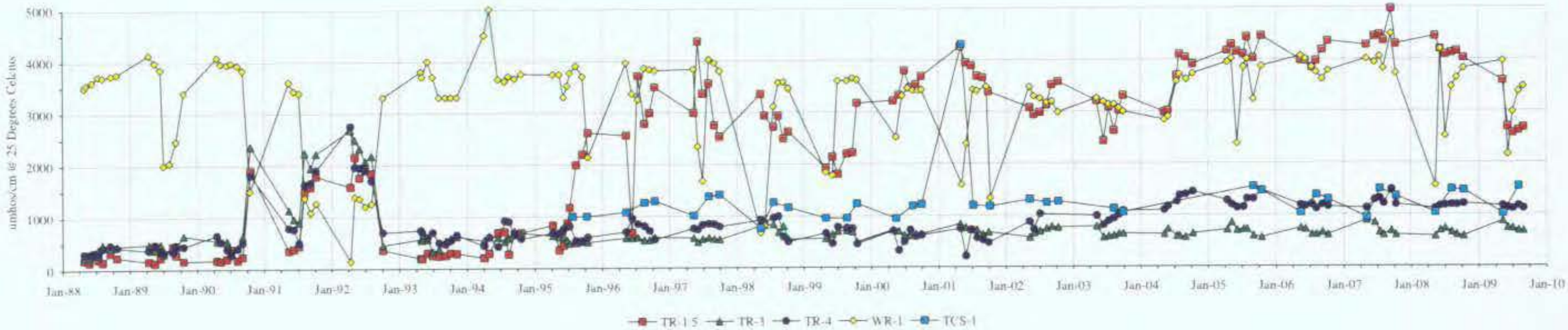


Chart 25. Ground Water Total Dissolved Solids

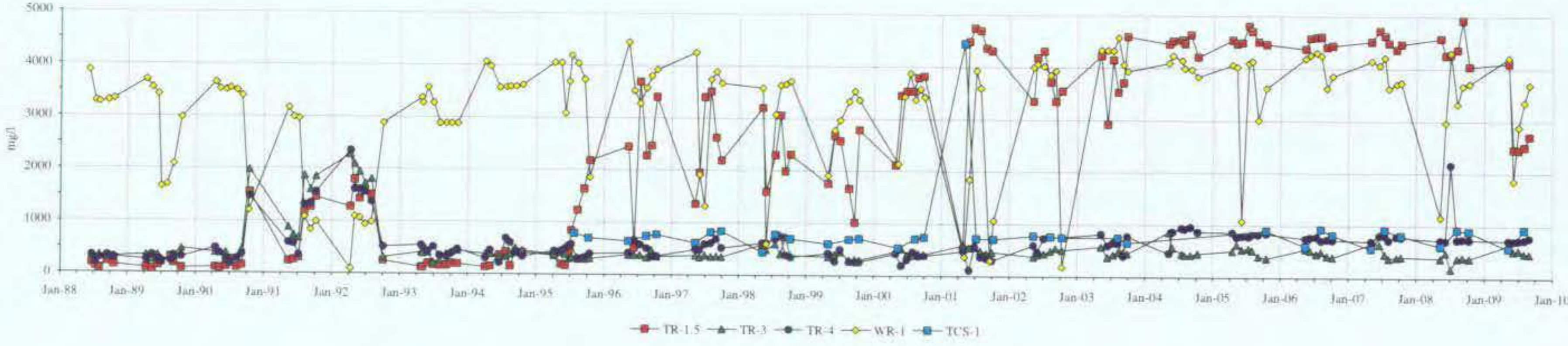


Chart 26. Ground Water Calcium

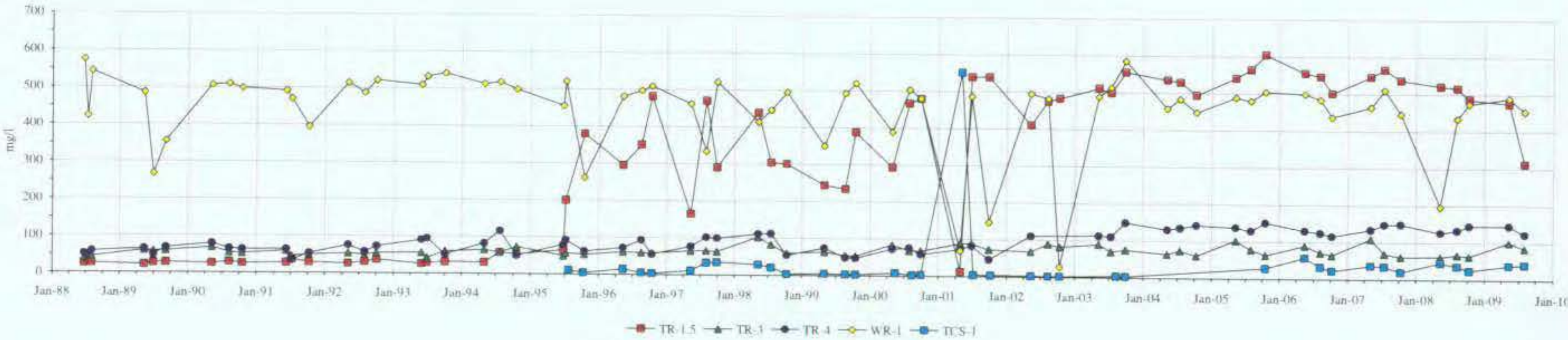


Chart 27. Ground Water Magnesium

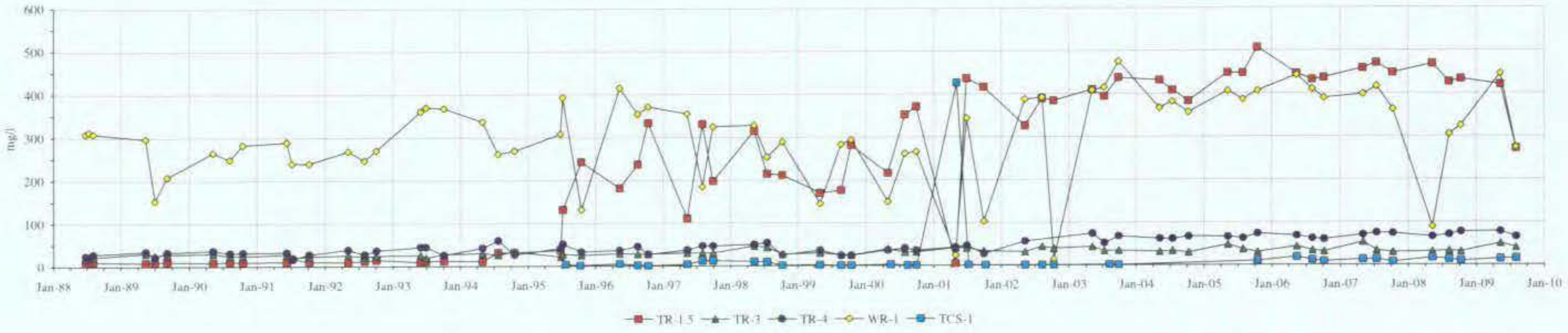


Chart 28. Ground Water Sodium

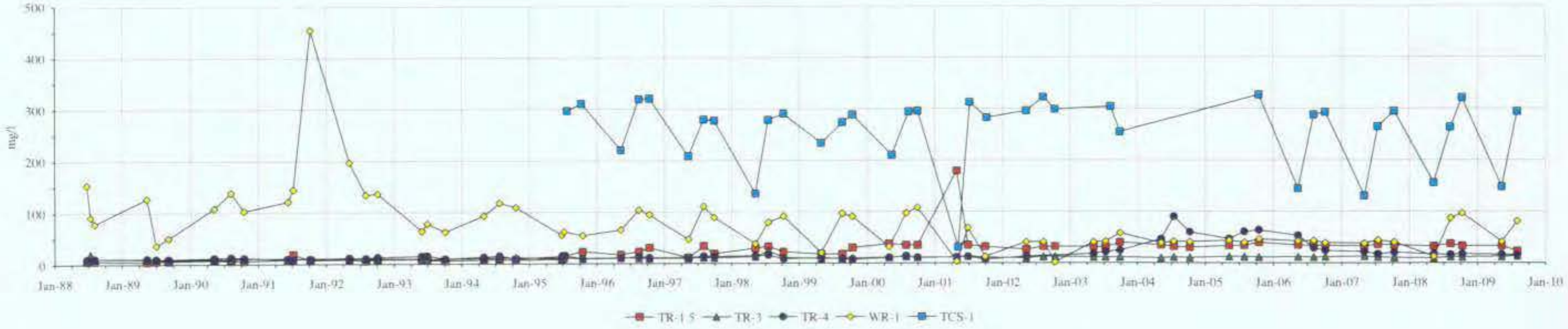


Chart 29. Ground Water Bicarbonate

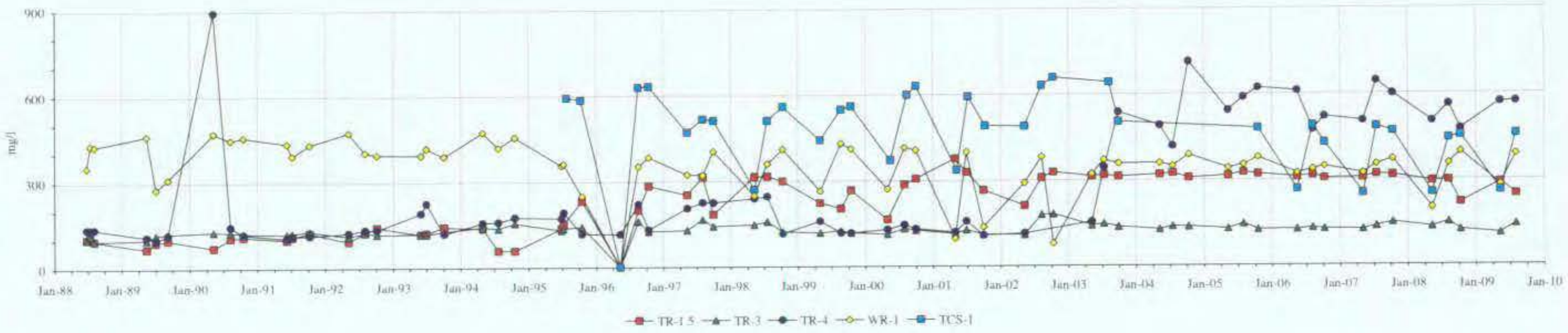


Chart 30. Ground Water Sulfate

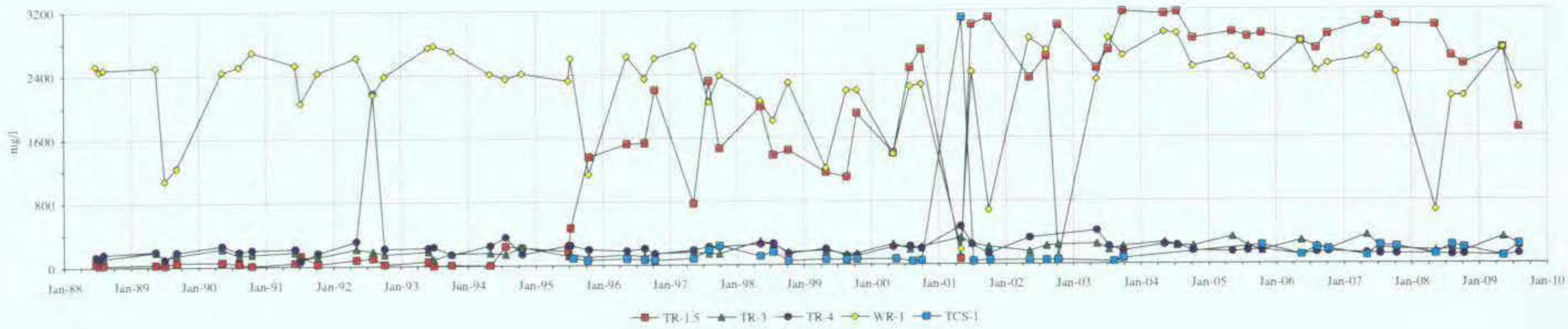
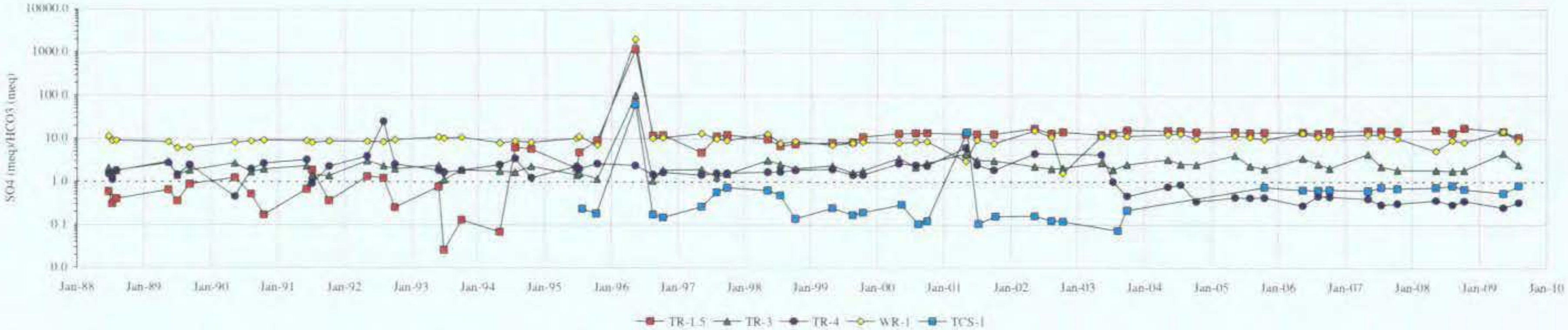


Chart 31. Ground Water Sulfate/Bicarbonate Ratio



(SO4 = HCO3 for y = 1.0 (---); SO4 > HCO3 for y > 1.0; SO4 < HCO3 for y < 1.0)

Chart 32. Ground Water Dissolved Iron

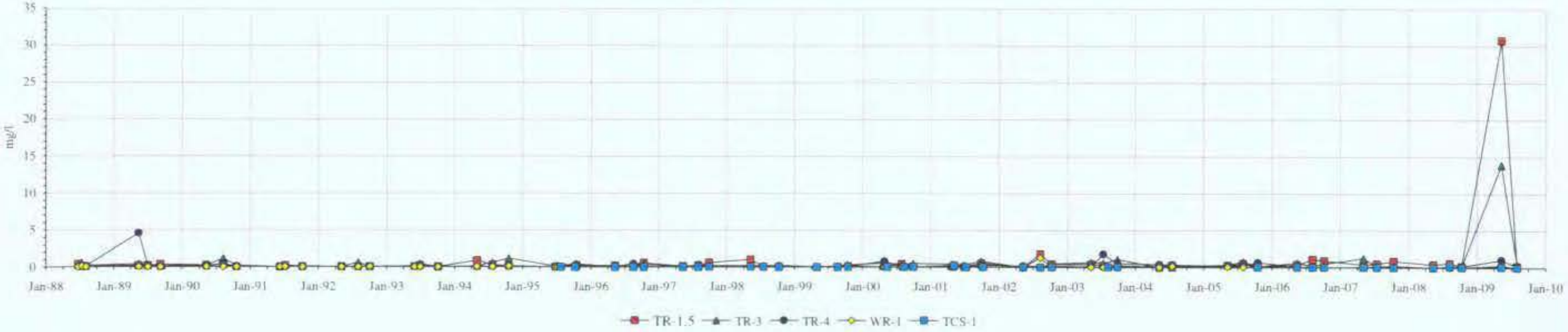


Chart 33. Ground Water Manganese

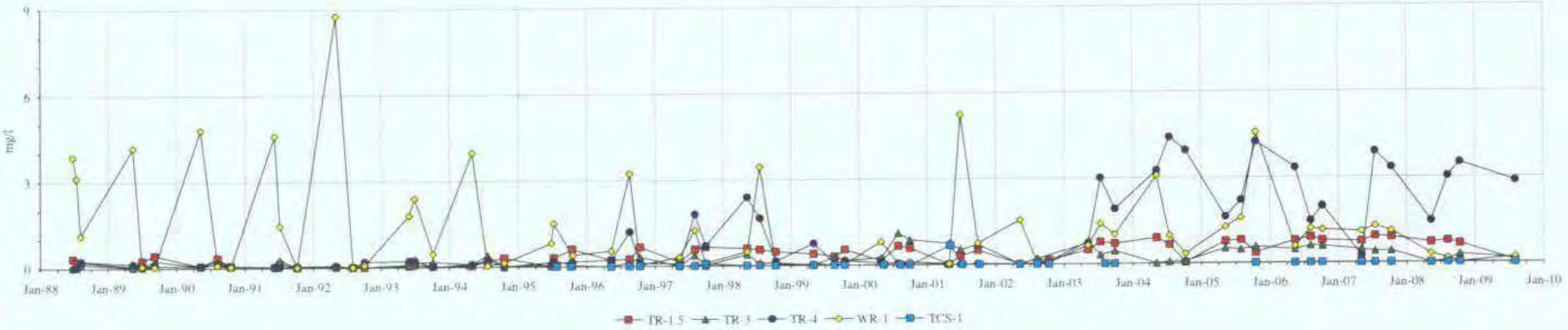


Chart 34. Ground Water Orthophosphate

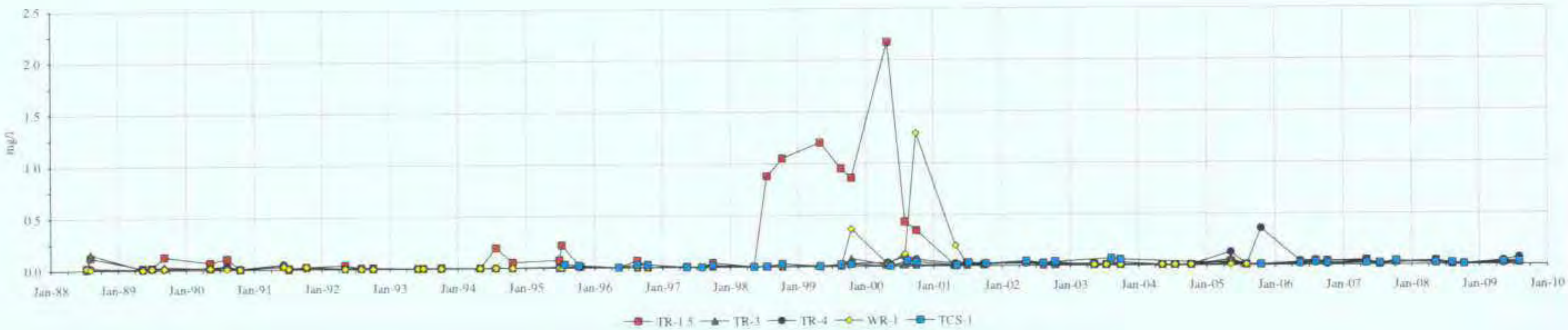


Chart 35. Ground Water Nitrite

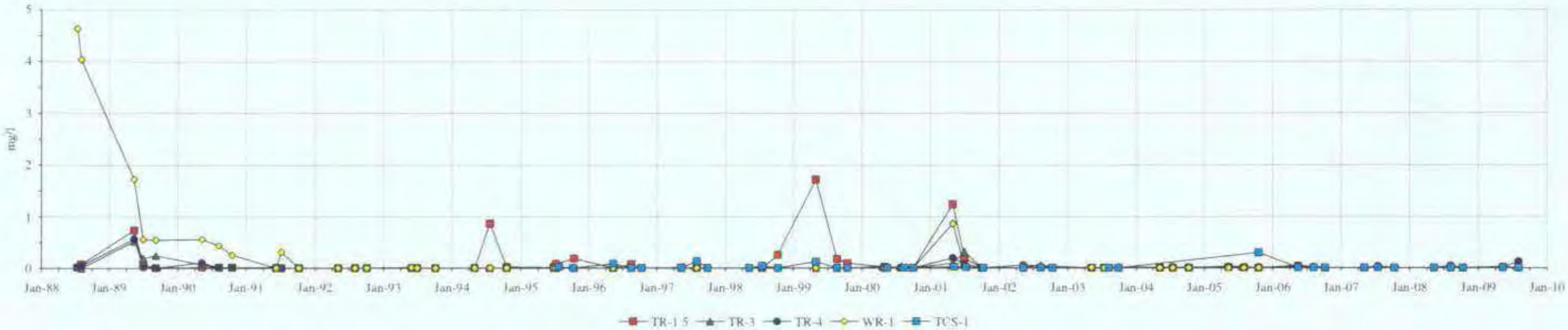


Chart 36. Ground Water Chloride

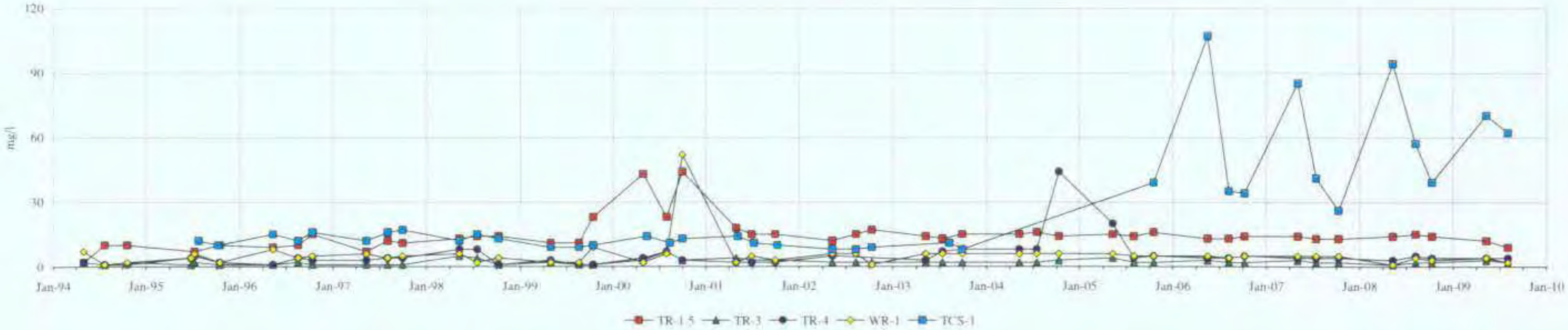
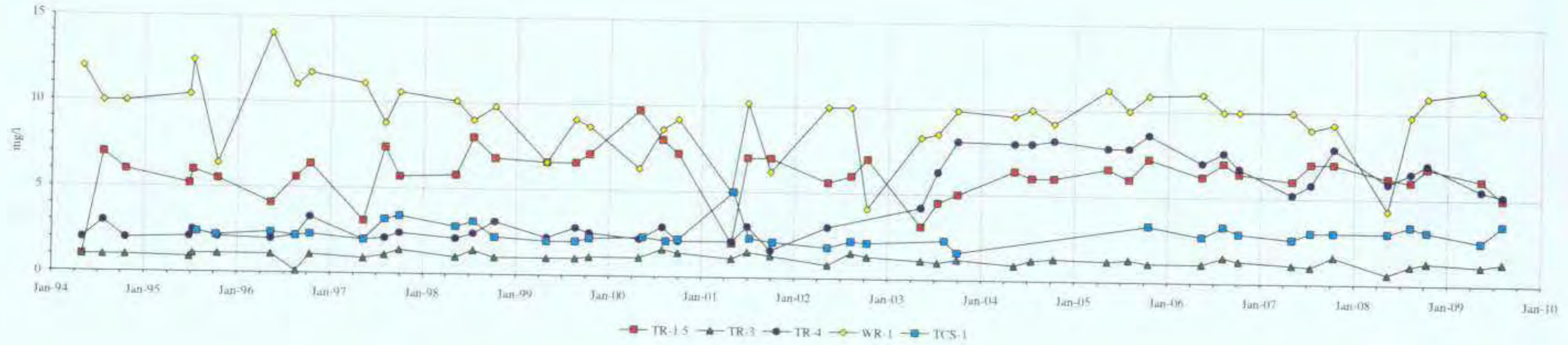


Chart 37. Ground Water Potassium



TABLES

Table 1. Trout Creek Average Streamflow at Site(s) TR-a (a) and/or TR-b (b)

Date	TR-a cfs. (avg)	TR-b cfs. (avg)	TR - A	TR - B	TR - C	TR - D
04/10/89	31.71		a			
04/13/89	24.48			a		
04/14/89	26.95	68.73			ab	ab
05/15/89	58.35	93.60	ab	ab	ab	ab
06/16/89	78.40		a	a		
06/19/89	102.88	93.60			b	b
07/03/89	6.34	19.72	ab	ab	ab	ab
08/03/89	4.03		a			
08/23/89	5.04	10.10		ab	ab	ab
09/07/89	1.79		a			
09/08/89		12.98		b	b	b
04/19/90	21.04	*217.94	ab	ab	ab	ab
05/14/90	58.48	*255.09			ab	ab
06/14/90	101.70	**	a	a	a	a
07/06/90	5.75	**	a	a	a	a
08/10/90	6.20	**				
09/07/90	7.80	25.02	ab	ab	ab	ab
10/16/90	5.88	28.28	ab	ab	ab	ab
05/06/91	21.60	23.57	ab	ab	ab	ab
06/11/91	233.75	**	a	a	a	a
07/09/91	42.29	**	a	a	a	a
08/09/91	24.41	**	a	a	a	a
09/11/91	13.48	**	a	a	a	a
04/13/92	23.35	68.73	ab	ab	ab	ab
05/06/92	81.38	176.20	ab	ab	ab	ab
06/01/92	141.27	148.23	ab	ab	ab	ab
07/01/92	12.09	35.51	ab	ab	ab	ab
08/03/92	18.10	28.15	ab	ab	ab	ab
10/05/92	8.17	33.99	ab	ab	ab	ab
04/28/93		115.23	b	b	b	b
05/04/93	79.49	186.15	ab	ab	ab	ab
06/02/93	198.24	255.09	ab	ab	ab	ab
07/01/93	42.61	78.14	ab	ab	ab	ab
08/04/93	14.46	*142.97	ab	ab	ab	ab
09/09/93	29.00	*257.53	ab	ab	ab	ab
10/06/93	25.49	*351.41	ab	ab	ab	ab
11/08/93	30.99	*295.69	ab	ab	ab	ab
05/03/94	29.83	*186.15	ab	ab	ab	ab
06/20/94	24.86		a	a	a	a
07/25/94	3.08		a	a	a	a
08/16/94	9.42	19.92	ab	ab	ab	ab
09/16/94	7.72	13.14	ab	ab	ab	ab
10/21/94	54.94	20.09	ab	ab	ab	ab

Table 1. Trout Creek Average Streamflow at Site(s) TR-a (a) and/or TR-b (b)

Date	TR-a cfs. (avg)	TR-b cfs. (avg)	TR - A	TR - B	TR - C	TR - D
04/11/95		20.45	b	b	b	b
05/16/95	94.94	76.91	ab	ab	ab	ab
06/08/95	109.17	119.04	ab	ab	ab	ab
07/11/95	177.95	199.82	ab	ab	ab	ab
08/14/95	24.34	29.78	ab	ab	ab	ab
09/18/95	17.83	19.23	ab	ab	ab	ab
10/18/95	20.91	15.95	ab	ab	ab	ab
04/16/96	42.65	71.57	ab	ab	ab	ab
05/13/96	152.68	195.25	ab	ab	ab	ab
06/14/96	110.61	128.08	ab	ab	ab	ab
07/15/96	26.87	13.20	ab	ab	ab	ab
08/19/96	12.10	8.71	ab	ab	ab	ab
09/16/96	9.62	10.12	ab	ab	ab	ab
10/14/96	10.87	16.03	ab	ab	ab	ab
04/16/97	17.78		a	a	a	a
05/13/97	81.30	122.90	ab	ab	ab	ab
06/04/97	162.14	307.07	ab	ab	ab	ab
07/01/97	82.48	65.51	ab	ab	ab	ab
08/04/97	42.18	38.29	ab	ab	ab	ab
09/02/97	34.30	18.14	ab	ab	ab	ab
10/01/97	18.63		a	a	a	a
04/14/98	37.84	42.96	ab	ab	ab	ab
05/12/98	101.80	135.33	ab	ab	ab	ab
06/02/98	167.38	156.95	ab	ab	ab	ab
07/20/98	17.68	17.10	ab	ab	ab	ab
08/17/98	29.07	18.89	ab	ab	ab	ab
09/14/98	27.78	19.06	ab	ab	ab	ab
10/12/98	29.43	15.21	ab	ab	ab	ab
04/01/99	35.06	47.79	ab	ab	ab	ab
05/01/99	82.39	117.22	ab	ab	ab	ab
06/01/99	123.44	153.24	ab	ab	ab	ab
07/01/99	31.19	28.61	ab	ab	ab	ab
08/01/99	25.28	26.53	ab	ab	ab	ab
09/01/99	24.53	*83.15	ab	ab	ab	ab
10/01/99	26.46	35.62	ab	ab	ab	ab
04/01/00	49.57	73.17	ab	ab	ab	ab
05/01/00	34.93	373.84*	ab	ab	ab	ab
06/01/00	23.29	94.76	ab	ab	ab	ab
07/01/00	20.14	8.82	ab	ab	ab	ab
08/01/00	13.15	18.74*	ab	ab	ab	ab
09/01/00	23.53	143.5*	ab	ab	ab	ab
10/01/00	76.87	6.54	ab	ab	ab	ab

Table 1. Trout Creek Average Streamflow at Site(s) TR-a (a) and/or TR-b (b)

Date	TR-a cfs. (avg)	TR-b cfs. (avg)	TR - A	TR - B	TR - C	TR - D
New stage/discharge curve developed in 2001.						
04/01/01	82.00	***	a	a	a	a
05/01/01	90.00	***	a	a	a	a
06/01/01	66.00	34.00	ab	ab	ab	ab
07/01/01	10.00	6.00	ab	ab	ab	ab
08/01/01	8.00	18.00	ab	ab	ab	ab
09/01/01	15.00	***	a	a	a	a
10/01/01	10.00	***	a	a	a	a
04/15/02	10.31	***	a	a	a	a
05/01/02	6.14	***	a	a	a	a
06/01/02	7.76	4.07	ab	ab	ab	ab
07/01/02	0.46	***	a	a	a	a
08/01/02	0.49	5.05	ab	ab	ab	ab
09/01/02	0.42	***	a	a	a	a
10/14/02	1.20	***	a	a	a	a
New digital recorders installed.						
04/16/03	9.77	23.69	ab	ab	ab	ab
05/01/03	13.80	36.68	ab	ab	ab	ab
06/01/03	733.47****	213.34	ab	ab	ab	ab
07/01/03	29.24	18.04	ab	ab	ab	ab
08/01/03	3.48	2.24	ab	ab	ab	ab
09/01/03	3.48	2.24	ab	ab	ab	ab
10/01/03	7.88	3.21	ab	ab	ab	ab
10/26/03	5.20	2.70	ab	ab	ab	ab
04/14/04	21.58	33.67	ab	ab	ab	ab
05/01/04	62.60	62.40	ab	ab	ab	ab
06/01/04	10.45	36.19	ab	ab	ab	ab
07/01/04	4.26	10.56	ab	ab	ab	ab
08/01/04	4.59	5.40	ab	ab	ab	ab
09/01/04	3.18	7.29	ab	ab	ab	ab
10/01/04	9.67	12.77	ab	ab	ab	ab
04/01/05	71.53	66.07	ab	ab	ab	ab
05/01/05	82.67	76.90	ab	ab	ab	ab
06/01/05	12.26	17.26	ab	ab	ab	ab
07/01/05	9.70	12.98	ab	ab	ab	ab
08/01/05	7.00	9.33	ab	ab	ab	ab
09/01/05	10.36	13.23	ab	ab	ab	ab
10/01/05	12.08	13.58	ab	ab	ab	ab
04/01/06	45.61	70.87	ab	ab	ab	ab
05/01/06	138.35	115.19	ab	ab	ab	ab
06/01/06	95.06	70.95	ab	ab	ab	ab
07/01/06	6.73	10.02	ab	ab	ab	ab
08/01/06	15.39	11.93	ab	ab	ab	ab
09/01/06	*****	9.92	b	b	b	b
10/01/06	*****	13.47	b	b	b	b

Table 1. Trout Creek Average Streamflow at Site(s) TR-a (a) and/or TR-b (b)

Date	TR-a cfs. (avg)	TR-b cfs. (avg)	TR - A	TR - B	TR - C	TR - D
04/01/07	31.88	28.29	ab	ab	ab	ab
05/01/07	81.57	58.74	ab	ab	ab	ab
06/01/07	37.32	34.95	ab	ab	ab	ab
07/01/07	2.78	4.10	ab	ab	ab	ab
08/01/07	9.84	5.61	ab	ab	ab	ab
09/01/07	11.11	6.28	ab	ab	ab	ab
10/01/07	15.39	9.42	ab	ab	ab	ab
04/01/08	35.23	94.37	ab	ab	ab	ab
05/01/08	87.35	139.68	ab	ab	ab	ab
06/01/08	200.24	196.29	ab	ab	ab	ab
07/01/08	47.71	63.95	ab	ab	ab	ab
08/01/08	27.11	31.76	ab	ab	ab	ab
09/01/08	17.47	21.02	ab	ab	ab	ab
10/01/08	15.70	17.79	ab	ab	ab	ab
04/01/09	45.46	86.98	ab	ab	ab	ab
05/01/09	136.88	181.01	ab	ab	ab	ab
06/01/09	102.13	138.54	ab	ab	ab	ab
07/01/09	21.59	42.59	ab	ab	ab	ab
08/01/09	15.57	27.72	ab	ab	ab	ab
09/01/09	27.53	32.30	ab	ab	ab	ab
10/01/09	47.45	37.81	ab	ab	ab	ab

*Water flow below Station B blocked by beaver dam

**Water level staff gauge destroyed by high flows

***Continuous reading meter down for repairs

**** Debris upstream of bridge forced water to backup to TR-a resulting in false high readings.

*****Battery failed on digital recorder. Data for TR-a unattainable.

Table 2. Irrigation Ditch Flow Observations at Site TR-A

Date	Flow Observation (Flowing/Not Flowing)	Approximate Flow (cfs)
04/18/00	Not Flowing	0.00
07/18/00	Flowing	1.69
08/15/00	Flowing	0.69
09/11/00	Flowing	0.23
04/09/01	Flowing	0.02
07/10/01	Flowing	8.63
08/01/01	Flowing	0.88
09/21/01	Flowing	0.88
10/10/01	Not Flowing	0.00
05/13/02	Flowing	9.23
06/03/02	Flowing	9.23
07/01/02	Flowing	2.59
07/30/02	Flowing	1.22
09/09/02	Not Flowing	0.00
04/14/03	Flowing	0.07
05/12/03	Flowing	0.02
06/17/03	Flowing	8.34
07/16/03	Flowing	4.63
08/12/03	Flowing	3.72
09/08/03	Flowing	1.01
10/01/03	Not Flowing	0.00
10/27/03	Not Flowing	0.00
04/05/04	Not Flowing	0.00
06/01/04	Flowing	2.49
07/01/04	Not Flowing	0.00
04/18/05	Flowing	1.69
05/12/05	Flowing	2.40
06/09/05	Flowing	9.38
07/15/05	Flowing	15.05
08/03/05	Flowing	0.02
10/20/05	Not Flowing	0.00
04/14/06	Not Flowing	0.00
05/19/06	Flowing	0.53
06/13/06	Flowing	1.10
07/18/06	Flowing	9.69
08/10/06	Not Flowing	0.00
10/11/06	Not Flowing	0.00
04/16/07	Not Flowing	0.00
05/08/07	Not Flowing	0.00
06/22/07	Flowing	9.54
07/01/07	Flowing	11.27
08/09/07	Not Flowing	0.00
09/21/07	Not Flowing	0.00
10/15/07	Not Flowing	0.00

Table 2. Irrigation Ditch Flow Observations at Site TR-A

Date	Flow Observation (Flowing/Not Flowing)	Approximate Flow (cfs)
04/14/08	Not Flowing	0.00
05/14/08	Not Flowing	0.00
06/11/08	Flowing	11.93
07/07/08	Not Flowing	0.00
08/11/08	Not Flowing	0.00
09/08/08	Not Flowing	0.00
10/14/08	Not Flowing	0.00
04/14/09	Not Flowing	0.00
05/14/09	Not Flowing	0.00
06/09/09	Flowing	13.98
07/06/09	Not Flowing	0.00
08/06/09	Not Flowing	0.00
09/02/09	Not Flowing	0.00

Table 3. Surface Water Quality at Site TR-A

Date	pH	Temp	S.C.	TDS	TSS	O-P	NO2	NH3	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss.Al	Diss.Mn	K	Cl	Fe
	(s.u.)	(C)	(umhos/cm)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
04/15/88	7.70	7.0	269		4														
05/25/88	7.90	8.1	216	90	12				53	10	0.3	16.0	6.0	3.0		0.020			
06/24/88	7.80	18.3	152		12														
07/14/88	8.10	13.5	270	152	14	0.010	0.02	0.01	114	8	0.1	32.0	11.0	4.0	0.05	0.009			
08/05/88	8.20	13.7	284	126	8	0.020	0.07	0.01	108	8	0.1	26.0	10.0	3.0	0.05	0.009			
09/21/88	8.20	12.5	201		2														
10/21/88	8.00	8.5	347		2														
04/10/89	7.90	2.8	331	132	38	0.010	0.02	0.01	96	16	0.3	25.0	10.0	3.0	0.09	0.010			
05/15/89	7.60	6.1	78		4														
06/16/89	7.20	16.2	98		18														
07/03/89	8.10	13.9	203	158	2	0.025	0.02	0.02	128	6	0.1	40.0	14.0	4.0	0.05	0.010			
08/03/89	8.10	17.7	223		2														
09/07/89	7.80	18.7	189	148	2	0.017	0.02	0.02	116	6	0.1	32.0	13.0	4.0	0.05	0.009			
10/13/89	7.90	11.1	181		6														
04/19/90	7.10	10.7	149	118	2	0.011	0.02	0.02	286	31	0.2	23.0	10.0	5.0	0.08	0.010			
05/11/90	8.00	8.3	66		6														
06/14/90	7.60	16.0	84		20														
07/06/90	7.50	23.4	211		10														
08/10/90	6.90	14.0	172	146	6	0.010	0.02	0.02	446	6	0.0	33.0	12.0	3.0	0.05	0.009			
09/07/90	6.90	17.9	169		4														
10/16/90	7.90	7.1	1920	132	2	0.005	0.02	0.02	112	4	0.1	26.0	10.0	4.0	0.05	0.010			
05/06/91	8.00	3.0	347	142	4	< 0.010	< 0.01	< 0.05	102	12	0.2	27.0	11.0	5.0	< 0.05	< 0.010			
06/11/91	7.00	5.6	135		30														
07/09/91	7.40	10.3	266	136	28	< 0.010	< 0.01	< 0.05	102	66	1.0	31.0	12.0	12.0	< 0.05	< 0.010			
08/09/91	7.70	9.8	196		8														
09/11/91	7.50	12.2	1200		4														
10/10/91	7.00	9.2	1232	130	< 2	0.030	< 0.01	< 0.05	102	16	0.2	25.0	10.0	4.0	< 0.05	< 0.010			
04/13/92	8.80	5.2	1671	122	< 2	0.008	< 0.01	< 0.05	90	29	0.5	23.0	9.0	3.0	< 0.05	< 0.010			
05/06/92	9.20	12.8	996		< 2														
06/01/92	8.30	6.5	1600		8														
07/01/92	9.00	14.5	1515		4														
08/03/92	8.10	17.9	1430	134	8	0.009	< 0.01	< 0.05	116	80	1.1	31.0	11.0	4.0	< 0.05	< 0.010			
09/08/92	8.40	13.0	180	153	< 2														
10/05/92	6.60	9.3	120	134	< 2	0.011	< 0.01	0.05	110	< 10	0.1	27.0	10.0	4.0	< 0.05	0.020			

Table 3. Surface Water Quality at Site TR-A

Date	pH	Temp	S.C.	TDS	TSS	O-P	NO2	NH3	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss.Al	Diss.Mn	K	Cl	Fe
	(s.u.)	(C)	(umhos/cm)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
04/28/93	8.90	6.0	175	108	< 2	< 0.005	< 0.01	< 0.05	88	37	0.7	25.0	10.0	4.0	< 0.05	0.010	1.0	< 1	
05/04/93	8.50	6.0	170		4														
06/02/93	8.40	8.5	74																
07/01/93	8.50	10.0	100	62	12	< 0.005	< 0.01	< 0.05	58	< 2	0.1	14.0	5.0	2.0	< 0.05	< 0.010	< 1.0	< 1	
08/04/93	8.80	15.3	270		6														
09/09/93	8.80	10.0	170		2														
10/06/93	8.40	6.5	170	132	8	< 0.005	< 0.01	< 0.05	78	6	0.1	26.0	10.0	3.0	< 0.05	< 0.010	1.0	3	
11/08/93	8.60	0.8	200		< 2														
04/05/94	8.60	1.0	200	96	< 2	< 0.005	< 0.01	< 0.05	106	< 2	0.0	23.0	9.0	3.0	< 0.05	< 0.010	< 1.0	< 1	
05/03/94	8.30	4.0	165	104															
06/20/94	7.80	13.1	370	134															
07/25/94	7.80	19.4	335	166	< 2	< 0.005	< 0.01	< 0.05	162	10	0.1	42.0	16.0	5.0	< 0.05	0.020	1.0	< 1	0.05
08/16/94	7.10	17.4	253	146															
09/16/94	7.40	9.1	352	172															
10/21/94	7.60	3.8	248	106	< 5	< 0.005	< 0.01	< 0.05	144	< 4	0.0	21.0	8.0	3.0	< 0.05	0.010	< 1.0	< 1	0.17
04/11/95	7.60	3.2	270	120	6	< 0.005	< 0.01	< 0.05	103	10	0.2	26.6	10.6	4.2	< 0.05	< 0.009	1.0	< 1	0.08
05/16/95	6.90	5.6	250	130	48	0.020	< 0.01	< 0.05	71	20	0.4	19.3	7.3	10.0	< 0.20	0.010	< 2.0	< 1	0.11
06/08/95	7.10	9.1	140	70															
07/11/95	8.00	11.3	101	70	24	0.060	< 0.01	< 0.05	46	40	1.4	11.4	4.0	1.5	0.05	< 0.005	0.5	2	0.11
08/14/95	8.20	17.3	240	100															
09/18/95	8.30	13.4	200	220															
10/18/95	8.50	3.4	240	100	6	0.017	< 0.01	< 0.05	88	7	0.1	20.6	7.9	3.0	< 0.05	< 0.010	0.9	< 1	0.13
04/16/96	8.10	3.8	280	108	< 5	< 0.005	< 0.01	< 0.05	106	< 10	0.1	27.7	10.8	4.0	< 0.03	0.011	1.1	1	0.10
05/13/96	8.70	7.2	200	14															
06/14/96	8.10	11.7	170	80															
07/15/96	7.70	11.9	230	120															
08/19/96	8.70	15.2	240	120	12	0.010	< 0.01	< 0.05	105	20	0.3	26.8	10.0	3.5	< 0.03	0.012	1.1	1	0.14
09/16/96	7.80	7.9	210	100															
10/14/96	8.50	11.3	250	120	6	< 0.005	< 0.01	< 0.05	95	< 10	0.2	22.9	8.3	3.2	< 0.03	0.008	0.9	3	0.12
04/16/97	8.46	10.9	230	130	< 5	< 0.005	< 0.01	0.01	96	10	0.2	132.0	10.4	3.9	< 0.03	0.011	1.0	< 1	0.08
05/13/97	6.96	6.2	230	130															
06/04/97	8.40	8.4	140	70															
07/01/97	8.37	14.1	210	110															
08/04/97	8.49	15.5	220	15	8	< 0.005	< 0.01	< 0.01	112	< 10	0.1	27.6	10.0	3.4	< 0.03	0.009	1.1	< 1	0.11
09/02/97	8.42	15.6	240	180															
10/01/97	8.33	14.7	220	90	< 5	0.009	< 0.01	< 0.01	82	< 10	0.2	19.7	7.3	2.9	< 0.03	0.012	0.9	< 1	0.13

Table 3. Surface Water Quality at Site TR-A

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/14/98	8.40	3.5	280	150	10	< 0.005	< 0.01	< 0.01	114	20	0.3	30.6	12.1	4.2	< 0.03	0.014	1.1	< 1	0.09
05/12/98	8.38	6.7	280	160															
06/02/98	8.25	10.7	130	70															
07/20/98	8.53	16.6	270	130	< 5	0.007	< 0.01	0.01	125	20	0.3	32.5	11.7	3.9	< 0.03	0.013	1.1	< 1	0.06
08/17/98	8.61	17.9	210	100															
09/14/98	8.35	9.8	220	120															
10/12/98	8.26	4.1	260	120	< 5	< 0.005	< 0.01	< 0.01	98	< 10	0.2	23.9	8.8	3.9	< 0.03	0.011	1.0	< 1	0.12
04/05/99	7.98	5.8	300	112	< 5	0.009	< 0.01	< 0.01	98	10	0.2	26.2	10.2	3.9	< 0.03	< 0.005	0.8	2	0.1
05/03/99	8.86	6.1	310	110															
06/01/99	8.39	8.2	180	50															
07/06/99	8.61	21.0	250	110															
08/24/99	8.43	12.9	390	130	< 5	< 0.005	< 0.01	< 0.01	95	< 10	0.2	23.7	8.8	3.4	< 0.03	< 0.005	1.1	< 1	0.06
09/23/99	8.71	14.5	210	110															
10/18/99	8.67	2.1	210	80	< 5	0.008	< 0.01	< 0.01	84	< 10	0.2	20.8	7.8	3.3	< 0.03	0.007	1.0	< 1	0.09
04/18/00	8.30	3.0	210	120	< 5	0.012	< 0.01	< 0.05	84	< 10	0.2	21.5	8.1	3.4	0.04	0.008	1.1	1	0.12
05/16/00	7.98	6.3	140	90															
06/19/00	7.63	11.1	180	110															
07/18/00	7.23	13.6	280	140															
08/15/00	7.80	16.0	310	170	< 5	0.015	< 0.01	< 0.05	145	10	0.1	39.1	13.5	4.3	< 0.03	0.011	1.4	2	0.07
09/11/00	8.63	14.8	230	120															
10/02/00	8.40	11.0	220	140	8	0.009	< 0.01	< 0.05	99	< 10	0.2	25.5	9.6	3.7	< 0.03	0.007	1.2	1	0.16
04/09/01	7.50	6.8	240	140	< 5	< 0.005	< 0.01	< 0.01	97	20	0.3	26.7	10.1	3.8	< 0.03	0.010	0.9	2	0.06
05/08/01	8.40	9.9	200	110															
06/04/01	7.40	7.3	160	60															
07/10/01	7.50	15.7	380	210	< 5	0.021	0.06	< 0.01	167	20	0.2	45.9	15.7	5.1	< 0.03	0.023	1.5	2	0.10
08/01/01	7.90	15.3	260	150															
09/21/01	8.40	8.2	230	150															
10/10/01	8.60	3.0	250	110	< 5	0.017	< 0.01	< 0.01	81	10	0.2	21.7	7.9	3.0	< 0.03	0.007	1.1	1	0.15
04/15/02	8.16	7.6	200	110	< 5	0.012	< 0.01	< 0.01	69	10	0.2	21.7	8.2	3.3	0.05	0.008	1.0	1	0.13
05/13/02	8.17	15.2	170	120															
06/03/02	8.47	13.6	210	200															
07/08/02	8.34	19.7	340	90															
08/13/02	8.49	16.4	300	180	8	0.014	< 0.01	< 0.01	164	10	0.1	38.0	14.4	4.6	< 0.03	0.013	1.4	< 1	0.13
09/09/02	8.02	15.8	250	160															
10/14/02	8.24	5.5	270	150	6	0.020	< 0.01	< 0.01	123	< 10	0.1	27.9	10.5	3.9	< 0.03	0.011	1.1	1	0.21

Table 3. Surface Water Quality at Site TR-A

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/14/03	7.70	2.8	200	120	14	< 0.010	< 0.01	< 0.01	88	20	0.4	23.4	9.0	4.5	< 0.03	0.013	1.5	1	0.09
05/12/03	8.60	12.8	240	160															
06/17/03	7.80	13.4	110	80															
07/16/03	8.40	21.9	310	180	10	0.020	< 0.01	< 0.01	165	< 10	0.1	39.2	13.7	4.1	< 0.03	0.005	1.1	1	0.05
08/12/03	8.30	16.5	250	140															
09/08/03	8.30	11.4	220	140															
10/01/03	8.30	11.2	210	120	< 5	0.020	< 0.01	< 0.01	101	< 10	0.2	19.1	7.0	3.2	< 0.03	0.006	0.7	< 1	0.14
04/05/04	8.13	10.1	200	120	6	< 0.010	< 0.01	< 0.01	88	< 10	0.2	23.0	8.8	3.8	0.04	0.007	1.1	1	0.10
05/12/04	7.44	9.5	90	70															
06/01/04	7.81	14.0	140	90															
07/19/04	8.62	20.3	230	160	12	0.020	< 0.01	< 0.01	139	< 10	0.1	29.9	10.6	3.6	< 0.03	0.011	1.2	1	0.21
08/03/04	8.71	24.1	250	170															
09/08/04	8.38	14.0	230	170															
10/13/04	7.93	10.0	160	120	< 5	< 0.010	< 0.01	< 0.01	106	10	0.1	24.1	9.0	3.4	< 0.03	0.005	1.0	1	0.21
04/18/05	8.10	7.9	150	90	12	0.020	0.02	< 0.01	79	10	0.2	19.4	7.3	3.1	0.04	0.013	1.0	< 1	0.13
05/12/05	8.24	6.7	120	110															
06/09/05	8.75	9.0	80	110															
07/15/05	8.36	19.7	190	140															
08/03/05	8.17	15.6	270	130	< 5	< 0.010	< 0.01	< 0.01	99	< 10	0.2	25.4	9.2	3.1	< 0.03	< 0.005	1.1	1	0.27
09/06/05	8.19	13.0	220	120															
10/20/05	7.80	10.3	130	100	10	0.010	< 0.01	< 0.01	88	< 10	0.2	23.3	8.5	3.4	0.06	0.007	1.0	1	0.23
04/14/06	7.79	7.7	160	120	6	0.030	< 0.01	< 0.01	92	< 10	0.2	23.8	9.3	4.0	< 0.03	0.007	1.6	2	0.14
05/19/06	8.28	10.3	70	70															
06/13/06	8.08	14.6	100	70															
07/18/06	8.37	15.5	290	160															
08/10/06	8.34	15.2	270	190	8	0.030	< 0.01	< 0.01	137	< 10	0.1	36.4	12.9	3.7	< 0.03	0.013	1.1	< 1	0.15
09/11/06	8.67	14.8	170	120															
10/11/06	8.54	8.1	180	110	< 5	0.030	< 0.01	< 0.01	86	< 10	0.2	21.9	8.2	3.4	< 0.03	0.009	1.0	1	0.07
04/16/07	8.36	6.0	180	130	< 5	0.020	< 0.01	< 0.01	97	< 10	0.2	24.4	9.5	4.1	< 0.03	0.010	0.9	1	0.06
05/08/07	8.15	3.9	150	100															
06/22/07	8.10	20.0	180	110															
07/19/07	8.30	17.1	300	200	< 5	0.020	0.03	< 0.01	172	< 10	0.1	43.1	14.8	4.5	< 0.03	0.008	1.6	1	0.23
08/09/07	8.20	15.8	220	120															
09/21/07	8.40	12.6	220	140															
10/15/07	8.00	6.4	190	120	< 5	0.030	< 0.01	< 0.01	96	< 10	0.2	19.1	6.9	3.0	< 0.03	< 0.005	1.0	1	0.22

Table 3. Surface Water Quality at Site TR-A

Date	pH	Temp	S.C.	TDS	TSS	O-P	NO2	NH3	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss.Al	Diss.Mn	K	Cl	Fe
	(s.u.)	(C)	(umhos/cm)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
04/14/08	8.46	7.1	220	120	6	0.020	< 0.01	< 0.01	90	< 10	0.2	24.3	8.7	3.7	< 0.03	0.007	1.0	2	0.09
05/14/08	7.76	5.2	250	160															
06/11/08	7.87	5.5	90	70															
07/07/08	8.32	12.3	130	90															
08/11/08	7.83	11.3	170	110	8	0.020	< 0.01	< 0.01	88	6	0.1	24.3	8.2	3.1	< 0.03	0.008	0.9	1	0.24
09/08/08	7.55	8.9	180	110															
10/14/08	7.94	1.2	150	110	5	< 0.010	< 0.01	< 0.01	67	6	0.1	21.5	8.0	3.3	< 0.03	0.016	1.0	< 1	0.15
04/14/09	8.14	4.8	240	130	< 5	< 0.010	< 0.01	< 0.02	105	14	0.2	26.5	10.0	4.4	< 0.03	0.015	1.2	< 1	0.25
05/14/09	7.78	7.2	110	90															
06/09/09	8.16	10.4	100	80															
07/06/09	7.16	16.9	150	100															
08/06/09	8.65	15.6	260	130	< 5	0.030	< 0.01	< 0.02	122	8	0.1	29.8	10.7	3.4	< 0.03	0.019	1.0	< 1	0.09
09/02/09	8.42	11.8	220	140															

Note: Monitoring site TR-A was removed from the Monitoring Program on September 2, 2009 in accordance with TR-48.

Table 4. Surface Water Quality at Site TR-B

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/28/88	7.90	8.2	378		4														
05/25/88	8.00	9.0	258	186	18				8	62	12.2	31.0	15.0	6.0		0.040			
06/24/88	7.90	18.8	187		4														
07/15/88	8.20	19.7	295	336	14	0.010	0.07	0.01	139	121	1.4	56.0	27.0	20.0	0.05	0.020			
08/05/88	8.00	22.4	228	242	4	0.020	0.02	0.01	124	74	0.9	41.0	19.0	6.0	0.05	0.020			
09/21/88	8.40	13.0	365		2														
10/21/88	7.30	10.5	397		2														
04/13/89	7.90	7.0	695	510	8	0.009	0.01	0.01	125	282	3.6	76.0	43.0	12.0	0.05	0.010			
05/15/89	8.00	7.2	243		6														
06/16/89	8.00	17.4	144		18														
07/03/89	7.50	15.9	375	358	6	0.025	0.02	0.02	140	144	1.6	70.0	31.0	10.0	0.05	0.050			
08/23/89	7.60	13.1	362		6														
09/08/89	7.20	14.5	606	544	6	0.029	0.07	0.01	156	253	2.6	77.0	40.0	12.0	0.05	0.009			
10/13/89	7.10	13.7	399		4														
04/19/90	7.90	11.3	536	456	2	0.014	0.02	0.02	148	247	2.6	64.0	35.0	13.0	0.05	0.040			
05/11/90	7.30	10.1	259		2														
06/14/90	6.70	16.2	124		14														
07/06/90	8.00	23.4	284		6														
08/10/90	8.10	16.2	316	270	4	0.026	0.02	0.02	150	84	0.9	50.0	21.0	6.0	0.05	0.010			
09/07/90	7.00	13.8	290		6														
10/16/90	8.30	7.1	2680	326	6	0.021	0.02	0.05	130	142	1.7	54.0	27.0	10.0	0.05	0.030			
05/06/91	8.10	3.8	1182	620	4	< 0.010	< 0.01	< 0.05	140	342	3.8	91.0	54.0	15.0	< 0.05	< 0.010			
06/11/91	7.60	4.8	1843		22														
07/09/91	7.90	11.4	396	238	20	< 0.010	< 0.01	< 0.05	110	37	0.5	36.0	16.0	5.0	< 0.05	0.010			
08/09/91	7.90	10.9	406		12														
09/11/91	8.30	13.1	1890		4														
10/10/91	7.90	6.7	2521	280	< 2	0.026	< 0.01	< 0.05	134	107	1.3	46.0	24.0	8.0	< 0.05	< 0.010			
04/13/92	7.00	8.4	2448	450	6	0.010	< 0.01	< 0.05	126	245	3.1	68.0	38.0	10.0	< 0.05	0.010			
05/06/92	8.00	14.2	1650		4														
06/01/92	7.80	8.0	1674		2														
07/01/92	9.00	16.6	1621		10														
08/03/92	7.10	20.1	1887	244	8	0.020	< 0.01	< 0.05	132	123	1.5	49.0	21.0	7.0	< 0.05	0.010			
09/08/92	8.50	15.2	470	312	< 2														
10/05/92	8.60	12.5	460	356	< 2	0.010	< 0.01	< 0.05	140	161	1.8	58.0	30.0	9.0	< 0.05	0.040			

Table 4. Surface Water Quality at Site TR-B

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/28/93	8.70	8.8	500	656	2	< 0.005	< 0.01	< 0.05	132	393	4.7	101.0	66.0	14.0	< 0.05	0.060	3.0	2	
05/04/93	8.40	8.3	1000		8														
06/02/93	8.40	8.5	74																
07/01/93	8.70	10.4	200	128	16	< 0.005	< 0.01	< 0.05	68	33	0.8	22.0	10.0	3.0	< 0.05	< 0.010	< 1.0	< 1	
08/04/93	8.90	18.9	620		< 2														
09/09/93	8.60	12.0	370		2														
10/06/93	8.60	7.1	450	274	6	< 0.005	< 0.01	< 0.05	124	101	1.3	46.0	23.0	7.0	< 0.05	0.030	1.0	2	
11/08/93	8.30	0.8	500		< 2														
04/05/94	8.60	2.0	600	594	< 2	< 0.005	< 0.01	< 0.05	144	313	3.4	82.0	49.0	13.0	< 0.05	0.070	2.0	1	
05/03/94	8.30	5.8	590	382															
06/20/94	7.70	16.6	430	246															
07/25/94	7.90	21.6	855	564	2	0.009	< 0.01	< 0.05	196	272	2.2	95.0	50.0	14.0	< 0.05	0.030	3.0	1	0.10
08/16/94	6.90	18.1	584	324															
09/16/94	7.80	12.3	410	236															
10/21/94	7.80	9.4	407	194	< 5	0.006	< 0.01	< 0.05	76	54	1.1	35.0	17.0	5.0	< 0.05	0.060	1.0	< 1	0.64
04/11/95	7.60	4.3	1080	760	< 5	< 0.005	< 0.01	< 0.05	147	460	4.9	112.0	70.2	12.8	< 0.05	0.065	2.2	2	0.05
05/16/95	7.00	7.9	580	570	24	0.015	< 0.01	< 0.05	102	290	4.5	53.5	28.9	13.0	< 0.20	0.040	2.0	2	0.12
06/08/95	7.60	10.7	370	190															
07/11/95	7.90	15.0	200	110	22	0.007	< 0.01	< 0.05	51	50	1.5	17.2	8.1	2.2	0.05	0.022	0.7	2	0.14
08/14/95	8.10	17.3	380	240															
09/18/95	8.10	16.5	380	340															
10/18/95	8.40	6.3	550	330	26	0.016	< 0.01	< 0.05	112	137	1.9	50.4	28.7	6.3	< 0.05	0.053	1.4	1	0.11
04/16/96	8.10	2.9	1320	897	< 5	0.008	< 0.01	< 0.05	163	550	5.3	133.0	93.5	16.4	< 0.03	0.088	3.2	2	0.08
05/13/96	8.50	10.2	530	350															
06/14/96	7.60	9.6	230	140															
07/15/96	7.90	13.8	410	260															
08/19/96	8.40	16.4	480	290	10	0.009	< 0.01	< 0.05	120	120	1.6	50.7	27.8	6.3	< 0.03	0.066	1.5	1	0.15
09/16/96	8.30	13.1	490	250															
10/14/96	8.10	10.2	430	270	8	< 0.005	< 0.01	< 0.05	113	100	1.4	44.7	23.5	5.7	0.03	0.060	1.3	3	0.20
04/16/97	8.22	10.5	1210	880	< 5	< 0.005	< 0.01	< 0.01	152	500	5.2	173.0	92.2	14.9	< 0.03	0.104	3.0	2	0.15
05/13/97	7.89	10.1	590	340															
06/04/97	8.81	12.1	280	170															
07/01/97	8.07	11.7	380	240															
08/04/97	8.61	19.1	410	230	10	0.010	< 0.01	< 0.01	119	70	0.9	42.7	20.5	4.9	< 0.03	0.045	1.3	< 1	0.18
09/02/97	8.44	19.2	380	240															
10/01/97	8.26	10.5	440	260	< 5	0.017	< 0.01	< 0.01	100	100	1.6	44.8	24.5	4.9	< 0.03	0.063	1.2	< 1	0.17

Table 4. Surface Water Quality at Site TR-B

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/14/98	8.20	4.5	1160	850	< 5	< 0.005	< 0.01	< 0.01	160	480	4.7	112.0	80.9	12.4	< 0.03	0.070	2.7	< 1	0.03
05/12/98	8.20	8.9	640	400															
06/02/98	8.35	13.1	230	130															
07/20/98	8.29	17.4	530	370	6	0.021	< 0.01	0.01	149	140	1.5	58.0	30.6	7.5	< 0.03	0.096	1.7	< 1	0.13
08/17/98	8.40	17.2	450	270															
09/14/98	8.45	13.8	380	220															
10/12/98	8.31	5.4	460	250	< 5	< 0.005	< 0.01	< 0.01	115	90	1.2	42.5	21.5	5.3	< 0.03	0.061	1.2	< 1	0.14
04/05/99	8.09	6.3	870	610	< 5	0.007	< 0.01	< 0.01	136	330	3.8	95.0	60.0	11.0	< 0.03	0.089	2.2	3	0.22
05/03/99	8.67	6.3	680	420															
06/01/99	8.43	9.1	280	130															
07/06/99	8.67	21.5	430	330															
08/24/99	8.48	17.7	440	280	< 5	0.014	< 0.01	< 0.01	111	80	1.1	40.8	21.7	5.0	< 0.03	0.035	1.3	< 1	0.08
09/23/99	8.64	12.4	400	200															
10/18/99	8.69	3.5	330	170	< 5	0.013	< 0.01	< 0.01	98	60	1.0	32.2	17.2	4.5	< 0.03	0.040	1.1	< 1	0.18
04/18/00	8.20	7.0	930	580	< 5	0.011	< 0.01	< 0.05	127	320	4.0	85.5	55.7	8.9	< 0.03	0.060	2.2	2	0.08
05/16/00	8.35	11.5	310	190															
06/19/00	8.34	12.7	330	210															
07/18/00	7.71	17.4	490	290															
08/15/00	8.20	21.0	560	410	< 5	0.016	< 0.01	< 0.05	156	140	1.4	71.7	34.3	6.8	< 0.03	0.048	2.0	2	0.09
09/11/00	8.46	14.9	470	290															
10/02/00	8.40	13.0	460	280	8	0.008	< 0.01	< 0.05	121	110	1.4	46.3	24.3	6.1	< 0.03	0.040	1.5	1	0.17
04/09/01	8.00	5.3	1160	850	< 5	< 0.050	< 0.01	< 0.01	151	490	5.1	117.0	78.3	11.7	< 0.03	0.083	2.6	3	0.05
05/08/01	8.40	8.9	540	340															
06/04/01	8.10	9.1	240	130															
07/10/01	7.90	20.2	780	600	< 5	0.024	0.02	< 0.01	184	240	2.1	87.5	47.1	10.7	< 0.03	0.073	2.3	2	0.06
08/01/01	8.20	20.0	410	270															
09/21/01	8.40	13.0	430	280															
10/10/01	8.60	6.5	400	230	6	0.011	< 0.01	< 0.01	96	90	1.5	38.5	20.3	6.1	< 0.03	0.047	1.8	2	0.19
04/15/02	7.82	7.8	700	440	6	0.012	< 0.01	< 0.01	97	230	3.7	65.2	42.1	8.3	< 0.03	0.071	1.9	2	0.29
05/13/02	8.54	12.0	510	310															
06/03/02	8.43	13.0	320	800															
07/08/02	8.08	16.8	1030	170															
08/13/02	8.57	22.1	590	420	6	0.013	< 0.01	< 0.01	207	170	1.3	67.2	36.9	11.1	< 0.03	0.039	2.2	1	0.18
09/09/02	8.05	15.0	400	260															
10/14/02	8.23	10.3	430	260	< 5	0.010	< 0.01	< 0.01	141	90	1.0	50.4	25.3	6.3	< 0.03	0.028	1.5	1	0.17

Table 4. Surface Water Quality at Site TR-B

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/14/03	7.90	7.3	700	500	20	< 0.010	< 0.01	< 0.01	117	250	3.4	74.3	40.1	8.9	< 0.03	0.038	2.3	2	0.05
05/12/03	8.10	9.0	820	600															
06/17/03	8.00	16.1	220	140															
07/16/03	8.20	19.4	610	450	6	0.030	< 0.01	< 0.01	181	170	1.5	70.2	37.8	9.0	< 0.03	0.033	1.7	1	0.08
08/12/03	8.40	21.8	480	370															
09/08/03	8.30	15.3	370	250															
10/01/03	8.20	13.5	380	240	< 5	0.020	< 0.01	< 0.01	116	90	1.2	44.1	22.5	5.9	0.04	0.012	1.2	1	0.17
04/05/04	7.80	9.9	740	560	10	< 0.010	< 0.01	< 0.01	126	310	3.9	80.4	52.4	9.3	< 0.03	0.038	2.2	2	0.09
05/12/04	7.75	7.6	250	140															
06/01/04	7.64	12.8	230	160															
07/19/04	8.48	20.1	340	250	8	0.020	< 0.01	< 0.01	147	70	0.7	46.0	20.7	5.6	0.04	0.032	1.3	1	0.25
08/03/04	8.55	21.4	360	240															
09/08/04	8.41	17.8	580	430															
10/13/04	8.07	9.9	370	250	< 5	< 0.010	< 0.01	< 0.01	124	100	1.3	41.4	21.9	5.7	< 0.03	0.017	1.3	1	0.30
04/18/05	8.21	9.3	520	360	12	0.010	< 0.01	< 0.01	109	190	2.7	57.3	34.0	7.5	< 0.03	0.013	1.8	1	0.11
05/12/05	8.39	5.6	470	280															
06/09/05	9.24	10.3	190	150															
07/15/05	8.45	22.3	400	270															
08/03/05	8.34	16.1	300	200	< 5	0.010	< 0.01	< 0.01	113	40	0.6	35.2	16.3	4.2	0.04	0.017	1.3	1	0.37
09/06/05	8.46	17.3	380	230															
10/20/05	8.31	8.4	290	200	8	< 0.010	< 0.01	< 0.01	99	60	1.0	38.7	19.3	5.1	< 0.03	0.035	1.4	1	0.11
04/14/06	8.24	8.8	900	690	< 5	0.020	< 0.01	< 0.01	135	400	4.7	97.1	70.5	10.6	< 0.03	0.014	3.0	2	0.09
05/19/06	8.04	14.0	210	140															
06/13/06	8.09	12.6	180	130															
07/18/06	8.64	21.9	640	430															
08/10/06	8.47	20.5	480	370	< 5	0.030	< 0.01	< 0.01	146	110	1.2	54.2	27.5	6.3	< 0.03	0.036	1.8	1	0.08
09/11/06	8.83	14.1	360	210															
10/11/06	8.46	8.1	300	200	6	0.020	< 0.01	< 0.01	100	40	0.6	31.8	16.8	4.7	< 0.03	0.034	1.2	1	0.10
04/16/07	8.39	9.6	720	500	< 5	0.020	< 0.01	< 0.01	125	260	3.3	72.8	46.8	8.3	< 0.03	0.037	1.5	2	0.04
05/08/07	8.32	6.9	420	280															
06/22/07	8.40	18.5	300	200															
07/19/07	8.50	23.1	550	390	< 5	0.020	< 0.01	< 0.01	167	120	1.1	66.5	33.3	10.1	< 0.03	0.023	2.0	2	0.06
08/09/07	8.30	17.6	320	200															
09/21/07	8.50	13.1	410	240															
10/15/07	8.30	9.4	330	220	< 5	0.030	< 0.01	< 0.01	107	70	1.0	29.5	14.8	4.5	< 0.03	0.013	1.2	1	0.17

Table 4. Surface Water Quality at Site TR-B

Date	pH	Temp	S.C.	TDS	TSS	O-P	NO2	NH3	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss.Al	Diss.Mn	K	Cl	Fe
	(s.u.)	(C)	(umhos/cm)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
04/14/08	8.49	6.5	610	360	< 5	0.020	< 0.01	< 0.01	106	170	2.5	54.5	33.4	8.9	< 0.03	0.056	1.6	2	0.07
05/14/08	8.41	6.4	910	630															
06/11/08	8.25	6.6	200	140															
07/07/08	8.43	15.2	280	180															
08/11/08	8.30	16.0	350	190	7	0.020	< 0.01	< 0.01	95	54	0.9	35.2	16.9	4.0	< 0.03	0.026	1.2	1	0.15
09/08/08	7.20	13.2	340	220															
10/14/08	8.42	3.6	300	190	< 5	< 0.010	< 0.01	< 0.01	92	58	1.0	34.2	17.9	4.6	< 0.03	0.043	1.3	1	0.22
04/14/09	7.26	6.0	740	490	5	0.010	< 0.01	0.04	125	230	2.9	71.0	43.8	9.6	< 0.03	0.059	1.9	2	0.37
05/14/09	8.39	9.4	320	210															
06/09/09	8.20	9.6	250	150															
07/06/09	8.07	14.4	240	160															
08/06/09	8.51	16.3	430	270	6	0.030	< 0.01	< 0.02	131	92	1.1	49.5	25.0	5.8	< 0.03	0.051	1.4	1	0.09
09/02/09	8.37	12.4	400	260															

Note: Monitoring site TR-B was removed from the Monitoring Program on September 2, 2009 in accordance with TR-48.

Table 5. Surface Water Quality at Site TR-C

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/29/88	8.10	6.0	679		4														
05/17/88	7.70	5.2	331	190	90				62	68	1.7	29.0	14.0	4.0		0.130			
06/25/88	7.90	15.5	255		6														
07/14/88	8.20	23.3	354	396	8	0.009	0.03	0.01	135	165	1.9	64.0	34.0	8.0	0.05	0.010			
08/05/88	8.00	20.7	320	298	8	0.020	0.02	0.01	129	123	1.5	49.0	26.0	8.0	0.05	0.010			
09/21/88	8.30	13.9	415		4														
10/21/88	8.00	9.8	451		2														
04/14/89	8.10	8.2	1005	754	6	0.005	0.01	0.01	140	449	5.0	99.0	76.0	18.0	0.05	0.020			
05/15/89	8.50	8.3	333		6														
06/19/89	7.80	17.4	232		10														
07/03/89	7.80	20.1	643	578	2	0.016	0.02	0.02	150	298	3.1	98.0	54.0	17.0	0.05	0.030			
08/23/89	7.60	13.3	487		4														
09/08/89	7.00	14.4	842	740	10	0.023	0.01	0.01	166	397	3.8	104.0	74.0	16.0	0.05	0.009			
10/13/89	7.90	15.0	51		2														
04/19/90	7.90	12.0	712	604	2	0.130	0.02	0.02	100	358	5.6	78.0	48.0	16.0	0.05	0.040			
05/14/90	7.50	7.2	335		12														
06/14/90	7.20	16.2	162		20														
07/06/90	7.70	21.3	371		14														
08/10/90	8.00	21.8	420	354	4	0.022	0.02	0.02	150	152	1.6	62.0	31.0	9.0	0.05	0.009			
09/07/90	8.00	20.2	477		4														
10/16/90	8.60	8.8	2280	422	2	0.120	0.02	0.05	138	218	2.5	64.0	36.0	12.0	0.05	0.030			
05/06/91	8.30	6.7	1272	780	2	< 0.010	< 0.01	< 0.05	147	459	4.9	109.0	69.0	21.0	< 0.05	0.050			
06/11/91	7.70	5.8	275		26														
07/09/91	8.00	13.5	482	304	10	< 0.010	< 0.01	< 0.05	115	78	1.1	43.0	22.0	7.0	< 0.05	0.020			
08/09/91	8.50	14.4	1743		8														
09/11/91	8.30	13.4	1819		< 2														
10/10/91	7.90	10.9	2042	376	< 2	0.022	< 0.01	< 0.05	140	183	2.1	57.0	33.0	11.0	< 0.05	0.020			
04/13/92	8.80	8.8	2282	566	< 2	0.006	< 0.01	< 0.05	122	311	4.0	80.0	48.0	14.0	< 0.05	0.020			
05/06/92	9.20	14.3	1748		6														
06/01/92	8.40	8.2	1972		8														
07/01/92	8.40	11.7	1599		2														
08/03/92	8.00	14.0	1769	356	8	0.017	< 0.01	< 0.05	142	58	0.6	62.0	31.0	10.0	< 0.05	0.010			
09/08/92	8.60	17.0	615	409	2														
10/05/92	8.70	6.9	640	426	4	0.007	< 0.01	< 0.05	140	230	2.6	68.0	38.0	13.0	< 0.05	0.040			

Table 5. Surface Water Quality at Site TR-C

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/28/93	8.90	11.0	900	824	2	< 0.005	< 0.01	< 0.05	140	515	5.8	118.0	81.0	20.0	< 0.05	0.050	3.0	2	
05/04/93	8.80	11.8	600		8														
06/02/93	8.50	9.0	220																
07/01/93	8.60	15.0	205	114	14	< 0.005	< 0.01	< 0.05	68	39	0.9	24.0	11.0	4.0	< 0.05	0.010	< 1.0	< 1	
08/04/93	8.90	20.0	700		14														
09/09/93	8.90	16.0	520		4														
10/06/93	9.00	11.3	590	366	< 2	< 0.005	< 0.01	< 0.05	140	173	1.9	56.0	31.0	10.0	< 0.05	0.030	2.0	< 1	
11/08/93	9.00	1.0	680		< 2														
04/05/94	8.80	6.8	1000	780	< 2	< 0.005	< 0.01	< 0.05	80	453	8.9	99.0	65.0	19.0	< 0.05	0.060	2.0	2	
05/03/94	8.60	7.2	600	444															
06/20/94	8.19	17.9	640	416															
07/25/94	7.90	16.1	1328	990	< 2	< 0.005	< 0.01	< 0.05	220	576	4.1	139.0	87.0	26.0	0.06	0.020	3.0	2	0.06
08/16/94	7.90	16.7	970	626															
09/16/94	8.40	11.5	595	384															
10/21/94	6.90	6.9	486	276	< 5	< 0.005	< 0.01	< 0.05	168	115	1.1	45.0	25.0	8.0	< 0.05	0.040	1.0	< 1	0.55
04/11/95	7.40	2.8	1480	1040	< 5	< 0.005	< 0.01	< 0.05	174	630	5.7	127.0	93.5	25.8	< 0.05	0.096	3.0	3	0.02
05/16/95	7.70	8.5	830	500	68	0.013	< 0.01	< 0.05	117	290	3.9	69.7	42.5	14.0	< 0.20	0.055	3.0	2	0.06
06/08/95	7.40	11.0	410	260															
07/11/95	8.10	15.3	260	130	28	0.007	< 0.01	< 0.05	54	60	1.7	19.7	9.4	2.9	0.04	0.017	0.8	1	0.13
08/14/95	8.00	12.2	510	340															
09/18/95	7.90	15.1	570	340															
10/18/95	8.50	6.6	610	390	8	0.014	< 0.01	< 0.05	137	189	2.2	57.7	34.5	8.6	< 0.03	0.047	1.5	1	0.10
04/16/96	8.20	4.1	1890	1470	10	0.013	< 0.01	< 0.05	194	960	7.8	191.0	152.0	43.4	< 0.03	0.091	5.5	5	0.08
05/13/96	8.50	11.1	630	420															
06/14/96	6.80	9.1	290	160															
07/15/96	8.20	16.4	530	330															
08/19/96	8.30	16.1	620	410	< 5	0.009	< 0.01	< 0.05	129	200	2.4	65.8	40.5	10.0	< 0.03	0.050	1.9	2	0.10
09/16/96	8.40	13.0	620	380															
10/14/96	8.00	8.9	530	350	6	< 0.005	< 0.01	< 0.05	120	150	2.0	53.1	30.7	8.2	0.03	0.045	1.5	4	0.12
04/16/97	8.17	9.9	1660	1270	6	< 0.005	< 0.01	< 0.01	172	780	7.1	172.0	137.0	28.6	0.03	0.118	4.5	3	0.13
05/13/97	7.62	9.0	660	440															
06/04/97	8.87	9.9	250	160															
07/01/97	7.77	11.1	430	260															
08/04/97	8.45	19.6	480	350	< 5	0.008	< 0.01	< 0.01	127	120	1.5	51.0	28.2	6.7	< 0.03	0.039	1.6	< 1	0.09
09/02/97	8.39	19.1	530	410															
10/01/97	8.24	9.1	580	330	< 5	0.010	< 0.01	< 0.01	110	170	2.4	56.3	33.4	7.8	< 0.03	0.061	1.6	< 1	0.12

Table 5. Surface Water Quality at Site TR-C

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/14/98	8.20	4.6	1420	1160	< 5	< 0.005	< 0.01	< 0.01	174	700	6.3	162.0	114.0	23.8	< 0.03	0.086	4.0	2	0.07
05/12/98	8.16	8.1	650	420															
06/02/98	8.22	11.4	240	140															
07/20/98	8.01	15.1	630	460	< 5	0.024	< 0.01	< 0.01	159	190	1.9	68.8	39.4	10.0	< 0.03	0.074	1.9	< 1	0.16
08/17/98	8.11	18.6	540	360															
09/14/98	8.31	11.9	490	310															
10/12/98	7.80	5.7	520	330	< 5	< 0.005	< 0.01	< 0.01	122	140	1.8	51.3	29.3	7.5	< 0.03	0.046	1.5	< 1	0.1
04/05/99	8.01	9.1	1110	980	< 5	0.006	< 0.01	< 0.01	158	590	5.9	150.0	99.7	18.7	< 0.03	0.095	3.2	3	0.17
05/03/99	8.60	6.7	740	540															
06/01/99	8.35	9.4	250	140															
07/06/99	8.53	22.9	490	320															
08/24/99	8.41	19.4	470	370	< 5	< 0.005	< 0.01	< 0.01	119	140	1.9	50.4	30.3	7.6	< 0.03	0.024	1.7	< 1	0.07
09/23/99	8.62	12.1	420	260															
10/18/99	8.55	3.7	480	250	< 5	0.011	< 0.01	< 0.01	106	130	1.9	43.8	27.0	7.2	< 0.03	0.040	1.7	< 1	0.11
04/18/00	8.20	8.0	1120	830	< 5	0.009	< 0.01	< 0.05	140	490	5.5	114.0	79.4	15.6	< 0.03	0.058	2.9	2	0.07
05/16/00	8.23	10.8	390	260															
06/19/00	7.51	13.9	430	280															
07/18/00	7.81	19.4	520	340															
08/15/00	8.20	20.0	740	560	6	0.019	< 0.01	< 0.05	168	250	2.3	88.5	54.6	10.6	< 0.03	0.040	2.3	2	0.06
09/11/00	8.47	13.6	650	430															
10/02/00	8.10	10.0	560	360	< 5	0.007	< 0.01	< 0.05	129	180	2.2	56.4	33.2	8.0	< 0.03	0.022	1.6	1	0.18
04/09/01	8.00	4.4	1450	1130	< 5	< 0.005	< 0.01	< 0.01	160	700	6.9	151.0	110.0	21.7	< 0.03	0.010	3.7	4	0.03
05/08/01	8.20	6.7	690	470															
06/04/01	8.10	8.2	200	120															
07/10/01	7.50	18.4	920	750	< 5	0.024	< 0.02	< 0.01	189	350	2.9	99.8	58.8	14.5	< 0.03	0.060	2.7	2	0.07
08/01/01	8.00	18.1	540	380															
09/21/01	8.10	10.9	450	270															
10/10/01	8.40	6.2	470	270	< 5	0.011	< 0.01	< 0.01	100	120	1.9	43.9	24.7	7.0	< 0.03	0.033	2.0	2	0.13
04/15/02	7.33	8.0	850	610	< 5	0.009	< 0.01	< 0.01	106	350	5.2	84.4	59.0	12.9	0.79	0.092	2.3	2	0.35
05/13/02	8.17	10.1	570	390															
06/03/02	8.18	14.0	360	950															
07/08/02	8.14	20.5	1170	220															
08/13/02	8.55	20.7	850	680	8	0.013	< 0.01	< 0.01	188	330	2.8	101.0	67.3	17.1	< 0.03	0.033	3.0	2	0.07
09/09/02	8.10	14.4	550	380															
10/14/02	8.17	8.1	580	370	< 5	< 0.010	< 0.01	< 0.01	152	160	1.7	63.8	35.9	9.8	< 0.03	0.025	1.8	2	0.13

Table 5. Surface Water Quality at Site TR-C

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/14/03	7.80	5.4	910	720	22	< 0.010	< 0.01	< 0.01	127	430	5.3	96.2	64.4	14.0	< 0.03	0.069	2.8	2	0.03
05/12/03	8.10	11.0	1050	850															
06/17/03	7.90	14.3	260	180															
07/16/03	8.10	16.3	800	670	< 5	0.020	< 0.01	< 0.01	191	330	2.7	95.8	60.7	14.0	< 0.03	0.020	1.9	2	0.04
08/12/03	8.30	19.6	660	550															
09/08/03	8.20	13.9	460	320															
10/01/03	8.10	10.4	500	350	< 5	0.020	< 0.01	< 0.01	125	160	2.0	60.7	35.6	9.0	< 0.03	0.007	1.2	1	0.13
04/05/04	8.27	10.3	1110	980	10	< 0.010	< 0.01	< 0.01	142	590	6.5	121.0	93.1	19.9	< 0.03	0.048	3.4	2	0.06
05/12/04	7.40	6.5	240	170															
06/01/04	7.42	10.8	320	210															
07/19/04	8.43	18.2	440	310	6	0.010	< 0.01	< 0.01	150	110	1.2	48.5	25.3	6.9	0.07	0.028	1.6	2	0.19
08/03/04	8.57	17.1	470	320															
09/08/04	8.48	13.5	760	580															
10/13/04	7.74	9.0	510	360	< 5	< 0.010	< 0.01	< 0.01	133	170	2.0	55.8	33.0	9.2	< 0.03	0.024	2.0	2	0.38
04/18/05	8.08	8.7	730	500	22	0.010	< 0.01	< 0.01	118	300	4.0	75.2	50.7	12.0	0.06	0.023	2.3	2	0.13
05/12/05	8.16	6.8	610	440															
06/09/05	8.56	10.2	230	170															
07/15/05	8.57	20.7	540	350															
08/03/05	8.36	15.4	410	460	< 5	0.010	< 0.01	< 0.01	119	70	0.9	43.2	23.0	5.7	0.03	0.016	1.5	1	0.23
09/06/05	8.44	14.3	580	380															
10/20/05	7.94	9.3	400	250	< 5	< 0.010	< 0.01	< 0.01	104	100	1.5	47.4	27.1	7.1	< 0.03	0.027	1.5	1	0.14
04/14/06	8.26	9.0	1180	950	14	0.020	< 0.01	< 0.01	144	550	6.0	126.0	97.6	20.6	< 0.03	0.012	3.9	3	0.08
05/19/06	8.09	14.1	260	180															
06/13/06	8.25	12.1	230	150															
07/18/06	8.65	15.6	920	640															
08/10/06	8.57	21.2	640	480	< 5	0.030	< 0.01	< 0.01	149	180	1.9	70.1	40.9	9.7	< 0.03	0.028	2.0	1	0.09
09/11/06	8.73	11.9	500	320															
10/11/06	8.58	6.7	410	280	8	0.020	< 0.01	< 0.01	105	100	1.5	41.7	24.8	6.9	< 0.03	0.028	1.4	2	0.07
04/16/07	8.27	9.6	1050	780	< 5	0.010	< 0.01	< 0.01	135	450	5.2	103.0	76.4	15.4	< 0.03	0.048	2.5	2	0.05
05/08/07	8.16	8.1	560	380															
06/22/07	8.30	20.3	360	230															
07/19/07	8.40	21.8	790	600	< 5	0.010	< 0.01	< 0.01	174	260	2.4	89.3	54.8	15.0	0.04	0.033	2.5	2	0.07
08/09/07	8.10	18.3	420	260															
09/21/07	8.40	12.5	440	330															
10/15/07	8.70	6.5	450	290	< 5	0.030	< 0.01	< 0.01	114	120	1.7	43.0	24.8	7.1	< 0.03	0.014	1.6	1	0.09

Table 5. Surface Water Quality at Site TR-C

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/14/08	7.87	6.9	740	420	< 5	0.020	< 0.01	< 0.01	109	200	2.9	61.6	38.6	11.1	< 0.03	0.064	1.7	3	0.07
05/14/08	7.98	6.6	1140	860															
06/11/08	7.55	7.2	250	170															
07/07/08	8.36	14.4	280	460															
08/11/08	7.57	15.7	360	230	6	0.020	< 0.01	< 0.01	97	74	1.2	38.6	20.6	5.2	< 0.03	0.022	1.3	1	0.09
09/08/08	7.36	13.7	510	340															
10/14/08	7.41	4.5	430	270	< 5	< 0.010	< 0.01	< 0.01	97	108	1.8	44.5	26.5	6.7	< 0.03	0.060	1.5	1	0.08
04/14/09	7.24	5.9	1010	740	8	0.010	< 0.01	0.06	127	420	5.2	99.5	70.5	15.6	< 0.03	0.072	2.6	2	0.36
05/14/09	7.54	8.9	410	280															
06/09/09	7.51	9.0	270	180															
07/06/09	7.55	14.0	280	180															
08/06/09	7.98	17.0	540	340	< 5	0.040	< 0.01	< 0.02	134	127	1.5	57.8	32.6	7.1	< 0.03	0.029	1.5	2	0.08
09/02/09	7.79	12.9	550	380															

Note: Monitoring site TR-C was removed from the Monitoring Program on September 2, 2009 in accordance with TR-48.

Table 6. Surface Water Quality at Site TR-D

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/29/88	8.30	6.5	727		2														
05/17/88	7.80	5.8	369	192	106				66	70	1.7	29.0	15.0	5.0		0.160			
06/25/88	7.80	15.2	273		12														
07/14/88	8.40	22.7	358	100	8	0.010	0.02	0.01	135	169	2.0	64.0	34.0	9.0	0.05	0.010			
08/05/88	8.30	21.3	302	306	4	0.020	0.02	0.01	131	126	1.5	49.0	26.0	8.0	0.05	0.020			
09/21/88	8.30	14.2	457		8														
10/21/88	8.00	9.6	558		2														
04/14/89	8.30	8.4	785	756	2	0.005	0.01	0.01	140	447	5.0	113.0	76.0	20.0	0.18	0.010			
05/15/89	8.50	8.3	429		6														
06/19/89	8.20	17.0	231		12														
07/03/89	7.90	21.0	687	632	6	0.012	0.02	0.02	150	338	3.5	103.0	57.0	18.0	0.05	0.030			
08/23/89	7.90	14.4	467		2														
09/08/89	7.60	14.7	755	692	10	0.020	0.01	0.01	158	360	3.6	88.0	68.0	16.0	0.05	0.009			
10/13/89	7.90	15.0	51		2														
04/19/90	8.20	12.6	685	596	2	0.009	0.02	0.02	102	354	5.5	80.0	50.0	18.0	0.06	0.030			
05/14/90	7.50	7.2	336		10														
06/14/90	7.70	16.3	158		28														
07/06/90	7.70	21.3	368		2														
08/10/90	8.20	20.7	432	382	4	0.019	0.02	0.02	152	165	1.7	63.0	31.0	10.0	0.05	0.009			
09/07/90	8.10	20.4	367		12														
10/16/90	8.60	9.2	2140	418	2	0.013	0.02	0.05	137	208	2.4	63.0	35.0	12.0	0.05	0.020			
05/06/91	8.50	7.2	1145	782	4	< 0.010	< 0.01	< 0.05	140	455	5.1	106.0	68.0	21.0	< 0.05	0.040			
06/11/91	7.70	5.1	245		20														
07/09/91	8.00	12.6	579	326	28	< 0.010	< 0.01	< 0.05	120	86	1.1	43.0	22.0	7.0	< 0.05	< 0.010			
08/09/91	8.50	14.6	1686		10														
09/11/91	8.90	15.5	1629		< 2														
10/10/91	8.70	12.3	1851	358	< 2	0.020	< 0.01	< 0.05	140	185	2.1	37.0	33.0	11.0	< 0.05	< 0.010			
04/13/92	9.00	8.5	2209	566	< 2	0.006	< 0.01	< 0.05	124	294	3.7	81.0	49.0	14.0	< 0.05	< 0.010			
05/06/92	9.00	15.2	1648		12														
06/01/92	8.30	8.7	1824		4														
07/01/92	8.50	16.7	1558		4														
08/03/92	7.90	13.7	1748	362	2	0.016	< 0.01	< 0.05	140	167	1.9	60.0	30.0	10.0	< 0.05	0.010			
09/08/92	8.70	17.0	615	409	4														
10/05/92	8.60	6.0	610	406	2	0.006	< 0.01	< 0.05	142	214	2.4	69.0	37.0	12.0	< 0.05	0.030			

Table 6. Surface Water Quality at Site TR-D

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/28/93	8.90	11.8	800	808	6	< 0.005	< 0.01	< 0.05	212	471	3.5	116.0	78.0	19.0	< 0.05	0.050	3.0	< 1	
05/04/93	8.90	12.0	600		< 2														
06/02/93	8.50	9.0	180																
07/01/93	8.50	17.0	200	114	12	< 0.005	< 0.01	< 0.05	70	37	0.8	22.0	10.0	4.0	< 0.05	0.010	< 1.0	< 1	
08/04/93	8.80	19.5	700		6														
09/09/93	8.90	17.8	510		< 2														
10/06/93	9.00	11.9	500	356	< 2	< 0.005	< 0.01	< 0.05	126	161	2.0	56.0	31.0	10.0	< 0.05	0.020	2.0	< 1	
11/08/93	9.00	1.0	690		< 2														
04/05/94	8.40	6.1	1000	562	< 2	< 0.005	< 0.01	< 0.05	58	457	12.4	97.0	63.0	18.0	< 0.05	0.060	2.0	2	
05/03/94	8.60	7.8	600	428															
06/20/94	8.24	22.7	680	470															
07/25/94	8.20	18.0	1346	1076	< 2	< 0.005	< 0.01	< 0.05	222	646	4.6	157.0	99.0	29.0	< 0.05	0.030	4.0	2	0.10
08/16/94	8.10	16.5	970	684															
09/16/94	8.20	13.2	561	384															
10/21/94	8.40	8.2	468	290	12	< 0.005	< 0.01	< 0.05	72	121	2.6	45.0	25.0	8.0	< 0.05	0.020	1.0	< 1	0.12
04/11/95	6.80	2.6	1140	810	< 5	< 0.005	< 0.01	< 0.05	144	490	5.4	105.0	73.5	20.1	< 0.05	0.081	2.6	2	0.03
05/16/95	7.60	8.8	770	510	28	0.028	< 0.01	< 0.05	117	300	4.0	70.8	42.8	14.0	< 0.20	0.062	2.0	1	0.09
06/08/95	7.10	11.8	390	300															
07/11/95	8.00	16.8	190	130	28	0.005	< 0.01	< 0.05	46	60	2.1	19.1	9.4	2.8	0.05	0.017	0.8	1	0.15
08/14/95	8.10	16.8	520	350															
09/18/95	8.00	15.9	530	220															
10/18/95	8.50	6.5	610	380	8	0.013	< 0.01	< 0.05	126	190	2.4	58.2	34.7	8.7	< 0.05	0.043	1.6	1	0.07
04/16/96	8.20	3.8	1840	1440	10	0.010	< 0.01	< 0.05	193	920	7.5	194.0	157.0	45.6	< 0.03	0.097	5.7	4	0.07
05/13/96	8.40	12.4	570	400															
06/14/96	7.10	9.1	250	160															
07/15/96	8.30	17.9	510	340															
08/19/96	8.40	17.0	620	400	10	0.008	< 0.01	< 0.05	128	190	2.3	65.1	39.3	9.7	< 0.03	0.048	1.8	2	0.11
09/16/96	8.40	12.6	610	370															
10/14/96	8.10	8.5	540	340	8	< 0.005	< 0.01	< 0.05	122	150	1.9	53.7	31.1	8.3	0.03	0.041	1.5	3	0.14
04/16/97	8.20	9.8	1670	1290	< 5	< 0.005	< 0.01	< 0.01	171	790	7.3	27.1	138.0	27.1	< 0.03	0.117	4.4	4	0.11
05/13/97	7.56	8.9	660	440															
06/04/97	8.75	10.4	250	160															
07/01/97	7.63	11.5	380	250															
08/04/97	8.47	18.6	490	370	8	0.008	< 0.01	< 0.01	125	120	1.5	51.9	28.7	6.8	< 0.03	0.032	1.4	< 1	0.11
09/02/97	8.51	20.2	520	350															
10/01/97	8.32	10.0	570	340	< 5	0.013	< 0.01	< 0.01	110	170	2.4	56.7	34.3	7.9	< 0.03	0.054	1.6	< 1	0.13

Table 6. Surface Water Quality at Site TR-D

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/14/98	8.30	4.8	1450	1150	8	< 0.005	< 0.01	< 0.01	174	690	6.2	162.0	111.0	23.6	< 0.03	0.087	3.9	2	0.04
05/12/98	8.13	7.2	660	400															
06/02/98	8.28	11.3	250	150															
07/20/98	8.16	15.8	630	460	< 5	0.018	< 0.01	< 0.01	159	190	1.9	69.1	39.6	10.0	< 0.03	0.059	2.1	< 1	0.13
08/17/98	8.45	19.1	540	390															
09/14/98	8.31	12.3	480	300															
10/12/98	8.48	6.0	510	330	< 5	< 0.005	< 0.01	< 0.01	123	140	1.8	51.4	29.4	7.5	< 0.03	0.032	1.4	< 1	0.11
04/05/99	7.94	9.4	1190	1090	< 5	< 0.005	0.32	< 0.01	164	660	6.3	145.0	109.0	21.0	< 0.03	0.106	3.4	3	0.14
05/03/99	8.64	7.1	770	540															
06/01/99	8.31	9.9	250	150															
07/06/99	8.53	23.7	510	240															
08/24/99	8.53	20.1	480	370	< 5	0.009	< 0.01	< 0.01	120	140	1.8	52.0	31.4	7.6	< 0.03	0.023	1.8	< 1	0.06
09/23/99	8.51	11.8	440	260															
10/18/99	8.64	3.7	500	290	< 5	0.010	< 0.01	< 0.01	106	140	2.1	44.9	27.9	7.3	< 0.03	0.030	1.5	< 1	0.08
04/18/00	8.30	8.0	1130	820	< 5	0.012	< 0.01	< 0.05	141	490	5.5	109.0	79.5	16.4	< 0.03	0.061	2.9	2	0.05
05/16/00	8.24	10.1	410	260															
06/19/00	8.28	15.6	430	280															
07/18/00	7.81	19.3	520	340															
08/15/00	8.20	20.0	750	580	< 5	0.024	< 0.01	< 0.05	168	260	2.4	94.0	56.5	11.2	< 0.03	0.025	2.3	2	0.05
09/11/00	8.20	13.3	620	390															
10/02/00	7.90	9.0	640	380	< 5	< 0.005	< 0.01	< 0.05	130	180	2.2	58.9	35.0	8.5	< 0.03	0.015	1.7	2	0.18
04/09/01	7.70	4.3	1430	1110	8	< 0.005	< 0.01	< 0.01	156	680	6.9	143.0	104.0	20.9	< 0.03	0.089	3.5	4	0.04
05/08/01	7.90	6.6	740	470															
06/04/01	7.80	8.2	210	110															
07/10/01	7.60	18.4	900	740	< 5	0.022	< 0.02	< 0.01	186	340	2.9	98.7	57.5	14.4	< 0.03	0.044	2.8	2	0.04
08/01/01	7.90	18.6	560	360															
09/21/01	8.00	10.4	460	310															
10/10/01	8.50	6.1	470	270	< 5	0.011	< 0.01	< 0.01	99	120	1.9	43.7	24.8	7.5	< 0.03	0.023	2.0	2	0.15
04/15/02	7.25	8.6	860	620	< 5	< 0.005	< 0.01	< 0.01	106	340	5.0	84.1	57.8	13.1	0.04	0.061	2.4	2	0.10
05/13/02	8.01	10.5	580	390															
06/03/02	7.69	13.8	440	860															
07/08/02	7.77	21.0	1060	230															
08/13/02	8.63	22.1	840	680	8	0.013	< 0.01	< 0.01	178	330	2.9	100.0	67.6	16.7	< 0.03	0.013	3.3	2	0.03
09/09/02	8.11	15.3	550	380															
10/14/02	8.32	10.9	590	380	6	< 0.010	< 0.01	< 0.01	153	160	1.6	63.4	36.5	9.1	< 0.03	0.010	1.8	2	0.10

Table 6. Surface Water Quality at Site TR-D

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/14/03	7.90	5.2	890	710	68	< 0.010	< 0.01	< 0.01	125	420	5.3	92.0	60.5	13.5	< 0.03	0.081	2.8	2	0.07
05/12/03	8.30	10.8	1040	840															
06/17/03	8.00	15.8	260	190															
07/16/03	8.00	17.9	860	690	8	0.020	< 0.01	< 0.01	167	340	3.2	97.6	61.3	14.1	< 0.03	< 0.010	2.2	2	0.06
08/12/03	8.50	20.4	720	580															
09/08/03	8.40	14.5	460	330															
10/01/03	8.30	10.6	510	350	6	0.020	< 0.01	< 0.01	126	160	2.0	49.6	28.6	7.5	< 0.03	0.009	1.3	1	0.16
04/05/04	8.41	10.5	1130	950	12	< 0.010	< 0.01	< 0.01	132	590	7.0	123.0	95.3	20.8	< 0.03	0.055	3.3	2	0.06
05/12/04	7.45	8.9	300	170															
06/01/04	7.66	12.0	310	210															
07/19/04	8.54	18.6	440	300	18	0.010	< 0.01	< 0.01	150	110	1.2	49.0	25.2	6.8	< 0.03	0.013	1.6	1	0.15
08/03/04	8.65	19.8	480	330															
09/08/04	8.64	15.6	720	550															
10/13/04	8.39	10.2	510	370	6	< 0.010	< 0.01	< 0.01	134	180	2.1	55.0	32.8	8.7	< 0.03	0.011	1.5	2	0.23
04/18/05	8.13	10.2	650	520	26	0.010	< 0.01	< 0.01	117	260	3.5	71.7	47.9	11.7	< 0.03	0.019	2.5	2	0.08
05/12/05	8.15	9	580	450															
06/09/05	9.02	13.6	240	170															
07/15/05	8.59	25.1	520	370															
08/03/05	8.46	16.7	410	270	8	0.010	< 0.01	< 0.01	118	90	1.2	42.2	22.4	5.7	0.05	0.015	1.5	1	0.32
09/06/05	8.49	16.8	550	370															
10/20/05	8.16	9.0	400	250	6	< 0.010	< 0.01	< 0.01	104	110	1.7	47.7	29.0	8.1	0.07	0.248	1.6	1	0.20
04/14/06	8.16	9.0	1160	940	22	0.020	< 0.01	< 0.01	143	560	6.2	120.0	92.3	20.0	< 0.03	0.010	3.7	3	0.06
05/19/06	8.22	16.4	260	190															
06/13/06	8.31	12.6	230	160															
07/18/06	8.64	16.7	900	690															
08/10/06	8.49	22.4	590	480	< 5	< 0.010	< 0.01	< 0.01	150	170	1.8	66.3	38.5	9.3	< 0.03	0.021	1.9	1	0.06
09/11/06	8.83	11.9	500	330															
10/11/06	8.51	6.9	420	260	< 5	0.030	< 0.01	< 0.01	107	100	1.5	43.5	25.4	7.0	< 0.03	0.025	1.4	1	0.07
04/16/07	8.08	10.4	1070	770	8	0.010	< 0.01	< 0.01	139	450	5.1	104.0	76.9	15.7	< 0.03	0.056	2.7	2	0.05
05/08/07	8.18	7.9	550	370															
06/22/07	8.40	21.2	360	250															
07/19/07	8.40	23.5	800	610	< 5	0.020	< 0.01	< 0.01	178	250	2.2	85.7	52.1	14.0	0.06	0.058	3.2	2	0.06
08/09/07	8.10	18.1	430	270															
09/21/07	8.40	12.8	580	330															
10/15/07	8.20	6.4	460	270	< 5	0.030	< 0.01	< 0.01	113	90	1.3	36.8	21.3	6.6	< 0.03	0.008	1.7	< 1	0.10

Table 6. Surface Water Quality at Site TR-D

Date	pH (s.u.)	Temp (C)	S.C. (umhos/cm)	TDS (mg/l)	TSS (mg/l)	O-P (mg/l)	NO2 (mg/l)	NH3 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss.Al (mg/l)	Diss.Mn (mg/l)	K (mg/l)	Cl (mg/l)	Fe (mg/l)
04/14/08	7.71	7.2	890	410	8	0.020	< 0.01	< 0.01	115	200	2.7	63.9	41.2	11.6	< 0.03	0.069	1.9	2	0.07
05/14/08	7.97	6.5	1140	840															
06/11/08	8.12	7.1	260	170															
07/07/08	8.34	14.1	280	720															
08/11/08	7.97	15.4	390	230	8	0.020	< 0.01	< 0.01	97	75	1.2	37.5	20.1	4.8	< 0.03	0.022	1.2	< 1	0.11
09/08/08	7.61	13.0	520	360															
10/14/08	7.80	4.2	430	260	< 5	< 0.010	< 0.01	< 0.01	98	101	1.6	42.9	25.2	6.5	< 0.03	0.029	1.3	1	0.12
04/14/09	7.05	6.2	1000	710	11	< 0.010	< 0.01	0.03	126	380	4.7	99.7	69.6	15.7	0.04	0.082	2.6	2	0.42
05/14/09	7.66	8.8	410	270															
06/09/09	7.35	9.4	270	180															
07/06/09	7.54	16.1	300	190															
08/06/09	7.91	16.6	500	320	5	0.030	< 0.01	< 0.02	132	118	1.4	54.3	30.2	6.7	< 0.03	0.029	1.5	2	0.07
09/02/09	7.76	12.8	480	380															

Note: Monitoring site TR-D was removed from the Monitoring Program on September 2, 2009 in accordance with TR-48.

Table 7. Monitoring Well Static Water Level Elevations

Date	TR-1.5	TR-3	TR-4	WR-1
	(asl)	(asl)	(asl)	(asl)
May-87	7170.92	6952.55	6908.50	
Jun-87	7170.45	6952.75	6905.50	7140.38
Jul-87	7169.90	6950.80	6904.90	7138.38
Aug-87	7169.85	6950.65	6905.35	7139.18
Sep-87	7169.60	6950.65	6905.30	7138.18
Apr-88	7171.55	6953.65	6907.60	7149.28
May-88	7171.75	6952.95	6907.00	7145.48
Jun-88	7170.70	6952.10	6907.10	7142.38
Jul-88	7169.90	6951.31	6906.13	7139.93
Aug-88	7169.69	6950.70	6905.52	7139.08
Sep-88	7169.90	6950.95	6905.30	7138.78
Oct-88	7170.05	6951.40	6905.35	7138.98
Apr-89	7170.65	6953.50	6907.05	7145.18
May-89	7171.25	6952.65	6907.10	7141.48
Jun-89	7170.75	6952.05	6906.50	7139.68
Jul-89	7169.90	6951.40	6905.55	7138.43
Aug-89	7169.90	6950.75	6906.00	7137.78
Sep-89	7169.45	6950.25	6905.75	7137.28
Oct-89	7169.90	6951.15	6906.00	7136.88
Apr-90	7170.50	6952.90	6907.10	7143.88
May-90	7170.57	6952.65	6906.90	7143.55
Jun-90	7171.65	6952.70	6907.30	7138.88
Jul-90	7170.00	6951.25	6905.55	7138.18
Aug-90	7169.65	6950.30	6905.15	7137.53
Sep-90	7169.60	6950.35	6911.70	7137.28
Oct-90	7169.95	6951.15	6905.20	7137.03
May-91	7170.90	6953.05	6907.50	7144.68
Jun-91	7171.35	6953.35	6905.60	7140.38
Jul-91	7170.15	6951.60	6906.10	7138.88
Aug-91	7169.75	6953.55	6904.80	7137.98
Sep-91	7170.05	6950.85	6905.45	7137.68
Oct-91	7170.40	6951.37	6905.37	7137.96
Apr-92	7170.57	6952.62	6906.12	7148.48
May-92	7171.37	6952.62	6906.93	7146.96
Jun-92	7171.45	6952.49	6907.03	7144.69
Jul-92	7169.98	6951.24	6905.57	7143.82
Aug-92	7170.15	6951.03	6905.62	7143.15
Sep-92	7170.07	6951.03	6905.37	7142.82
Oct-92	7170.32	6951.37	6905.62	7142.65

Table 7. Monitoring Well Static Water Level Elevations

Date	TR-1.5	TR-3	TR-4	WR-1
	(asl)	(asl)	(asl)	(asl)
Apr-93	7171.23	6953.28	6907.03	7153.98
May-93	7171.15	6953.12	6907.66	7154.90
Jun-93	7171.86	6953.53	6905.91	7150.15
Jul-93	7170.69	6952.53	6907.41	7146.48
Aug-93	7169.48	6950.95	6907.32	7144.27
Sep-93	7169.90	6951.20	6908.24	7143.32
Oct-93	7169.15	6951.70	6908.70	7143.32
Nov-93	7170.36	6952.03	6908.53	7143.02
Apr-94	7170.69	6952.91	6908.62	7148.19
May-94	7170.98	6952.99	6908.77	7146.36
Jun-94	7172.89	6954.24	6906.46	7145.77
Jul-94	7172.82	6953.18	6905.71	7144.63
Aug-94	7173.52	6953.21	6905.77	7142.72
Sep-94	7171.84	6953.53	6907.36	7137.87
Oct-94	7172.16	6954.12	6907.66	7143.84
Apr-95	7172.51	6956.02	6907.59	7144.96
May-95	7173.49	6956.51	6907.72	7154.13
Jun-95	7173.01	6956.36	6908.18	7152.14
Jun-95	7173.01	6956.36	6908.53	7151.39
Jul-95	7172.13	6955.61	6908.14	7148.98
Aug-95	7170.84	6954.01	6906.47	7147.62
Sep-95	7171.02	6953.53	6906.03	7145.28
Oct-95	7171.53	6954.08	6906.24	7146.39
May-96	7172.26	6957.16	6908.39	7163.76
Jun-96	7172.06	6955.88	6908.28	7151.60
Jul-96	7171.13	6954.47	6907.03	7147.12
Aug-96	7170.70	6953.52	6906.94	7145.23
Sep-96	7170.97	6953.57	6908.43	7146.37
Oct-96	7171.24	6954.03	6908.69	7144.43
May-97	7172.16	6957.32	6908.54	7160.27
Jun-97	7172.54	6957.39	6909.29	7153.64
Jul-97	7171.49		6907.50	7149.31
Aug-97	7170.70	6954.26	6906.98	7146.37
Sep-97	7171.12	6954.34	6906.96	7145.53
Oct-97	7171.37	6955.37		7146.09

Table 7. Monitoring Well Static Water Level Elevations

Date	TR-1.5	TR-3	TR-4	WR-1
	(asl)	(asl)	(asl)	(asl)
May-98	7172.13	6956.93	6908.09	7156.07
Jun-98	7172.14	6955.91	6908.28	7150.67
Jul-98	7170.74	6954.04	6906.72	7146.04
Aug-98	7170.84	6953.76	6906.53	7145.19
Sep-98	7171.02	6953.74	6906.41	7144.69
May-99	7171.69	6955.84	6907.26	7151.84
Jun-99	7171.93	6955.46	6907.81	7148.36
Jul-99	7170.97	6954.29	6906.67	7146.51
Aug-99	7170.84	6953.64	6906.14	7144.79
Sep-99	7171.06	6954.19	6906.12	7144.47
Oct-99	7171.11	6954.49	6906.09	7144.31
May-00	7171.86	6955.44	6907.36	7150.39
Jun-00	7171.19	6954.38	6906.96	7146.96
Jul-00	7171.02	6953.59	6906.69	7145.69
Aug-00	7170.74	6953.04	6906.36	7144.94
Sep-00	7170.84	6953.40	6906.28	7144.79
Oct-00	7171.02	6953.94	6906.98	7144.79
May-01	7171.79	6955.52	6907.31	7148.19
Jun-01	7171.68	6955.10	6907.54	7148.14
Jul-01	7171.53	6954.04	6906.51	7141.86
Aug-01	7171.39	6953.28	6906.49	7135.77
Sep-01	7171.80	6954.36	6906.68	7145.31
Oct-01	7172.11	6955.06	6906.74	7145.13
May-02	7171.77	6955.69	6904.87	7148.17
Jun-02	7171.94	6954.94	6904.39	7147.04
Jul-02	7170.84	6953.42	6903.46	7145.87
Aug-02	7171.67	6953.44		7145.14
Sep-02	7171.87	6953.33		7144.91
Oct-02	7172.08	6954.16		7145.11
May-03	7172.19	6956.46	6906.99	7155.28
Jun-03	7171.44	6955.51	6906.87	7149.01
Jul-03	7170.88	6953.67	6905.28	7147.48
Aug-03	7170.84	6953.22	6904.24	7147.08
Sep-03	7171.22	6953.39	6903.69	7146.96
Oct-03	7171.27	6953.72	6903.12	7146.86

Table 7. Monitoring Well Static Water Level Elevations

Date	TR-1.5	TR-3	TR-4	WR-1
	(asl)	(asl)	(asl)	(asl)
May-04	7171.75	6955.21	6905.82	7148.97
Jun-04	7171.42	6954.97	6905.53	7147.83
Jul-04	7170.63	6953.61	6904.28	7147.24
Aug-04	7170.46	6953.39	6904.09	7147.18
Sep-04	7170.87	6953.60	6903.17	7147.36
Oct-04	7171.50	6954.20	6903.28	7147.32
Apr-05	7171.82	6955.49	6904.92	7151.51
May-05	7171.73	6955.54	6904.69	7151.34
Jun-05	7171.57	6955.51	6902.59	7149.14
Jul-05	7170.81	6954.01	6905.57	7147.94
Aug-05	7170.83	6953.58	6904.59	7147.51
Sep-05	7170.33	6953.44	6903.88	7147.21
Oct-05	7170.93	6954.27	6903.56	7146.86
May-06	7172.13	6955.61	6906.98	7154.36
Jun-06	7171.46	6955.13	6906.77	7149.61
Jul-06	7170.62	6953.61	6905.09	7147.67
Aug-06	7170.41	6953.30	6904.29	7147.08
Sep-06	7170.49	6953.53	6903.77	7147.13
Oct-06	7170.84	6954.03	6903.99	7147.14
May-07	7171.62	6955.41	6906.38	7151.22
Jun-07	7170.73	6954.23	6905.78	7147.64
Jul-07	7170.12	6953.76	6904.21	7147.36
Aug-07	7170.32	6954.04	6903.53	7147.21
Sep-07	7170.29	6954.23	6903.27	7147.12
Oct-07	7170.79	6954.93	6903.67	7147.29
May-08	7172.06	6957.59	6907.53	7165.44
Jun-08	7172.16	6956.34	6907.58	7155.71
Jul-08	7171.57	6954.64	6907.31	7155.49
Aug-08	7171.00	6953.88	6905.67	7147.48
Sep-08	7170.61	6953.44	6904.86	7147.16
Oct-08	7172.08	6953.88	6905.14	7147.01
May-09	7172.49	6955.96	6907.59	7155.01
Jun-09	7172.37	6955.52	6907.19	7149.91
Jul-09	7172.19	6955.56	6906.98	7149.48
Aug-09	7171.34	6953.67	6905.44	7147.38
Sep-09	7171.69	6953.44	6904.64	7147.2

Note: Monitoring wells TR-1.5, TR-3, TR-4 and WR-1 were removed from the Monitoring Program on September 2, 2009 in accordance with TR-48. Monitoring wells TR-1.5 and WR-1 were plugged and abandoned September 8, 2009. Monitoring wells TR-3 and TR-4 were transferred to the current land owner September 15, 2009.

Table 8. Ground Water Quality at Monitoring Well TR-1.5

Date	pH	Temp	S.C	TDS	O-P	NO2	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss. Fe	Diss. Mn	K	Cl
	(s.u.)	(C)	(umhos/cm)	mg/l	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
04/28/88	7.50	5.7	179													
05/25/88	6.80	11.2	141													
06/24/88	6.60	12.2	322	194			104	39	0.6	25.0	9.0	6.0	0.38	0.330		
07/14/88	6.60	12.7	198	128	0.020	0.02	118	23	0.3	31.0	12.0	8.0	0.07	0.230		
08/05/88	6.60	11.5	148	93	0.120	0.08	98	25	0.4	26.0	11.0	6.0	0.08	0.220		
09/16/88	7.50	12.3	324	221												
10/21/88	6.90	9.8	235	155												
04/14/89	6.90	7.2	160	101												
05/15/89	8.10	8.1	123	76	0.016	0.74	70	29	0.7	22.0	9.0	5.0	0.18	0.060		
06/16/89	7.80	12.0	222	145												
07/03/89	7.10	12.5	301	203	0.020	0.08	92	21	0.4	27.0	10.0	6.0	0.18	0.260		
08/23/89	6.90	11.8	444	313												
09/07/89	7.10	13.0	278	186	0.124	0.01	100	56	0.9	28.0	11.0	6.0	0.35	0.440		
10/19/89	6.50	10.7	160	101												
04/19/90	8.10	6.3	174	111												
05/11/90	7.50	7.5	155	98	0.069	0.02	73	58	1.3	26.0	9.0	8.0	0.23	0.070		
06/14/90	7.40	13.6	200	129												
07/06/90	7.50	12.2	380	263												
08/10/90	7.80	12.9	174	111	0.105	0.02	106	35	0.5	30.0	11.0	6.0	0.29	0.340		
09/07/90	7.20	14.7	234	154												
10/19/90	6.30	10.0	1890	1555	0.005	0.02	110	12	0.2	26.0	10.0	6.0	0.03	0.070		
05/15/91	6.80	5.5	348	239												
06/11/91	6.80	7.7	379	262	0.030	< 0.01	100	43	0.7	28.0	11.0	9.0	< 0.02	0.040		
07/09/91	7.30	8.2	437	307	< 0.010	0.01	110	132	1.9	37.0	18.0	19.0	0.21	0.150		
08/09/91	6.10	13.8	1480	1186												
09/11/91	7.00	12.8	1573	1269												
10/10/91	6.70	9.2	1786	1460	0.022	< 0.01	124	29	0.4	29.0	11.0	8.0	0.04	0.020		
04/13/92	8.10	5.5	1582	1277												
05/06/92	6.50	9.7	2155	1798	0.038	0.01	94	80	1.3	26.0	10.0	9.0	0.08	0.030		
06/01/92	7.60	9.5	1754	1432												
07/01/92	8.30	12.8	1923	1585												
08/03/92	7.70	15.0	1840	1509	0.008	< 0.01	124	97	1.2	31.0	13.0	6.0	0.02	< 0.010		
10/05/92	7.50	11.9	360	248	0.011	< 0.01	142	23	0.3	37.0	15.0	9.0	0.04	0.020		

Table 8. Ground Water Quality at Monitoring Well TR-1.5

Date	pH	Temp	S.C	TDS	O-P	NO2	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss. Fe	Diss. Mn	K	Cl
	(s.u.)	(C)	(umhos/cm)	mg/l	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
04/28/93	7.40	5.3	200	129												
05/04/93	7.20	7.0	190	122												
06/02/93	7.00	2.0	300	203	< 0.005	< 0.01	118	58	0.8	26.0	10.0	9.0	0.07	0.050		
07/01/93	7.20	12.0	255	169	< 0.005	< 0.01	122	2	0.0	29.0	12.0	7.0	0.19	0.090		
08/04/93	7.80	14.3	240	158												
09/09/93	7.70	15.0	250	166												
10/06/93	7.20	10.0	300	203	0.008	< 0.01	144	12	0.1	32.0	13.0	6.0	0.05	0.030		
11/08/93	8.30	5.8	290	195												
04/07/94	6.60	3.5	210	137												
05/03/94	7.20	5.8	290	154	< 0.005	< 0.01	138	6	0.1	31.0	12.0	8.0	0.89	0.040	< 1.0	2
06/20/94	7.50	14.2	690	370												
07/25/94	6.60	17.3	707	434	0.197	0.87	60	243	6.4	58.0	32.0	8.0	0.29	0.210	7.0	10
08/16/94	7.20	19.1	275	156												
09/16/94	6.30	12.2	667	412												
10/21/94	6.20	7.6	686	418	0.056	0.03	60	224	5.9	53.0	32.0	8.0	0.16	0.310	6.0	10
04/11/95	7.30	4.1	830	360												
05/16/95	6.80	6.6	350	200												
06/08/95	6.90	10.0	440	170												
06/28/95	7.10	9.9	870	430	0.080	0.02	138	180	2.1	65.4	37.0	8.5	0.03	0.021	5.2	
07/11/95	7.10	14.0	1170	840	0.220	0.09	153	470	4.8	200.0	132.0	15.4	0.08	0.315	6.0	7
08/14/95	7.30	13.3	1990	1230												
09/18/95	7.40	13.8	2190	1640												
10/18/95	7.60	8.7	2610	2180	0.013	0.19	233	1360	9.2	379.0	243.0	23.3	0.18	0.610	5.5	10
05/13/96	7.50	8.7	2560	2450	< 0.005	< 0.01	< 2	1520	1196.4	295.0	182.0	17.5	0.18	0.220	4.1	9
06/14/96	6.90	7.2	680	520												
07/15/96	6.90	8.2	3710	3690												
08/19/96	7.50	11.2	2780	2280	0.072	0.08	201	1530	12.0	350.0	237.0	23.4	< 0.02	0.260	5.6	10
09/16/96	7.10	11.9	2990	2470												
10/14/96	7.20	9.7	3490	3400	< 0.005	< 0.01	285	2200	12.2	481.0	334.0	30.7	0.57	0.670	6.4	15
05/13/97	7.04	8.3	2990	1360	0.009	0.02	254	770	4.8	165.0	111.0	11.2	0.14	0.150	3.1	7
06/04/97	7.46	14.7	4370	1960												
07/01/97	7.43	8.6	3360	3400												
08/04/97	7.53	9.2	3560	3510	< 0.005	< 0.01	316	2310	11.5	470.0	331.0	33.6	0.18	0.586	7.4	12
09/02/97	7.42	11.7	2750	2630												
10/01/97	7.18	11.9	2530	2190	0.044	< 0.01	185	1460	12.4	290.0	198.0	18.9	0.64	0.660	5.7	11

Table 8. Ground Water Quality at Monitoring Well TR-1.5

Date	pH	Temp	S.C	TDS	O-P	NO2	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss. Fe	Diss. Mn	K	Cl
	(s.u.)	(C)	(umhos/cm)	mg/l	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
05/12/98	7.21	7.2	3350	3200	< 0.005	< 0.01	316	1990	9.9	438.0	315.0	29.9	1.02	0.614	5.8	13
06/02/98	7.13	9.1	2930	1600												
07/20/98	7.68	9.8	2710	2300	0.879	< 0.01	317	1380	6.9	304.0	215.0	33.0	< 0.05	0.560	8.0	14
08/17/98	7.54	10.2	2930	3060												
09/14/98	7.64	12.1	2480	1990												
10/12/98	7.51	11.7	2620	2310	1.050	0.26	300	1440	7.6	301.0	212.0	22.4	0.06	0.490	6.8	14
05/03/99	8.19	5.5	1920	1760	1.200	1.72	224	1160	8.2	244.0	170.0	18.2	0.03	0.407	6.6	11
06/07/99	7.84	9.2	2130	2680												
07/06/99	8.11	10.4	1800	2580												
08/24/99	7.53	11.1	2190	1670	0.950	0.18	204	1100	8.5	234.0	176.0	17.9	0.05	0.310	6.6	11
09/23/99	7.81	11.6	2210	1020												
10/18/99	7.58	9.1	3170	2790	0.859	0.10	268	1900	11.2	387.0	281.0	30.0	0.11	0.550	7.1	23
05/16/00	7.46	8.8	3210	2120	2.170	0.03	165	1400	13.4	293.0	216.0	37.9	0.09	0.149	9.7	43
06/19/00	7.14	9.4	3320	3450												
07/18/00	6.85	9.7	3790	3530												
08/15/00	7.14	12.6	3460	3530	0.432	0.01	287	2470	13.5	466.0	352.0	35.0	0.42	0.670	8.0	23
09/11/00	7.46	11.6	3520	3790												
10/02/00	7.30	10.8	3680	3820	0.350	< 0.01	307	2700	13.8	478.0	371.0	35.2	0.09	0.590	7.2	44
05/08/01	7.30	7.1	4250	530	0.005	1.24	377	70	0.3	12.9	4.7	179.0	0.06	0.016	2.0	18
06/04/01	7.20	6.7	3940	4480												
07/10/01	7.20	10.3	3880	4740	0.033	0.20	329	3010	14.4	538.0	436.0	35.0	< 0.05	0.310	7.0	15
08/01/01	7.30	11.8	3680	4690												
09/21/01	7.70	11.8	3650	4360												
10/10/01	7.70	9.2	3380	4310	0.013	< 0.01	266	3100	18.3	538.0	416.0	32.0	0.53	0.500	7.0	15
05/13/02	7.56	8.4	3070	3350	0.039	0.01	212	2340	17.4	410.0	326.0	26.5	< 0.02	< 0.010	5.6	12
06/03/02	7.82	11.8	2930	4180												
07/08/02	7.28	11.3	2980	4310												
08/13/02	7.84	12.3	3120	3720	0.028	< 0.01	309	2610	13.3	474.0	389.0	32.0	1.82	< 0.030	6.0	15
09/09/02	7.10	11.4	3510	3350												
10/14/02	7.14	10.3	3570	3550	< 0.010	< 0.01	328	3000	14.4	482.0	384.0	32.0	0.44	0.140	7.0	17
05/12/03	6.90	8.8	3200	4230	0.010	< 0.01	314	2460	12.3	510.0	410.0	32.0	0.44	0.490	3.1	14
06/17/03	7.00	12.3	2420	2920												
07/16/03	6.90	11.5	3080	4150	< 0.010	< 0.01	318	2690	13.3	498.0	394.0	31.0	0.25	0.770	4.5	13
08/12/03	7.10	14.8	2620	3530												
09/08/03	7.10	13.2	3010	3710												
10/01/03	7.00	13.6	3300	4590	0.010	< 0.01	313	3170	15.9	554.0	437.0	40.0	0.25	0.710	5.0	15

Table 8. Ground Water Quality at Monitoring Well TR-1.5

Date	pH	Temp	S.C	TDS	O-P	NO2	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss. Fe	Diss. Mn	K	Cl
	(s.u.)	(C)	(umhos/cm)	mg/l	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
05/12/04	6.88	9.9	2980	4450	< 0.010	< 0.01	320	3140	15.4	534.0	431.0	35.2	0.14	0.900	6.4	15
06/01/04	6.69	11.2	3010	4510												
07/19/04	7.06	16.7	3680	4530	< 0.010	< 0.01	324	3160	15.4	528.0	408.0	32.0	0.29	0.660	6.0	16
08/03/04	7.19	14.4	4090	4460												
09/08/04	7.26	15.9	4030	4630												
10/13/04	6.90	10.3	3900	4210	< 0.010	< 0.01	308	2830	14.5	493.0	383.0	30.0		0.040	6.0	14
04/18/05	7.12	9.8	4160	4530												
05/12/05	7.20	6.7	4280	4460	0.040	0.02	315	2910	14.5	540.0	448.0	33.9	0.27	0.774	6.6	15
06/09/05	8.46	10.1	4140	4480												
07/15/05	7.08	18.0	4090	4800												
08/03/05	7.06	11.6	4420	4700	< 0.010	< 0.01	326	2850	13.8	563.0	447.0	34.0	0.50	0.820	6.0	14
09/06/05	7.07	16.4	4010	4500												
10/20/05	7.14	9.4	4440	4450	< 0.010	< 0.01	320	2890	14.2	603.0	506.0	39.8	< 0.02	0.364	7.2	16
05/19/06	7.04	12.1	3970	4370	0.030	0.04	309	2790	14.2	554.0	446.0	34.7	0.37	0.800	6.2	13
06/13/06	6.87	11.6	3960	4570												
07/18/06	7.09	15.4	3830	4590												
08/10/06	7.08	13.8	3960	4600	0.040	< 0.01	316	2700	13.5	545.0	432.0	34.0	1.10	0.910	7.0	13
09/11/06	7.34	13.3	4170	4400												
10/11/06	6.94	9.4	4340	4430	0.040	< 0.01	305	2880	14.9	500.0	436.0	34.0	0.92	0.795	6.4	14
05/08/07	7.10	8.6	4260	4510	0.050	0.01	306	3030	15.6	545.0	458.0	33.0	0.40	0.760	6.0	14
06/22/07	7.22	11.5	4430	4720												
07/19/07	7.60	11.6	4460	4620	< 0.010	0.01	318	3100	15.3	565.0	470.0	36.0	0.50	0.940	7.0	13
08/09/07	6.98	11.8	4350	4480												
09/21/07	7.25	11.8	4960	4360												
10/15/07	7.70	10.1	4280	4460	0.030	< 0.01	315	3000	15.0	536.0	447.0	35.0	0.90	0.900	7.0	13
05/14/08	7.39	7.2	4430	4570	0.040	0.01	294	2990	16.0	520.0	468.0	32.3	0.45	0.716	6.2	14
06/11/08	6.93	7.4	4180	4250												
07/07/08	7.19	11.2	4080	4270												
08/11/08	6.80	12.7	4110	4360	0.010	< 0.01	296	2600	13.8	515.0	426.0	37.0	0.60	0.770	6.0	15
09/08/08	6.95	12.6	4140	4920												
10/14/08	6.75	6.6	4010	4040	< 0.010	< 0.01	219	2500	18.0	485.0	433.0	33.2	0.22	0.670	6.8	14
05/14/09	6.82	9.6	3570	4100	0.020	0.02	289	2700	14.7	474.0	420.0	32.7	30.70		6.1	12
06/09/09	6.98	9.2	2680	2460												
07/06/09	7.20	15.2	2560	2450												
08/06/09	6.75	13.7	2610	2510	0.020	< 0.01	248	1700	10.8	312.0	271.0	22.8	0.21	0.071	5.0	9
09/02/09	7.58	13.7	2670	2710												

Note: Monitoring well TR-1.5 was removed from the Monitoring Program on September 2, 2009 in accordance with TR-48. Monitoring well TR-1.5 was plugged and abandoned September 8, 2009.

Table 9. Ground Water Quality at Monitoring Well TR-3

Date	pH	Temp	S.C	TDS	O-P	NO2	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss. Fe	Diss. Mn	K	Cl
	(s.u.)	(C)	(umhos/cm)	mg/l	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
04/28/88	6.90	6.7	242													
05/17/88	7.00	9.3	240													
06/25/88	7.20	10.8	298	332			104	138	2.1	41.0	19.0	8.0	0.22	0.030		
07/14/88	7.30	14.5	397	277	0.009	0.05	118	117	1.6	48.0	23.0	20.0	0.59	0.050		
08/05/88	7.40	16.1	490	349	0.150	0.00	98	113	1.8	44.0	22.0	11.0	0.18	0.140		
09/21/88	7.70	11.7	433	304												
10/21/88	7.50	10.8	453	320												
04/14/89	7.10	5.7	485	345												
05/15/89	8.40	7.7	376	260	0.010	0.52	102	189	2.9	61.0	31.0	10.0	0.45	0.030		
06/19/89	6.60	10.9	486	346												
07/03/89	7.50	14.4	376	260	0.016	0.19	118	107	1.4	59.0	26.0	10.0	0.18	0.040		
08/23/89	7.20	12.3	369	255												
09/08/89	7.60	11.1	447	315	0.032	0.25	122	144	1.9	60.0	28.0	8.0	0.11	0.260		
10/19/89	7.70	9.6	643	471												
04/19/90	8.30	6.0	551	397												
05/11/90	7.50	7.0	535	385	0.015	0.07	129	222	2.7	69.0	30.0	10.0	0.19	0.060		
06/17/90	7.20	10.1	549	396												
07/06/90	7.50	10.7	365	252												
08/10/90	7.80	13.0	420	294	0.031	0.02	127	138	1.7	55.0	24.0	9.0	1.14	0.260		
09/07/90	7.70	13.4	630	461												
10/16/90	7.40	9.5	2360	1988	0.005	0.02	123	154	2.0	53.0	24.0	11.0	0.18	0.060		
05/15/91	7.40	2.7	1137	886												
06/11/91	6.90	5.1	966	740	0.050	< 0.01	120	179	2.3	60.0	28.0	11.0	< 0.02	0.030		
07/09/91	7.70	6.3	901	685	<0.010	0.01	123	111	1.4	46.0	21.0	10.0	0.23	0.270		
08/09/91	6.80	10.3	2238	1875												
09/11/91	6.60	10.9	1948	1608												
10/10/91	7.30	10.5	2223	1860	0.022	< 0.01	130	117	1.4	50.0	23.0	11.0	0.09	0.020		
04/13/92	8.50	7.5	2675	2284												
05/06/92	7.50	8.6	2485	2105	0.006	< 0.01	112	218	3.1	54.0	26.0	11.0	0.06	0.040		
06/01/92	8.20	9.7	2321	1952												
07/01/92	8.20	11.7	2076	1725												
08/03/92	8.00	10.8	2177	1818	0.020	0.01	124	187	2.4	50.0	22.0	10.0	0.62	0.030		
10/05/92	7.40	10.0	450	318	0.005	< 0.01	118	150	2.0	55.0	25.0	10.0	0.08	0.010		

Table 9. Ground Water Quality at Monitoring Well TR-3

Date	pH	Temp	S.C	TDS	O-P	NO2	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss. Fe	Diss. Mn	K	Cl
	(s.u.)	(C)	(umhos/cm)	mg/l	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
04/28/93	7.60	6.8	570	412												
05/04/93	7.20	7.3	550	397												
06/02/93	7.40	8.0	570	412	< 0.005	< 0.01	120	183	2.4	56.0	26.0	10.0	0.15	0.090		
07/01/93	7.50	10.5	330	225	< 0.005	< 0.01	118	84	1.1	42.0	20.0	9.0	0.44	0.170		
08/04/93	8.50	10.0	380	263												
09/09/93	7.40	11.0	540	389												
10/06/93	7.50	11.0	590	429	< 0.005	< 0.01	128	154	1.9	61.0	28.0	10.0	< 0.01	0.190		
11/08/93	8.30	7.9	620	453												
04/07/94	6.70	5.0	540	389												
05/03/94	7.30	6.5	630	392	< 0.005	< 0.01	142	161	1.8	65.0	31.0	11.0	0.13	0.100	1.0	2
06/20/94	7.04	9.4	600	346												
07/25/94	7.10	13.7	523	340	< 0.005	< 0.01	138	146	1.7	58.0	27.0	11.0	0.60	0.400	1.0	< 1
08/16/94	7.90	16.7	583	390												
09/16/94	7.20	13.9	719	502												
10/21/94	7.70	10.8	683	460	< 0.005	< 0.01	156	230	2.3	73.0	34.0	12.0	1.17	0.005	1.0	2
04/11/95	7.30	4.0	630	390												
05/16/95	6.70	7.4	610	420												
06/08/95	7.40	9.8	620	390												
06/28/95	6.70	11.0	540	310	< 0.005	< 0.01	131	120	1.4	49.5	22.6	10.3	0.12	0.167	.9	< 1
07/11/95	6.90	12.8	480	340	< 0.005	< 0.01	138	140	1.6	57.7	27.9	10.9	0.22	0.235	1.1	2
08/14/95	7.60	10.7	490	300												
09/18/95	7.60	11.2	510	300												
10/18/95	8.10	9.8	500	310	0.014	< 0.01	142	106	1.2	53.6	25.4	10.2	0.42	0.040	1.1	1
05/13/96	7.80	6.9	580	380	< 0.005	< 0.01	< 2	130	102.3	61.4	29.1	11.5	0.02	< 0.005	1.1	< 1
06/14/96	6.90	7.2	580	380												
07/15/96	7.10	9.3	590	380												
08/19/96	7.50	9.9	540	330	< 0.005	< 0.01	162	110	1.1	59.7	28.2	11.0	0.49	0.133	.1	2
09/16/96	7.40	10.7	540	480												
10/14/96	7.20	9.2	590	350	< 0.005	< 0.01	126	150	1.9	59.0	27.9	10.2	0.45	0.319	1.1	< 1
05/13/97	7.41	6.3	580	370	< 0.005	< 0.01	130	160	1.9	65.2	30.4	10.6	0.02	< 0.005	.9	1
06/04/97	8.01	8.8	500	340												
07/01/97	6.64	8.4	560	380												
08/04/97	7.67	9.7	580	350	< 0.005	< 0.01	168	140	1.3	65.6	30.5	11.2	0.17	0.377	1.1	< 1
09/02/97	7.81	10.9	560	360												
10/01/97	7.18	10.7	550	350	0.012	< 0.01	144	140	1.5	63.8	30.6	11.0	0.20	0.015	1.4	< 1

Table 9. Ground Water Quality at Monitoring Well TR-3

Date	pH	Temp	S.C	TDS	O-P	NO2	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss. Fe	Diss. Mn	K	Cl
	(s.u.)	(C)	(umhos/cm)	mg/l	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
05/12/98	7.38	6.4	800	590	< 0.005	< 0.01	148	300	3.2	103.0	47.1	13.2	0.22	0.404	1.0	5
06/02/98	7.57	8.9	820	490												
07/20/98	7.81	9.4	830	600	0.006	< 0.01	159	260	2.6	83.3	43.2	24.3	0.16	0.095	1.4	4
08/17/98	7.83	11.4	680	410												
09/14/98	7.72	10.9	800	740												
10/12/98	7.74	9.9	550	380	< 0.005	< 0.01	123	160	2.0	59.9	27.4	11.5	0.24	0.102	1.0	< 1
05/03/99	8.30	4.9	560	358	< 0.005	< 0.01	119	180	2.4	63.9	29.7	9.3	0.05	0.015	1.0	2
06/07/99	8.30	8.4	640	410												
07/06/99	8.16	8.9	700	460												
08/24/99	7.89	11.9	710	299	0.008	< 0.01	126	130	1.6	54.9	25.5	9.9	0.17	0.294	1.0	1
09/23/99	8.31	11.2	690	320												
10/18/99	8.12	8.9	490	304	0.081	0.01	120	140	1.8	53.7	25.0	10.1	0.30	0.180	1.1	1
05/16/00	7.28	7.9	720	468	0.014	0.01	114	260	3.6	84.2	39.1	11.5	0.55	0.248	1.1	3
06/19/00	7.51	9.7	700	520												
07/18/00	7.12	11.5	620	410												
08/15/00	7.74	13.3	610	394	0.016	0.04	133	190	2.2	69.0	31.1	13.3	0.44	1.110	1.6	7
09/11/00	7.70	11.6	640	430												
10/02/00	7.50	11.1	640	414	0.015	< 0.01	127	220	2.7	68.1	32.1	11.6	0.49	0.873	1.4	3
05/08/01	7.80	5.4	830	590	0.007	0.10	115	330	4.5	89.3	41.5	11.4	0.45	0.748	1.1	4
06/04/01	7.60	6.5	760	550												
07/10/01	7.30	10.4	720	560	0.009	0.32	128	260	3.2	87.8	41.0	13.8	0.31	0.531	1.5	3
08/01/01	7.60	11.4	720	490												
09/21/01	7.90	11.8	630	440												
10/10/01	8.10	10.1	670	470	0.013	< 0.01	111	220	3.1	73.5	34.2	10.9	0.79	0.703	1.3	3
05/13/02	8.02	6.8	570	380	0.036	< 0.01	110	160	2.3	68.9	32.1	10.0	< 0.01	< 0.005	.8	2
06/03/02	7.94	8.1	650	420												
07/08/02	8.14	11.9	690	440												
08/13/02	8.26	11.1	740	491	0.007	0.06	180	230	2.0	89.3	44.0	12.5	< 0.01	0.203	1.5	2
09/09/02	7.70	10.6	780	550												
10/14/02	7.09	12.1	760	510	< 0.010	< 0.01	182	240	2.1	82.5	39.3	12.2	0.52	0.102	1.3	2
05/12/03	6.90	8.3	780	580	< 0.010	0.02	142	250	2.8	89.9	43.6	11.8	0.69	0.784	1.1	2
06/17/03	7.10	13.5	570	380												
07/16/03	6.90	13.3	590	430	< 0.010	< 0.01	148	180	1.9	70.6	33.5	11.4	0.58	0.313	1.0	2
08/12/03	7.00	13.4	600	480												
09/08/03	7.10	12.3	640	480												
10/01/03	6.90	12.5	640	450	0.010	< 0.01	137	220	2.5	75.7	34.4	11.6	1.10	0.448	1.2	2

Table 9. Ground Water Quality at Monitoring Well TR-3

Date	pH	Temp	S.C	TDS	O-P	NO2	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss. Fe	Diss. Mn	K	Cl
	(s.u.)	(C)	(umhos/cm)	mg/l	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
05/12/04	7.01	7.2	630	860	< 0.010	< 0.01	128	270	3.3	65.1	32.0	10.1	0.01	0.020	.9	2
06/01/04	6.64	10.1	730	570												
07/19/04	7.19	12.7	590	450	< 0.010	< 0.01	139	230	2.6	75.0	33.9	11.4	0.08	0.061	1.2	2
08/03/04	7.15	16.2	590	430												
09/08/04	7.36	16.1	570	430												
10/13/04	7.08	10.2	640	460	< 0.010	< 0.01	137	220	2.5	61.2	29.6	10.2		0.081	1.3	3
04/18/05	7.04	8.6	710	510												
05/12/05	6.99	5.8	850	630	0.060	0.04	130	340	4.1	103.0	47.9	12.6	0.36	0.523	1.2	4
06/09/05	8.48	9.7	700	540												
07/15/05	7.07	16.1	720	560												
08/03/05	7.10	12.4	720	520	< 0.010	0.03	146	220	2.4	78.4	37.5	12.2	0.81	0.488	1.3	2
09/06/05	7.17	14.6	590	410												
10/20/05	7.27	10.5	560	370	0.010	< 0.01	126	160	2.0	64.0	30.5	11.7	0.14	0.570	1.1	2
05/19/06	6.96	11.3	740	550	0.030	0.05	127	290	3.6	89.7	43.4	12.0	0.62	0.481	1.1	3
06/13/06	7.06	11.5	720	520												
07/18/06	7.20	13.6	620	460												
08/10/06	7.12	13.9	620	500	0.040	0.03	132	220	2.6	71.4	34.5	11.8	0.24	0.613	1.5	2
09/11/06	7.86	12.8	660	420												
10/11/06	7.20	9.4	610	400	0.040	< 0.01	128	170	2.1	65.1	32.2	11.9	0.49	0.595	1.3	2
05/08/07	7.20	6.8	892	650	0.040	0.01	126	360	4.5	109.0	53.6	13.4	1.24	0.468	1.1	3
06/22/07	7.55	9.5	850	640												
07/19/07	7.70	11.9	665	460	< 0.010	0.03	137	200	2.3	69.7	33.7	11.7	0.17	0.411	1.0	2
08/09/07	7.10	13.1	610	380												
09/21/07	7.51	11.6	690	400												
10/15/07	7.80	9.6	608	410	0.030	< 0.01	150	180	1.9	61.4	29.5	10.8	0.24	0.423	1.6	2
05/14/08	7.94	6.9	580	380	0.020	< 0.01	134	160	1.9	62.3	31.1	9.5	< 0.02	< 0.005	.6	1
06/11/08	7.40	8.3	700	490												
07/07/08	7.75	10.0	730	180												
08/11/08	7.42	13.2	660	381	< 0.010	< 0.01	151	174	1.8	67.4	32.8	12.0	0.19	0.098	1.1	2
09/08/08	7.29	11.8	610	400												
10/14/08	7.30	9.7	580	380	< 0.010	< 0.01	123	148	1.9	63.3	31.1	11.6	0.15	0.292	1.3	2
05/14/09	7.36	7.1	870	630	0.030	0.03	111	330	4.7	101.0	50.5	12.2	13.90		1.1	3
06/09/09	7.01	8.9	740	520												
07/06/09	7.01	12.7	730	540												
08/06/09	7.24	13.1	690	480	0.030	0.01	144	230	2.5	85.2	40.8	13.2	0.43	0.153	1.3	2
09/02/09	7.19	13.0	680	470												

Note: Monitoring well TR-3 was removed from the Monitoring Program on September 2, 2009 in accordance with TR-48. Monitoring well TR-3 was transferred to the current land owner September 15, 2009.

Table 10. Ground Water Quality at Monitoring Well TR-4

Date	pH	Temp	S.C	TDS	O-P	NO2	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss. Fe	Diss. Mn	K	Cl
	(s.u.)	(C)	(umhos/cm)	mg/l	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
04/29/88	7.40	5.1	304													
05/17/88	7.50	8.4	295													
06/25/88	6.90	12.6	309	338			139	134	1.5	51.0	24.0	10.0	0.06	0.009		
07/14/88	7.70	15.2	296	200	0.010	0.02	137	97	1.1	46.0	22.0	9.0	0.06	0.030		
08/05/88	8.00	14.7	410	286	0.020	0.05	139	161	1.8	58.0	29.0	11.0	0.15	0.260		
09/21/88	7.70	13.5	475	337												
10/21/88	7.50	10.5	426	299												
04/14/89	8.00	4.7	368	254												
05/15/89	8.00	6.7	480	341	0.008	0.57	112	196	2.8	65.0	35.0	11.0	4.61	0.150		
06/19/89	7.50	12.0	364	251												
07/03/89	7.60	12.9	321	218	0.022	0.02	100	93	1.5	48.0	22.0	10.0	0.12	0.070		
08/23/89	7.70	15.7	339	232												
09/08/89	7.70	13.9	468	332	0.012	0.01	118	185	2.5	68.0	33.0	10.0	0.02	0.090		
10/19/89	7.10	10.7	440	310												
04/19/90	8.10	5.4	655	481												
05/14/90	6.70	8.1	532	382	0.023	0.11	895	261	0.5	79.0	37.0	12.0	0.12	0.050		
06/14/90	7.90	12.7	384	266												
07/06/90	6.80	12.1	269	180												
08/10/90	8.10	16.4	395	275	0.036	0.02	146	185	2.0	66.0	31.0	13.0	0.43	0.140		
09/07/90	7.70	16.7	507	362												
10/16/90	7.60	13.2	1810	1482	0.010	0.02	120	206	2.7	63.0	32.0	12.0	0.08	0.080		
05/15/91	7.80	3.1	788	590												
06/11/91	7.70	7.3	768	573	0.050	0.02	106	220	3.3	64.0	33.0	10.0	<0.02	0.010		
07/09/91	7.70	8.9	499	356	<0.010	< 0.01	113	66	0.9	34.0	17.0	10.0	0.02	0.020		
08/09/91	6.90	15.8	1623	1314												
09/11/91	7.80	15.3	1660	1346												
10/10/91	8.10	12.0	1899	1563	0.018	< 0.01	114	167	2.3	54.0	28.0	10.0	0.09	0.050		
04/13/92	8.50	5.2	2749	2354												
05/06/92	7.20	7.6	1960	1619	0.008	< 0.01	124	311	3.9	76.0	39.0	12.0	0.04	0.070		
06/01/92	8.00	9.7	1952	1611												
07/01/92	8.40	12.0	1899	1563												
08/03/92	7.20	14.7	1698	1381	0.014	< 0.01	134	2165	25.4	58.0	28.0	11.0	0.08	0.014		
10/05/92	8.00	11.3	700	518	< 0.005	< 0.01	134	218	2.6	73.0	37.0	13.0	0.06	0.200		

Table 10. Ground Water Quality at Monitoring Well TR-4

Date	pH	Temp	S.C	TDS	O-P	NO2	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss. Fe	Diss. Mn	K	Cl
	(s.u.)	(C)	(umhos/cm)	mg/l	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
04/28/93	7.80	6.0	740	551												
05/04/93	7.50	11.3	700	518												
06/02/93	7.60	10.0	600	437	< 0.005	< 0.01	192	228	1.9	91.0	45.0	15.0	0.04	0.220		
07/01/93	7.40	11.8	700	518	0.007	< 0.01	226	239	1.7	95.0	45.0	16.0	0.23	0.240		
08/04/93	7.70	15.5	500	357												
09/09/93	7.80	16.0	470	333												
10/06/93	8.30	11.5	540	389	< 0.005	< 0.01	120	142	1.9	52.0	26.0	10.0	< 0.01	0.020		
11/08/93	8.80	5.0	650	477												
04/07/94	7.20	3.0	440	310												
05/03/94	7.70	6.0	600	458	< 0.005	< 0.01	158	251	2.5	82.0	43.0	13.0	0.06	0.100	2.0	2
06/20/94	8.35	13.5	420	216												
07/25/94	6.90	15.8	917	690	0.006	< 0.01	160	356	3.5	116.0	60.0	15.0	0.06	0.240	3.0	1
08/16/94	6.90	16.9	900	608												
09/16/94	7.00	16.3	643	422												
10/21/94	7.30	10.1	570	340	< 0.005	< 0.01	176	140	1.3	50.0	27.0	10.0	0.11	0.030	2.0	< 1
04/11/95	6.80	6.3	680	450												
05/16/95	6.80	6.3	680	450												
06/08/95	7.10	8.6	760	500												
06/28/95	6.90	12.7	800	560	0.012	< 0.01	173	250	2.3	80.0	42.0	14.0	0.02	0.068	2.1	4
07/11/95	7.10	14.3	810	580	< 0.005	< 0.01	194	250	2.0	92.0	51.9	15.6	0.02	0.118	2.5	5
08/14/95	7.70	12.5	530	310												
09/18/95	7.80	14.3	530	330												
10/18/95	8.10	10.4	600	400	0.020	< 0.01	118	198	2.6	62.8	33.2	9.7	0.34	0.167	2.1	2
05/13/96	7.90	7.1	700	420	< 0.005	< 0.01	117	180	2.4	72.6	36.9	10.6	0.07	0.220	2.0	1
06/14/96	7.00	6.5	960	660												
07/15/96	7.20	8.9	850	580												
08/19/96	7.60	11.9	810	510	< 0.005	< 0.01	222	210	1.5	93.8	45.6	13.7	0.44	1.210	2.2	4
09/16/96	7.50	12.9	720	340												
10/14/96	7.30	10.1	550	360	< 0.005	< 0.01	132	140	1.7	55.9	27.5	11.4	0.09	0.112	3.3	3
05/13/97	7.20	8.2	760	490	< 0.005	< 0.01	207	190	1.4	76.6	37.7	11.7	0.03	0.097	2.0	3
06/04/97	7.85	11.3	740	480												
07/01/97	7.31	7.9	830	590												
08/04/97	7.58	11.2	850	610	< 0.005	< 0.01	227	230	1.6	102.0	47.5	13.9	0.31	1.810	2.1	4
09/02/97	7.71	11.4	840	690												
10/01/97			797	520	< 0.005	< 0.01	226	230	1.6	99.6	46.8	13.6	0.12	0.702	2.4	4

Table 10. Ground Water Quality at Monitoring Well TR-4

Date	pH (s.u.)	Temp (C)	S.C (umhos/cm)	TDS mg/l	O-P (mg/l)	NO2 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss. Fe (mg/l)	Diss. Mn (mg/l)	K (mg/l)	Cl (mg/l)
05/12/98	7.34	6.0	920	620	< 0.005	< 0.01	240	260	1.7	112.0	50.4	14.6	0.20	2.400	2.1	8
06/02/98	7.70	10.7	870	620												
07/20/98	7.64	10.1	960	700	< 0.005	< 0.01	248	270	1.7	113.0	54.0	16.0	0.10	1.660	2.4	8
08/17/98	7.80	12.9	990	750												
09/14/98	7.90	13.7	590	390												
10/12/98	8.06	11.3	500	350	< 0.005	< 0.01	117	140	1.9	54.7	25.6	9.0	0.11	0.154	3.1	< 1
05/03/99	8.50	4.8	660	424	0.006	< 0.01	160	200	2.0	74.5	36.1	11.0	0.05	0.770	2.2	3
06/07/99	8.38	9.2	460	270												
07/06/99	8.28	9.6	780	500												
08/24/99	8.07	15.8	760	266	0.022	< 0.01	119	110	1.5	49.1	23.9	8.9	0.07	0.073	2.8	< 1
09/23/99	8.40	12.7	750	260												
10/18/99	8.27	9.6	450	264	0.031	< 0.01	118	110	1.5	47.6	23.9	7.9	0.12	0.160	2.5	1
05/16/00	7.73	7.5	700	427	0.039	0.03	130	220	2.7	73.1	36.1	10.9	0.80	0.079	2.2	4
06/19/00	7.98	13.0	320	200												
07/18/00	7.24	19.4	490	310												
08/15/00	7.52	19.1	720	459	0.095	< 0.01	146	230	2.5	75.8	40.5	14.0	0.04	0.058	2.9	7
09/11/00	7.85	13.1	590	380												
10/02/00	7.69	12.2	610	390	0.069	< 0.01	132	200	2.4	58.9	35.5	10.9	0.07	0.014	2.1	3
05/08/01	7.90	5.8	740	480	0.029	0.20	120	475	6.2	73.1	42.6	11.8	0.09	0.010	2.1	2
06/04/01	7.80	8.4	210	120												
07/10/01	7.30	18.9	720	570	0.037	0.08	158	250	2.5	83.2	46.6	12.7	< 0.01	< 0.005	3.0	2
08/01/01	7.90	18.6	560	370												
09/21/01	8.00	13.4	520	340												
10/10/01	8.50	9.8	470	300	0.023	< 0.01	108	130	1.9	45.7	27.1	7.5	0.25	0.029	1.6	2
05/13/02	7.82	7.6	870	600	0.024	0.06	115	330	4.5	111.0	56.4	13.1	0.21	0.012	3.0	5
06/03/02	7.63	8.8	730	470												
07/08/02	7.67	12.3	1020	730												
08/13/02																
09/09/02																
10/14/02																
05/12/03	7.80	10.1	980	820	0.020	< 0.01	155	420	4.3	113.0	74.2	18.1	0.13	0.727	4.2	3
06/17/03	7.00	14.1	800	600												
07/16/03	6.90	14.6	880	650	< 0.010	< 0.01	345	220	1.0	111.0	52.2	22.2	1.80	3.000	6.3	7
08/12/03	7.00	16.8	930	640												
09/08/03	7.10	15.3	1000	400												
10/01/03	7.00	12.8	1080	780	0.030	0.02	537	160	0.5	149.0	68.1	24.5	0.54	1.920	8.1	8

Table 10. Ground Water Quality at Monitoring Well TR-4

Date	pH	Temp	S.C	TDS	O-P	NO2	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss. Fe	Diss. Mn	K	Cl
	(s.u.)	(C)	(umhos/cm)	mg/l	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
05/12/04	6.75	7.6	1090	460	< 0.010	0.02	491	240	0.8	131.0	62.2	46.4	0.45	3.250	8.0	8
06/01/04	6.52	10.5	1160	870												
07/19/04	7.26	14.1	1250	940	0.010	0.02	419	230	0.9	135.0	61.6	89.8	0.37	4.410	8.0	8
08/03/04	7.26	15.0	1370	920												
09/08/04	7.31	15.4	1390	960												
10/13/04	7.28	12.2	1440	870	< 0.010	0.02	713	160	0.4	143.0	66.9	59.9		3.950	8.2	44
04/18/05	7.06	8.9	1270	860												
05/12/05	7.00	6.3	1190	770	0.130	0.02	542	150	0.4	138.0	66.5	46.7	0.20	1.630	7.8	20
06/09/05	8.44	10.9	1130	790												
07/15/05	7.17	19.0	1140	780												
08/03/05	7.13	14.1	1300	820	0.010	0.02	588	160	0.4	129.0	63.1	60.8	0.25	2.210	7.8	4
09/06/05	7.23	15.9	1300	820												
10/20/05	7.22	11.5	1470	840	0.360	0.02	621	170	0.4	151.0	73.8	63.7	0.67	4.240	8.6	5
05/19/06	7.61	14.6	1180	750	0.040	0.02	610	110	0.3	130.0	68.4	53.2	0.14	3.330	7.0	4
06/13/06	7.25	14.2	1160	770												
07/18/06	7.36	14.1	1190	780												
08/10/06	7.07	16.0	1110	710	0.050	0.02	474	140	0.5	124.0	62.0	28.7	0.06	1.480	7.6	4
09/11/06	7.52	13.2	1190	730												
10/11/06	7.32	11.6	1150	720	0.010	< 0.01	520	150	0.5	116.0	60.3	24.3	0.08	1.990	6.7	5
05/08/07	7.70	8.8	1120	700	0.040	< 0.01	505	130	0.4	134.0	70.7	21.7	0.03	0.249	5.2	4
06/22/07	7.40	12.9	1280	810												
07/19/07	7.80	15.4	1310	810	< 0.010	0.04	644	120	0.3	148.0	75.0	17.3	0.22	3.890	5.8	4
08/09/07	7.15	13.2	1210	720												
09/21/07	7.31	14.0	1480	790												
10/15/07	7.90	11.3	1190	780	0.030	< 0.01	599	120	0.3	149.0	73.6	20.5	0.13	3.340	7.9	4
05/14/08	7.10	6.8	1110	720	0.040	0.01	503	120	0.4	127.0	66.2	17.2	0.04	1.470	5.9	3
06/11/08	7.16	8.7	1160	710												
07/07/08	7.34	12.3	1170	2160												
08/11/08	7.18	15.1	1180	730	0.020	0.05	561	106	0.3	133.0	70.9	16.5	0.13	3.030	6.5	5
09/08/08	7.09	13.0	1180	740												
10/14/08	7.13	9.9	1200	730	< 0.010	0.01	475	110	0.4	145.0	77.6	17.3	0.22	3.500	7.0	4
05/14/09	7.22	9.8	1160	720	0.040	0.02	569	92	0.3	145.0	78.2	16.4	1.08		5.5	4
06/09/09	6.93	9.9	1120	710												
07/06/09	7.41	13.5	1100	720												
08/06/09	7.31	13.4	1160	730	0.070	0.13	571	121	0.3	123.0	65.6	14.9	0.18	2.860	5.2	4
09/02/09	7.24	13.2	1110	770												

Note: Monitoring well TR-4 was removed from the Monitoring Program on September 2, 2009 in accordance with TR-48. Monitoring well TR-4 was transferred to the current land owner September 15, 2009.

Table 11. Ground Water Quality at Monitoring Well WR-1

Date	pH	Temp	S.C	TDS	O-P	NO2	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss. Fe	Diss. Mn	K	Cl
	(s.u.)	(C)	(umhos/cm)	mg/l	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
04/28/88	6.70	11.0	3499													
05/09/88	6.80	9.9	3549													
06/09/88	6.60	12.7	3605	3874			353	2527	11.3	574.0	309.0	153.0	0.03	3.880		
07/14/88	6.70	13.6	3720	3290	0.020	4.64	431	2457	9.0	422.0	313.0	91.0	0.12	3.140		
08/05/88	6.80	12.6	3698	3269	0.010	4.04	427	2472	9.1	543.0	309.0	78.0	0.03	1.140		
09/21/88	6.80	12.3	3729	3299												
10/21/88	6.70	9.6	3764	3334												
04/13/89	6.90	10.8	4129	3693												
05/15/89	6.80	10.5	3982	3548	0.005	1.73	464	2503	8.5	485.0	297.0	127.0	0.04	4.180		
06/16/89	6.70	12.5	3850	3418												
07/03/89	7.00	13.3	2000	1655	0.013	0.56	278	1076	6.1	267.0	153.0	36.0	0.03	0.060		
08/03/89	6.80	12.3	2040	1692												
09/07/89	6.90	13.4	2465	2086	0.014	0.55	312	1239	6.3	355.0	208.0	50.0	0.02	0.040		
10/19/89	6.60	11.5	3399	2978												
04/19/90	7.20	11.2	4083	3648												
05/11/90	6.70	9.7	3959	3525	0.017	0.56	472	2441	8.1	506.0	265.0	108.0	0.06	4.800		
06/14/90	6.70	12.7	3942	3509												
07/06/90	7.20	12.9	3974	3540												
08/10/90	7.00	13.8	3930	3497	0.007	0.44	448	2507	8.8	509.0	249.0	138.0	0.02	0.090		
09/07/90	6.80	14.4	3830	3398												
10/16/90	6.70	11.9	1500	1204	0.005	0.26	458	2690	9.2	498.0	283.0	103.0	0.02	0.040		
05/15/91	6.70	7.2	3602	3175												
06/11/91	6.40	9.4	3422	3000	0.030	< 0.01	436	2529	9.1	491.0	289.0	121.0	< 0.02	4.590		
07/09/91	6.80	9.4	3392	2971	< 0.010	0.32	392	2046	8.2	469.0	240.0	144.0	0.04	1.450		
08/09/91	6.80	11.8	1370	1089												
09/11/91	6.80	12.2	1084	840												
10/10/91	6.80	10.9	1265	997	0.027	< 0.01	432	2428	8.8	395.0	240.0	454.0	< 0.02	< 0.010		
04/13/92	6.10	9.5	147	92												
05/06/92	6.30	11.4	1385	1102	< 0.005	0.01	474	2618	8.7	513.0	268.0	197.0	< 0.02	8.760		
06/01/92	6.40	10.6	1350	1071												
07/01/92	6.70	12.7	1203	943												
08/03/92	7.30	15.0	1257	990	< 0.005	< 0.01	404	2151	8.4	486.0	247.0	134.0	< 0.02	0.010		
10/05/92	7.60	12.0	3300	2882	0.005	< 0.01	396	2379	9.5	520.0	270.0	136.0	0.08	0.080		

Table 11. Ground Water Quality at Monitoring Well WR-1

Date	pH	Temp	S.C	TDS	O-P	NO2	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss. Fe	Diss. Mn	K	Cl
	(s.u.)	(C)	(umhos/cm)	mg/l	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
04/28/93	7.20	10.8	3800	3369												
05/04/93	6.80	11.5	3700	3271												
06/02/93	6.90	12.0	4000	3566	< 0.005	0.02	394	2741	11.0	508.0	361.0	64.0	< 0.02	1.800		
07/01/93	7.00	13.0	3700	3271	< 0.005	< 0.01	418	2766	10.4	531.0	370.0	78.0	< 0.02	2.400		
08/04/93	7.20	13.0	3300	2882												
09/09/93	6.80	13.8	3300	2882												
10/06/93	6.90	11.8	3300	2882	< 0.005	< 0.01	390	2696	10.9	540.0	368.0	62.0	< 0.02	0.470		
11/08/93	6.80	10.8	3300	2882												
04/07/94	6.20	10.0	4500	4062												
05/03/94	6.90	11.0	5000	3974	< 0.005	< 0.01	474	2408	8.0	512.0	337.0	93.0	0.09	3.980	12.0	7
06/20/94	7.03	12.8	3650	3572												
07/25/94	6.60	15.9	3610	3578	< 0.005	< 0.01	420	2346	8.8	516.0	262.0	118.0	0.06	0.040	10.0	1
08/16/94	6.80	12.7	3710	3586												
09/16/94	6.80	12.3	3660	3592												
10/21/94	7.00	10.3	3750	3620	< 0.005	< 0.01	456	2410	8.3	498.0	269.0	109.0	0.12	0.140	10.0	2
04/11/95	6.60	11.4	3740	4050												
05/16/95	6.60	11.4	3740	4050												
06/08/95	7.50	11.3	3300	3090												
06/28/95	7.10	12.7	3520	3690	< 0.005	< 0.01	357	2320	10.2	454.0	308.0	55.5	< 0.01	0.826	10.4	4
07/11/95	6.70	13.5	3770	4190	< 0.005	< 0.01	362	2600	11.3	520.0	393.0	62.3	< 0.01	1.510	12.4	6
08/14/95	6.90	13.2	3900	4040												
09/18/95	7.00	12.4	3700	3730												
10/18/95	7.30	11.9	2140	1860	0.011	< 0.01	251	1140	7.2	261.0	132.0	54.6	< 0.01	0.400	6.4	2
05/13/96	7.10	10.3	3960	4440	< 0.005	< 0.01	< 2	2620	2062.3	480.0	415.0	66.0	< 0.05	0.540	14.0	8
06/14/96	7.50	12.6	3360	3520												
07/15/96	7.20	13.0	3250	3280												
08/19/96	7.10	12.5	3860	3570	< 0.005	< 0.01	354	2340	10.4	496.0	354.0	104.0	< 0.05	3.240	11.0	4
09/16/96	7.10	13.5	3830	3800												
10/14/96	7.40	12.4	3810	3920	< 0.005	< 0.01	385	2600	10.6	508.0	371.0	95.0	0.04	0.040	11.7	5
05/13/97	7.55	10.8	3830	4250	< 0.005	< 0.01	324	2750	13.4	461.0	355.0	47.0	0.03	0.310	11.1	6
06/04/97	8.01	12.1	2340	1920												
07/01/97	7.72	12.3	1670	1320												
08/04/97	7.04	13.5	4020	3740	0.006	< 0.01	322	2050	10.0	333.0	185.0	111.0	< 0.01	1.250	8.8	4
09/02/97	7.20	14.2	3950	3890												
10/01/97	7.21	13.8	3800	3670	< 0.005	< 0.01	405	2380	9.3	520.0	325.0	89.3	0.03	0.100	10.6	5

Table 11. Ground Water Quality at Monitoring Well WR-1

Date	pH	Temp	S.C	TDS	O-P	NO2	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss. Fe	Diss. Mn	K	Cl
	(s.u.)	(C)	(umhos/cm)	mg/l	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(Ratio)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
05/12/98	7.66	10.4	670	3580	< 0.005	0.01	251	2060	12.9	413.0	328.0	38.0	0.04	0.498	10.1	6
06/02/98	7.87	12.3	810	600												
07/20/98	7.17	12.9	3110	3080	0.008	< 0.01	361	1810	7.9	445.0	254.0	80.0	< 0.05	3.450	9.0	2
08/17/98	6.91	13.4	3570	3630												
09/14/98	7.01	13.1	3580	3650												
10/12/98	7.39	13.1	3460	3710	< 0.005	< 0.01	412	2290	8.8	494.0	289.0	91.7	< 0.02	0.040	9.8	4
05/03/99	7.98	9.9	1840	1910	0.011	< 0.01	265	1210	7.2	350.0	145.0	20.7	< 0.01	0.045	6.6	2
06/07/99	7.34	12.0	1780	2780												
07/06/99	7.31	12.8	3600	2970												
08/24/99	7.18	13.4	3600	3330	0.011	< 0.01	431	2190	8.0	492.0	283.0	96.5	0.02	0.030	9.1	2
09/23/99	7.64	14.1	3650	3530												
10/18/99	7.60	11.8	3620	3360	0.366	< 0.01	412	2190	8.4	519.0	294.0	91.0	0.04	0.040	8.7	9
05/16/00	7.30	12.4	2510	2140	0.025	< 0.01	272	1390	8.0	388.0	150.0	31.9	0.02	0.811	6.3	2
06/19/00	6.67	12.5	3310	3430												
07/18/00	6.70	13.4	3450	3870												
08/15/00	7.14	14.3	3410	3370	0.120	< 0.01	415	2240	8.5	502.0	262.0	97.1	0.06	0.040	8.6	6
09/11/00	7.51	13.4	3410	3570												
10/02/00	7.39	13.1	3420	3420	1.290	< 0.01	407	2260	8.7	479.0	266.0	108.0	0.08	0.100	9.2	52
05/08/01	7.80	11.7	1590	370	0.200	0.87	98	190	3.1	69.6	24.2	3.8	0.03	0.039	5.0	2
06/04/01	7.10	11.1	2380	1850												
07/10/01	6.90	13.9	3420	3930	0.018	< 0.02	399	2420	9.5	485.0	344.0	68.1	0.03	5.240	10.2	5
08/01/01	7.00	13.1	3400	3600												
09/21/01	7.90	13.5	3480	300												
10/10/01	8.00	11.5	1330	1070	0.025	< 0.01	138	680	7.8	147.0	103.0	12.7	< 0.01	0.755	6.2	3
05/13/02	7.50	11.8	3470	4000	0.027	< 0.01	291	2840	15.4	494.0	387.0	41.0	< 0.05	1.550	10.0	6
06/03/02	7.41	12.3	3290	4060												
07/08/02	7.06	12.6	3250	4020												
08/13/02	7.64	13.7	3170	3850	0.007	< 0.01	382	2690	11.1	481.0	392.0	41.0	1.31	< 0.030	10.0	6
09/09/02	7.04	12.2	3190	3930												
10/14/02	7.28	13.6	2980	190	0.030	< 0.01	80	80	1.6	28.2	13.7	1.8	0.04	0.060	4.1	< 1
05/12/03	6.90	13.5	3250	4330	0.010	0.02	322	2320	11.3	487.0	408.0	41.0	< 0.05	0.650	8.3	6
06/17/03	6.90	14.1	3180	4330												
07/16/03	6.80	15.3	3130	4320	< 0.010	< 0.01	370	2840	12.1	512.0	415.0	42.0	< 0.05	1.410	8.5	6
08/12/03	6.90	15.2	3130	4570												
09/08/03	6.90	13.6	3060	4060												
10/01/03	6.90	15.1	2990	3930	< 0.010	< 0.01	359	2620	11.5	584.0	475.0	58.1	< 0.02	1.030	9.9	6

Table 11. Ground Water Quality at Monitoring Well WR-1

Date	pH (s.u.)	Temp (C)	S.C (umhos/cm)	TDS mg/l	O-P (mg/l)	NO2 (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	SO4:HCO3 (Ratio)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Diss. Fe (mg/l)	Diss. Mn (mg/l)	K (mg/l)	Cl (mg/l)
05/12/04	6.63	12.1	2830	4090	< 0.010	< 0.01	360	2910	12.7	456.0	367.0	39.1	0.06	3.080	9.6	6
06/01/04	6.58	12.7	2890	4230												
07/19/04	6.94	16.4	3570	4140	< 0.010	< 0.01	349	2890	13.0	482.0	382.0	42.0	0.16	0.980	10.0	6
08/03/04	6.98	15.8	3710	3990												
09/08/04	7.02	17.1	3610	3970												
10/13/04	6.77	11.7	3720	3830	< 0.010	< 0.01	388	2480	10.1	447.0	357.0	40.9		0.340	9.2	6
04/18/05	6.78	12.9	3940	4060												
05/12/05	6.98	10.0	4010	4020	< 0.010	< 0.01	341	2590	12.0	487.0	406.0	43.7	0.01	1.280	11.2	6
06/09/05	7.21	12.8	2370	1080												
07/15/05	6.72	18.1	3840	4090												
08/03/05	6.85	14.3	4000	4130	< 0.010	< 0.01	353	2460	11.0	478.0	386.0	40.0	0.10	1.590	10.0	5
09/06/05	6.82	14.8	3220	3010												
10/20/05	6.94	11.0	3860	3620	< 0.010	< 0.01	378	2340	9.7	503.0	406.0	46.5	0.05	4.560	10.9	5
05/19/06	7.18	15.3	4050	4190	< 0.010	0.04	323	2790	13.6	498.0	442.0	42.5	0.08	0.590	11.0	5
06/13/06	6.93	14.6	3990	4250												
07/18/06	7.01	17.2	3840	4300												
08/10/06	6.89	15.6	3740	4240	0.020	< 0.01	337	2420	11.3	483.0	410.0	43.0	< 0.10	1.210	10.0	4
09/11/06	7.11	13.9	3610	3620												
10/11/06	6.90	12.4	3770	3850	< 0.010	< 0.01	346	2510	11.4	436.0	389.0	39.6	0.03	1.170	10.0	5
05/08/07	7.50	13.6	4000	4140	0.020	< 0.01	322	2590	12.7	463.0	398.0	38.0	0.10	1.100	10.0	5
06/22/07	7.09	13.7	3930	4060												
07/19/07	7.60	14.2	4040	4210	< 0.010	< 0.01	353	2690	12.0	509.0	416.0	44.0	< 0.10	1.290	9.0	5
08/09/07	6.81	14.1	3810	3620												
09/21/07	7.14	13.1	4480	3700												
10/15/07	7.70	12.1	3720	3730	0.020	< 0.01	370	2400	10.2	445.0	363.0	40.3	< 0.04	1.120	9.3	5
05/14/08	7.53	7.5	1560	1160	0.040	< 0.01	201	670	5.2	196.0	89.2	12.2	< 0.02	0.312	4.3	< 1
06/11/08	6.93	11.5	4180	2970												
07/07/08	7.31	12.1	2510	4300												
08/11/08	7.08	13.1	3460	3320	< 0.010	< 0.01	355	2100	9.3	433.0	305.0	86.8	0.04	0.160	9.8	4
09/08/08	6.94	13.1	3630	3670												
10/14/08	6.81	10.9	3810	3710	< 0.010	< 0.01	396	2100	8.3	473.0	325.0	96.3	< 0.04	0.020	10.9	3
05/14/09	7.03	13.7	3950	4210	0.010	0.02	281	2700	15.1	488.0	445.0	40.9	0.33		11.3	4
06/09/09	7.08	11.6	2150	1860												
07/06/09	6.92	14.2	2970	2890												
08/06/09	6.97	13.2	3360	3360	0.020	< 0.01	388	2200	8.9	453.0	274.0	80.9	0.02	0.187	10.0	2
09/02/09	6.82	13.2	3460	3690												

Note: Monitoring well WR-1 was removed from the Monitoring Program on September 2, 2009 in accordance with TR-48. Monitoring well WR-1 was plugged and abandoned September 8, 2009.

Table 12. Ground Water Quality at Monitoring Well TCS-1

Date	pH	Temp	S.C	TDS	O-P	NO2	HCO3	SO4	SO4:HCO3	Ca	Mg	Na	Diss.Fe	Diss.Mn	K	Cl
	(s.u.)	Cel.	umhos/cm	mg/l	(mg/l)	(mg/l)	(mg/l)	(mg/l)	Ratio	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
7/27/1995	8.20	12.5	1000	790	0.036	0.03	594	90	0.2	11.9	4.6	296.0	0.01	0.0080	2.4	12
10/12/1995	8.00	10.0	1000	700	0.025	< 0.01	586	68	0.2	5.0	1.7	310.0	< 0.01	< 0.0090	2.2	10
5/13/1996	8.00	10.5	1080	640	< 0.005	0.09	< 2	80	63.0	15.0	5.7	220.0	0.01	< 0.0050	2.4	15
8/19/1996	8.40	14.2	1260	740	0.031	< 0.01	630	70	0.2	5.5	1.9	319.0	< 0.01	0.0060	2.2	12
10/14/1996	8.30	13.4	1290	770	0.030	< 0.01	633	60	0.1	4.2	1.4	320.0	0.01	0.0050	2.3	16
5/13/1997	6.98	8.9	1010	620	< 0.005	< 0.01	472	80	0.3	11.9	4.4	208.0	< 0.01	0.0050	2.0	12
8/4/1997	7.67	18.5	1380	820	< 0.005	0.14	518	190	0.6	33.1	12.7	279.0	0.01	0.0140	3.2	16
10/1/1997	7.56	13.2	1410	840	0.020	< 0.01	513	240	0.7	34.4	12.9	277.0	0.03	0.0770	3.4	17
5/12/1998	7.60	8.9	760	440	< 0.005	0.01	272	110	0.6	29.1	10.4	135.0	0.06	0.0110	2.8	12
7/20/1998	8.08	13.8	1260	780	0.007	0.05	512	160	0.5	21.1	9.5	278.0	< 0.05	0.0190	3.1	15
10/12/1998	8.41	10.4	1160	700	0.030	< 0.01	560	50	0.1	4.3	1.5	290.0	< 0.01	0.0050	2.2	13
5/3/1999	8.51	14.1	950	606	0.006	0.13	443	70	0.2	5.6	2.2	233.0	< 0.01	0.0110	2.0	9
8/24/1999	8.54	15.1	950	692	0.021	< 0.01	550	60	0.2	4.1	1.4	273.0	< 0.01	0.0070	2.0	9
10/18/1999	8.41	8.3	1230	712	0.024	< 0.01	561	70	0.2	3.8	1.3	288.0	0.02	0.0060	2.2	10
5/16/2000	7.91	8.9	940	535	< 0.005	< 0.01	372	70	0.3	8.3	3.0	210.0	0.03	0.0100	2.3	14
8/15/2000	8.22	14.1	1180	711	0.055	< 0.01	600	40	0.1	3.1	.9	294.0	0.02	< 0.0050	2.1	11
10/2/2000	8.37	12.6	1210	742	0.043	< 0.01	631	50	0.1	4.0	1.2	295.0	0.04	0.0050	2.2	13
5/8/2001	7.90	17.8	4290	4440	0.008	0.03	337	3100	14.5	550.0	426.0	31.0	0.23	0.6800	5.0	14
7/10/2001	8.10	15.6	1190	720	0.036	< 0.02	593	40	0.1	4.9	1.7	312.0	0.01	0.0060	2.3	11
10/10/2001	8.70	10.1	1170	710	0.025	< 0.01	491	50	0.2	3.6	1.1	282.0	0.02	0.0060	2.1	10
5/13/2002	8.51	10.5	1300	780	0.047	< 0.01	489	50	0.2	3.1	1.0	295.0	0.02	< 0.0050	1.8	8
8/13/2002	8.47	14.5	1240	765	0.029	< 0.01	631	50	0.1	3.0	1.0	322.0	< 0.01	< 0.0050	2.2	8
10/14/2002	8.32	13.4	1260	750	0.040	< 0.01	658	50	0.1	2.8	.9	298.0	0.04	0.0050	2.1	9
8/12/2003	8.40	15.9	1120	750	0.070	< 0.01	642	30	0.1	4.8	1.6	303.0	0.08	< 0.0050	2.3	11
10/1/2003	8.50	16.0	1050	650	0.060	< 0.01	504	70	0.2	4.0	1.4	254.0	0.06	0.0080	1.6	8
9/6/2005	7.75	14.7	1540													
10/20/2005	7.42	11.6	1460	900	< 0.010	0.30	480	230	0.8	28.5	10.2	326.0	0.05	0.0140	3.3	39
5/19/2006	7.32	12.5	1030	600	0.020	< 0.01	267	110	0.6	57.5	18.7	144.0	0.05	0.0130	2.7	107
8/10/2006	7.62	13.8	1380	930	0.030	< 0.01	489	200	0.6	33.2	12.1	287.0	0.02	0.0170	3.3	35
10/11/2006	7.62	11.3	1290	820	0.020	< 0.01	429	180	0.7	23.0	8.7	292.0	< 0.02	0.0190	2.9	34
5/8/2007	7.40	10.4	945	560	0.020	< 0.01	252	100	0.6	37.4	13.2	130.0	0.03	0.0150	2.6	85
7/19/2007	8.20	12.7	1490	920	0.020	< 0.01	485	230	0.7	35.7	13.3	264.0	0.05	0.0150	3.0	41
10/15/2007	8.30	10.9	1350	810	0.040	< 0.01	468	210	0.7	20.8	7.5	294.0	< 0.02	0.0150	3.0	26
5/14/2008	7.69	11.3	1030	610	0.020	< 0.01	254	120	0.7	45.9	16.5	155.0	< 0.02	0.0060	3.0	94
8/11/2008	7.78	11.4	1480	920	0.020	< 0.01	444	230	0.8	36.5	13.3	263.0	0.21	0.0170	3.4	57
10/14/2008	7.70	10.6	1460	890	< 0.010	< 0.01	453	196	0.7	24.9	9.8	320.0	0.07	0.0190	3.1	39
5/14/2009	7.03	12.1	1010	570	0.030	< 0.01	261	91	0.5	39.0	14.4	147.0	0.12		2.5	70
8/6/2009	8.42	12.8	1530	930	0.030	< 0.01	458	240	0.8	41.3	15.8	293.0	0.03	0.0150	3.5	62

Note: Monitoring well TCS-1 was removed from the Monitoring Program on September 2, 2009 in accordance with TR-48.

Table 13. Spring and Seep Survey

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Spring [a]																	
SPR 1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SPR 2	X		X	X	X	X			X								
SPR 3	X		X	X	X	X			X	X	X	X	X	X	X	X	X
SPR 4	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X
SPR 5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SPR 6	X	X	X	X	X	X	X	X								X	X
SPR 7	X		X	X	X	X	X	X						X	X	X	X
SPR 10	X		X	X	X							X	X	X	X	X	X
SPR 11	X	X	X	X	X					X	X	X	X	X	X	X	X
SPR 12	X	X	X	X	X				X	X	X		X	X	X	X	X
SPR 13	X		X	X	X									X	X	X	X
SPR 14	X		X	X	X	X				X	X	X	X				
SPR 15			X	X	X	X			X			X					
SPR 16			X	X	X	X	X	X	X	X	X	X	X			X	X
SPR 17			X	X	X	X	X	X	X		X		X			X	X
Seep [a]																	
SE 1	X	X	X	X													
SE 2[b]	X	X	X	X	X	X	X	X	X								
SE 10	X	X	X	X	X	X											
SE 11	X	X	X	X	X	X											
SE 12	X	X	X	X	X	X											
SE 13	X	X	X	X	X	X			X	X	X		X		X	X	X
SE 14	X	X	X	X													
SE 15	X	X	X	X	X												
SE 16	X	X	X	X	X	X				X			X	X	X	X	X
SE 17	X	X	X	X	X	X						X					
SE 18	X	X	X	X	X	X											
SE 19	X	X	X	X	X	X											
SE 20	X	X	X	X	X	X			X	X	X	X	X	X	X	X	
SE 21	X	X	X	X													
SE 22	X	X	X	X													
SE 23	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SE 26	X		X	X	X												
SE 27	X		X	X	X									X	X	X	X
SE 28			X	X	X	X	X	X									
SE 29			X	X	X	X	X	X	X								
SE 30					X						X		X		X	X	X

[a] Springs 8 and 9, and Seeps 24 and 25 have been deleted from the survey. These areas actually represented surface expressions of ground water within the alluvial valley floor.

[b] Individual seeps 2, 3, 4, 5, 6 and 7 have been combined into one seep area (SE 2) to more accurately depict the seep area located adjacent to SPR 1.

Table 14. Spring and Seep Flow and Field Water Quality

Spring No.	Date	Level	Flow (gpm)	pH (s.u.)	Temp (°C)	SC (µmhos/cm)	TDS* (mg/l)
SPR 1	05/05/09	0.73	1012.51	6.68	11.2	3920	3920
SPR 2	05/06/09	0.00	0.00				
SPR 3	05/06/09	0.40	73.28	6.87	11.6	1880	1540
SPR 4	05/06/09	0.05	1.15	6.91	11.8	1870	
SPR 5	05/06/09	0.39	69.66	7.11	10.9	2630	2480
SPR 6	05/06/09	0.03	0.41	7.16	11.4	2710	
SPR 7	05/06/09	0.02	0.18	7.06	11.1	2740	
SPR 10	05/05/09	0.04	0.73	7.03	12.1	4210	
SPR 11	05/05/09	0.43	351.31	7.04	12.2	4350	4510
SPR 12	05/05/09	0.03	0.41	7.01	12.4	4360	
SPR 13	05/05/09	0.01	0.05	7.09	12.7	4290	
SPR 14	05/05/09	0.00	0.00				
SPR 15	05/06/09	0.00	0.00				
SPR 16	05/05/09	0.02	0.18	7.03	12.5	4400	
SPR 17	05/05/09	0.03	0.41	7.07	12.3	4380	

Seep No.	Date	Level	Flow (gpm)	pH (s.u.)	Temp (°C)	SC (µmhos/cm)	TDS (mg/l)
SE 1	05/06/09	0.00	0.00				
SE 2	05/05/09	0.00	0.00				
SE 8	05/06/09	0.00	0.00				
SE 12	05/06/09	0.00	0.00				
SE 13	05/06/09	0.01	0.05	7.58	12.1	1490	
SE 14	05/06/09	0.00	0.00				
SE 15	05/06/09	0.00	0.00				
SE 16	05/06/09	0.06	1.65	6.98	10.8	2690	
SE 17	05/06/09	0.00	0.00				
SE 18	05/06/09	0.00	0.00				
SE 19	05/06/09	0.00	0.00				
SE 21	05/05/09	0.00	0.00				
SE 22	05/05/09	0.00	0.00				
SE 23	05/05/09	0.44	367.84	6.84	10.6	2590	2270
SE 26	05/05/09	0.00	0.00				
SE 27	05/05/09	0.02	0.18	7.07	12.5	4340	
SE 28	05/05/09	0.00	0.00				
SE 29	05/05/09	0.00	0.00				
SE 30	05/05/09	0.01	0.05	7.02	12.6	4190	

* Measurements were analytically derived; all other measurements were derived with a field test meter.

Table 15. Spring and Seep Laboratory Water Quality

Spring/Seep	Date	Diss. Al (mg/l)	Ca (mg/l)	Fe (mg/l)	Mg (mg/l)	Diss. Mn (mg/l)	K (mg/l)	Na (mg/l)	HCO_3 (mg/l)	NH_3 (mg/l)	Cl (mg/l)	NO_2 (mg/l)	Ortho-P (mg/l)	SO_4 (mg/l)
SPR 1	May-98	< 0.2	522	< 0.05	406	0.950	12.0	48.0	360	< 0.01	7	< 0.01	< 0.005	2730
SPR 3	May-98	< 0.06	264	0.02	113	< 0.005	2.8	9.2	297	< 0.01	5	0.01	< 0.005	900
SPR 5 - 7	May-98	< 0.06	434	< 0.02	198	< 0.005	4.8	12.7	256	< 0.01	3	< 0.01	< 0.005	1590
SPR 16 & 17	May-98	< 0.2	515	< 0.05	490	0.170	16.0	63.0	532	< 0.01	11	< 0.01	< 0.005	3050
SE 23	May-98	< 0.06	313	< 0.02	183	0.010	6.7	15.0	364	< 0.01	5	< 0.01	< 0.005	1240
SPR 1; SE 2	May-99	< 0.06	540	< 0.02	418	1.240	11.3	45.2	375	< 0.01	6	< 0.01	< 0.005	2460
SPR 4	May-99	< 0.03	348	0.04	157	< 0.005	2.8	10.1	335	< 0.01	4	< 0.01	< 0.005	1030
SPR 5-7	May-99	< 0.06	426	< 0.02	191	< 0.005	3.9	11.9	256	< 0.01	3	< 0.01	< 0.005	1520
SPR 16-17; SE 28-29	May-99	< 0.2	543	< 0.05	504	0.120	17.0	72.0	432	< 0.01	12	< 0.01	< 0.005	2820
SE 23	May-99	< 0.06	331	0.06	190	0.020	7.0	14.8	376	< 0.01	4	< 0.01	< 0.005	1120
SPR 1	May-00	< 0.2	506	0.13	394	1.070	11.0	44.0	368	< 0.05	7	< 0.01	0.007	2630
SPR 5 - 7	May-00	< 0.06	392	0.03	181	< 0.010	4.4	11.6	242	< 0.05	3	< 0.01	0.019	1470
SPR 16-17; SE 28-29	May-00	< 0.2	503	< 0.05	480	0.050	15.0	69.0	414	< 0.05	12	< 0.01	0.007	2990
SPR 23	May-00	< 0.06	331	< 0.02	186	< 0.005	6.0	13.1	383	< 0.05	4	< 0.01	< 0.005	1280
SPR 1	May-01	< 0.2	509	< 0.05	403	1.120	11.0	45.0	364	< 0.05	6	< 0.01	0.009	2710
SPR 3	May-01	< 0.2	331	0.03	151	< 0.005	2.6	10.4	328	< 0.05	30	< 0.01	0.007	1160
SPR 5 - 7	May-01	< 0.2	383	0.06	178	< 0.010	3.8	11.2	254	< 0.05	3	< 0.01	0.021	1580
SPR 16 & 17	May-01	< 0.2	502	< 0.05	465	0.070	15.0	67.0	411	< 0.05	11	< 0.01	0.007	3050
SE 23	May-01	< 0.2	341	< 0.02	188	< 0.010	6.0	14.1	401	< 0.05	4	< 0.01	0.009	1380
SPR 1	May-02	< 0.06	486	< 0.02	385	1.240	10.2	41.8	286	< 0.01	6	< 0.01	0.022	2730
SPR 3	May-02	< 0.06	416	< 0.02	180	< 0.010	2.6	9.6	278	< 0.01	3	< 0.01	0.031	1450
SPR 5 - 7	May-02	< 0.06	433	< 0.02	189	< 0.010	4.4	11.0	208	< 0.01	3	< 0.01	0.032	1720
SPR 12	May-02	< 0.02	522	< 0.01	478	0.073	14.0	73.0	284	< 0.01	12	< 0.01	0.035	3150
SPR 1	May-03	< 0.06	491	< 0.02	389	0.700	6.2	42.0	337	< 0.01	6	< 0.01	< 0.01	2680
SPR 3	May-03	< 0.03	287	< 0.02	131	< 0.010	2.7	10.1	272	< 0.01	4	< 0.01	0.02	900
SPR 5 - 7	May-03	< 0.03	238	< 0.02	204	< 0.010	4.5	11.2	236	< 0.01	2	< 0.01	0.02	1410
SPR 14	May-03	< 0.06	486	< 0.02	479	0.020	6.7	64.0	407	< 0.01	11	< 0.01	0.01	3070
SE 23	May-03	< 0.03	183	< 0.02	211	< 0.010	6.3	13.7	363	< 0.01	4	< 0.01	< 0.01	1140

Table 15. Spring and Seep Laboratory Water Quality

Spring/Seep	Date	Diss. Al (mg/l)	Ca (mg/l)	Fe (mg/l)	Mg (mg/l)	Diss. Mn (mg/l)	K (mg/l)	Na (mg/l)	HCO_3 (mg/l)	NH_3 (mg/l)	Cl (mg/l)	NO_2 (mg/l)	Ortho-P (mg/l)	SO_4 (mg/l)
SPR 1	May-04	< 0.03	501	< 0.01	385	1.090	9.2	36.2	339	< 0.01	6	< 0.01	0.01	2870
SPR 5-7	May-04	0.04	405	0.03	184	< 0.005	3.9	10.9	269	< 0.01	2	< 0.01	0.03	1570
SPR 1	May-05	< 0.03	485	< 0.01	401	1.240	10.6	43.8	354	0.20	6	< 0.01	< 0.01	2510
SPR 3	May-05	< 0.03	200	0.03	84.3	0.084	3	8.1	219	< 0.05	3	0.01	0.02	590
SPR 5-7	May-05	< 0.03	409	< 0.01	197	< 0.005	4.6	11.7	260	< 0.05	3	< 0.01	0.01	1590
SPR 11	May-05	< 0.03	489	< 0.01	498	0.033	15.9	74.5	395	0.08	13	< 0.01	< 0.01	2080
SPR 1	May-06	< 0.06	505	< 0.04	432	0.810	10.9	43.8	330	< 0.05	5	< 0.01	< 0.01	2630
SPR 3	May-06	< 0.03	317	< 0.02	146	< 0.005	2.6	10.7	333	< 0.01	4	0.01	0.01	1050
SPR 5	May-06	< 0.06	426	< 0.04	206	< 0.010	4.7	12.1	272	< 0.01	3	0.01	0.01	1600
SPR 11	May-06	< 0.2	494	< 0.10	503	< 0.030	15	71.0	401	< 0.01	13	0.01	< 0.01	2930
SPR 1	May-07	< 0.2	465	< 0.1	386	0.950	10	37	331	< 0.05	5	< 0.01	0.01	2610
SPR 3	May-07	< 0.03	311	< 0.02	147	< 0.005	2.3	9.9	316	< 0.05	3	< 0.01	0.02	1060
SPR 5	May-07	< 0.06	401	< 0.04	195	< 0.010	4.1	11.2	269	< 0.05	2	< 0.01	0.02	1540
SPR 11	May-07	< 0.2	471	< 0.1	469	0.070	14	68	371	< 0.05	12	< 0.01	0.01	2870
SE 23	May-07	< 0.06	341	< 0.04	213	< 0.010	5.5	15.8	435	< 0.05	5	< 0.01	< 0.01	1430
SPR 1	May-08	0.09	518	< 0.04	461	0.730	11.6	47.7	292	< 0.01	4	< 0.01	0.01	2400
SPR 3	May-08	0.06	244	< 0.02	112	< 0.005	3.7	8.9	254	< 0.01	3	< 0.01	0.02	720
SPR 5	May-08	0.03	395	< 0.02	207	< 0.005	5.3	11.6	223	< 0.01	2	< 0.01	0.03	1370
SPR 11	May-08	< 0.06	502	< 0.04	540	< 0.010	15.6	64.8	368	< 0.01	8	< 0.01	0.01	2800
SE 23	May-08	0.03	342	< 0.02	224	< 0.005	7	15.3	318	< 0.01	3	< 0.01	0.01	1250
SPR 1	May-09	< 0.03	452	< 0.02	416	0.496	9.6	40.2	311	< 0.05	4	< 0.01	< 0.01	2300
SPR 3	May-09	0.07	261	0.19	121	0.007	2.1	9.3	262	< 0.01	3	< 0.01	0.02	770
SPR 5	May-09	< 0.03	389	< 0.02	200	< 0.005	4.2	11.8	217	< 0.01	2	< 0.01	0.02	1400
SPR 11	May-09	< 0.03	443	< 0.02	499	< 0.005	13.9	64.4	362	< 0.01	9	< 0.01	0.01	2800
SE 23	May-09	0.04	308	< 0.02	210	< 0.005	5.9	14.8	337	< 0.01	3	0.10	< 0.01	1200

Springs and Seeps with Flow Greater than 20 gpm

Table 16. Moffat Stability Monument Survey

	Date	Surveyed Coordinates			Δ from Initial Survey		
		Northing (feet)	Easting (feet)	Elevation (feet)	Northing (feet)	Easting (feet)	Elevation (feet)
SM-1	11/05/97	372660.78	1590514.65	7189.03	-	-	-
	03/13/98	372660.78	1590514.65	7188.99	0.00	0.00	-0.04
	06/26/98	372660.72	1590514.59	7188.49	0.06	0.06	-0.54
	09/28/98	372660.75	1590514.58	7188.40	0.03	0.07	-0.63
	10/13/99	372660.79	1590514.62	7187.92	-0.01	0.03	-1.11
	09/25/00	372660.78	1590514.70	7187.64	0.00	-0.05	-1.39
	09/21/01	372660.79	1590514.68	7187.64	0.00	-0.03	-1.39
	09/16/02	372660.83	1590514.58	7187.63	-0.05	0.07	-1.40
	09/12/03			7187.58	-	-	-1.45
	09/17/04	372660.91	1590514.54	7187.53	-0.13	0.11	-1.50
	09/20/05	372660.90	1590514.56	7187.74	-0.12	0.09	-1.29
	09/06/06	372660.92	1590514.55	7187.54	-0.14	0.10	-1.49
	08/24/07	372660.85	1590514.57	7187.53	-0.14	0.08	-1.50
	09/22/08	372660.92	1590514.50	7187.62	-0.14	0.15	-1.41
	08/12/09	372660.89	1590514.45	7187.64	-0.14	0.20	-1.39
SM-2	11/05/97	372458.06	1590451.58	7208.34	-	-	-
	03/13/98	372458.05	1590451.61	7208.38	0.01	-0.03	0.04
	06/26/98	372458.03	1590451.58	7208.33	0.03	0.00	-0.01
	09/28/98	372458.04	1590451.57	7208.30	0.02	0.01	-0.04
	10/13/99	372457.99	1590451.49	7208.22	0.07	0.09	-0.12
	09/25/00	372457.96	1590451.61	7207.82	0.10	-0.03	-0.52
	09/21/01	372457.98	1590451.54	7207.72	0.09	0.04	-0.62
	09/16/02	372458.01	1590451.46	7207.65	0.05	0.12	-0.69
	09/12/03			7207.48	-	-	-0.86
	09/17/04	372457.98	1590451.41	7207.22	0.08	0.17	-1.12
	09/20/05	372458.03	1590451.35	7207.38	0.03	0.23	-0.96
	09/06/06	372457.99	1590451.33	7207.08	0.08	0.25	-1.26
	08/24/07	372457.97	1590451.32	7206.96	0.09	0.26	-1.38
	09/22/08	372458.00	1590451.23	7207.06	0.06	0.35	-1.28
	08/12/09	372457.94	1590451.19	7207.01	0.12	0.39	-1.33
SM-3	11/05/97	372597.33	1591009.48	7258.66	-	-	-
	03/13/98	372597.35	1591009.46	7258.60	-0.02	0.02	-0.06
	06/26/98	372597.42	1591009.38	7257.89	-0.09	0.10	-0.77
	09/28/98	372597.46	1591009.38	7257.81	-0.13	0.10	-0.85
	10/13/99	372597.47	1591009.43	7257.60	-0.14	0.05	-1.06
	09/25/00	372597.45	1591009.56	7257.42	-0.12	-0.08	-1.24
	09/21/01	372597.54	1591009.56	7257.42	-0.20	-0.08	-1.24
	09/16/02	372597.58	1591009.49	7257.41	-0.25	-0.01	-1.25
	09/12/03			7257.39	-	-	-1.27
	09/17/04	372597.65	1591009.45	7257.30	-0.32	0.03	-1.36
	09/20/05	372597.66	1591009.47	7257.49	-0.33	0.01	-1.17
	09/06/06	372597.66	1591009.45	7257.27	-0.33	0.03	-1.39
	08/24/07	372597.65	1591009.48	7257.25	-0.32	0.00	-1.41
	09/22/08	372597.69	1591009.44	7257.41	-0.36	0.04	-1.25
	08/12/09	372597.64	1591009.43	7257.27	-0.31	0.05	-1.39

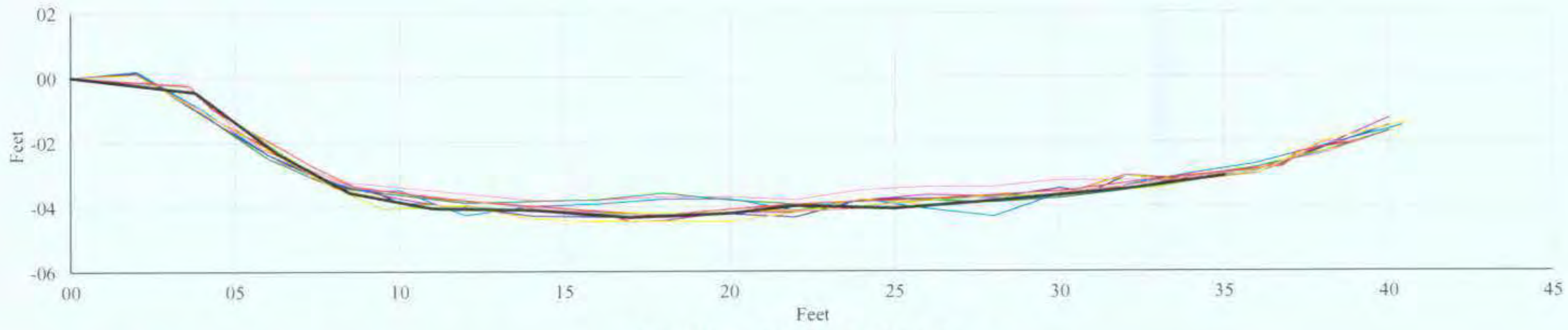
Table 16. Moffat Stability Monument Survey

	Date	Surveyed Coordinates			Δ from Initial Survey		
		Northing (feet)	Easting (feet)	Elevation (feet)	Northing (feet)	Easting (feet)	Elevation (feet)
SM-4	11/05/97	372388.45	1590956.14	7276.78	-	-	-
	03/13/98	372388.44	1590956.12	7276.75	0.01	0.02	-0.03
	06/26/98	372388.38	1590956.07	7276.45	0.07	0.07	-0.33
	09/28/98	372388.37	1590956.04	7276.36	0.08	0.10	-0.42
	10/13/99	372388.25	1590955.99	7276.13	0.20	0.15	-0.65
	09/25/00	372388.23	1590956.02	7275.71	0.22	0.12	-1.07
	09/21/01	372388.24	1590955.93	7275.62	0.21	0.21	-1.16
	09/16/02	372388.26	1590955.82	7275.54	0.19	0.32	-1.24
	09/12/03			7275.49	-	-	-1.29
	09/17/04	372388.28	1590955.70	7275.27	0.17	0.44	-1.51
	09/20/05	372388.26	1590955.62	7275.40	0.19	0.52	-1.38
	09/06/06	372388.28	1590955.61	7275.17	0.17	0.53	-1.61
	08/24/07	372388.28	1590955.55	7275.11	0.17	0.59	-1.67
	09/22/08	372388.30	1590955.52	7275.24	0.15	0.62	-1.54
	08/12/09	372388.24	1590955.45	7275.16	0.21	0.69	-1.62
SM-5	11/05/97	372451.43	1591657.64	7348.69	-	-	-
	03/13/98	372451.50	1591657.57	7348.69	-0.07	0.07	0.00
	06/26/98	372451.51	1591657.55	7348.51	-0.08	0.09	-0.18
	09/28/98	372451.53	1591657.55	7348.45	-0.10	0.09	-0.24
	10/13/99	372451.50	1591657.47	7348.29	-0.07	0.17	-0.40
	09/25/00	372451.41	1591657.49	7348.23	0.02	0.15	-0.46
	09/21/01	372451.43	1591657.52	7348.23	0.00	0.12	-0.46
	09/16/02	372451.51	1591657.52	7348.20	-0.08	0.12	-0.49
	09/12/03			7348.19	-	-	-0.50
	09/17/04	372451.54	1591657.41	7348.08	-0.11	0.23	-0.61
	09/20/05	372451.49	1591657.43	7348.22	-0.06	0.21	-0.47
	09/06/06	372451.50	1591657.44	7348.05	-0.07	0.20	-0.64
	08/24/07	372451.51	1591657.42	7347.96	-0.08	0.22	-0.73
	09/22/08	372451.50	1591657.42	7348.15	-0.07	0.22	-0.54
	08/12/09	372451.48	1591657.38	7348.12	-0.05	0.26	-0.57
SM-6	11/05/97	372257.93	1591585.79	7359.12	-	-	-
	03/13/98	372257.92	1591585.78	7359.12	0.01	0.01	0.00
	06/26/98	372257.97	1591585.71	7358.88	-0.04	0.08	-0.24
	09/28/98	372257.99	1591585.67	7358.81	-0.06	0.12	-0.31
	10/13/99	372257.92	1591585.60	7358.63	0.01	0.19	-0.49
	09/25/00	372257.98	1591585.61	7358.27	-0.05	0.18	-0.85
	09/21/01	372257.98	1591585.49	7358.19	-0.05	0.30	-0.93
	09/16/02	372258.03	1591585.37	7358.09	-0.10	0.42	-1.03
	09/12/03			7358.03	-	-	-1.09
	09/17/04	372258.04	1591585.22	7357.73	-0.11	0.57	-1.39
	09/20/05	372258.08	1591585.19	7357.83	-0.15	0.60	-1.29
	09/06/06	372258.05	1591585.16	7357.58	-0.12	0.63	-1.54
	08/24/07	372258.08	1591585.12	7357.52	-0.15	0.67	-1.60
	09/22/08	372258.07	1591585.05	7357.70	-0.14	0.74	-1.42
	08/12/09	372258.03	1591585.04	7357.59	-0.10	0.75	-1.53

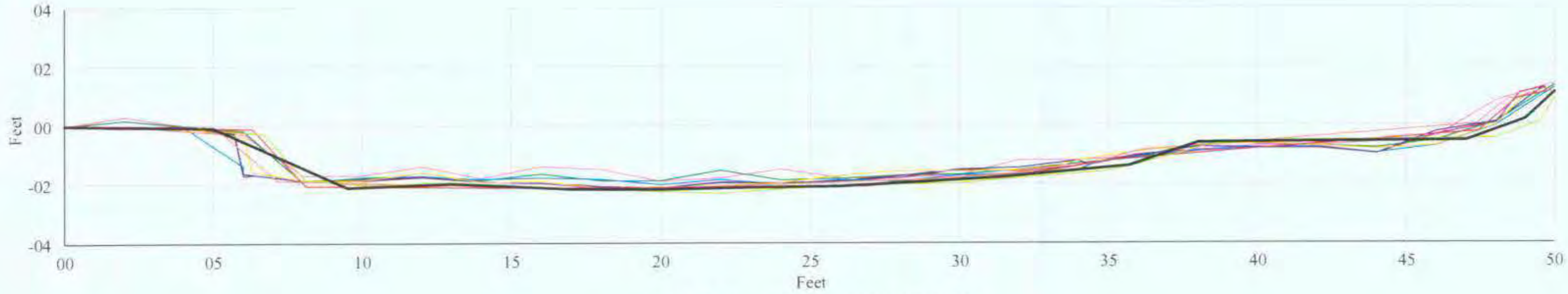
Note: Survey coordinates are based upon a Local coordinate system.

FIGURES

WWC ENGINEERING



CROSS-SECTION TR-a



CROSS-SECTION TR-b

LEGEND

- 2009 PROFILE
- 2008 PROFILE
- 2007 PROFILE
- 2006 PROFILE
- 2005 PROFILE
- 2004 PROFILE
- 2003 PROFILE
- 2002 PROFILE
- 2001 PROFILE
- 2000 PROFILE
- 1999 PROFILE

0 5'
SCALE

NO.	REVISIONS	DATE

WWC ENGINEERING

CHANNEL CROSS-SECTIONS

EDNA MINE
CHEVRON MINING INC

DESIGNED BY: TNS
DRAWN BY: TNS
CHECKED BY: TNS
DATE: 02/10

FIGURE
1

SHEET
1 OF 1

PLATES

CIVIL/WATER RESOURCE ENGINEERING

- Pumps and pipelines
- Surface and groundwater modeling
- FEMA floodplain assessments
- Hydraulic and hydrologic analysis and design
- Dam design and rehabilitation
- Water supply, treatment and distribution
- Wastewater treatment and disposal
- Irrigation systems
- GPS and conventional surveying
- Civil engineering design, plans and specifications
- Construction engineering
- Water rights
- Computer-aided design and drafting (CADD)
- GIS mapping
- Stormwater management
- Geotechnical sampling
- 404 permits

TRANSPORTATION SERVICES

- Reconnaissance reports
- Surveys (right of way, ground control, construction)
- Bridge hydraulics, scour analysis, structure selection
- Design of urban streets, rural roadways and interstate reconstruction
- Streetscape enhancements
- Utility replacement
- Drainage design
- Bicycle/pedestrian pathways
- Parking facilities
- Construction administration

MINE SERVICES

- NEPA compliance documents
- Baseline studies (climatology, geology, hydrology, wetlands and AVF assessments)
- GPS and conventional surveying
- Drilling and monitoring services
- Mining and reclamation design and permitting
- Hydrologic control plans
- Reservoir and dam design
- Haulroads and stream crossings
- Annual reports and bond calculations
- Blast monitoring and reporting
- Assessment of probable hydrologic consequences
- Mine simulation modeling
- Postmine topography design
- Reclaimed stream channels, AVF reclamation and wetland mitigation design
- Abandoned mine land reclamation

ENVIRONMENTAL SERVICES

- Environmental compliance and best management practices
- Environmental impact analysis and regulatory permitting
- Environmental site assessments
- Geomorphologic investigations
- Hydrocarbon product recovery system design
- Hydrologic and water quality monitoring
- Hazardous and non-hazardous waste management planning
- Site remediation planning and design
- Soil and groundwater cleanup plans
- Underground storage tanks investigation and removal plans
- NEPA compliance documents
- Environmental audits
- Wetland delineation and mitigation

Other offices:

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6000 East 2nd Street, Suite 1004
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(406) 443-3962
Fax: (406) 449-0056

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Exhibit 6

Trout Creek

EXECUTIVE SUMMARY

CWCB STAFF INSTREAM FLOW RECOMMENDATION

UPPER TERMINUS:	confluence with an unnamed tributary at UTM North: 4457645.23 UTM East: 323578.92
LOWER TERMINUS:	Koll Ditch headgate UTM North: 4464276.41 UTM East: 329133.88
WATER DIVISION:	6
WATER DISTRICT:	57
COUNTY:	Routt
WATERSHED:	Upper Yampa
EXISTING ISF:	77W1338, 5 cfs (01/01 - 12/31)
CWCB ID:	19/6/A-009
RECOMMENDER:	Bureau of Land Management (BLM)
LENGTH:	6.64 miles
FLOW RECOMMENDATION:	2.0 cfs (11/01 - 03/31) 8.0 cfs (04/01 - 07/31) 7.0 cfs (08/01 - 10/31)

Trout Creek

Introduction

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

The BLM recommended that the CWCB appropriate an increase to the existing ISF water right on a reach of Trout Creek. Trout Creek is located within Routt County and originates in the Flat Tops Mountains at an elevation of approximately 11,250 ft. The stream flows north 43 miles to the confluence with the Yampa River at an elevation of approximately 6,500 ft (See Vicinity Map). The proposed reach extends from the confluence with an unnamed tributary downstream to the Koll Ditch headgate. The BLM manages 11 percent of the land on the 6.64 mile proposed reach, and 89 percent is privately owned (See Land Ownership Map). The current ISF water right does not provide sufficient physical habitat during the warm weather portions of the year when the fish populations are feeding, growing, and spawning. The proposed increase in flow rates during winter is warranted to make much of the physical habitat in the stream channel less susceptible to freezing.

The information contained in this report and the associated supporting data and analyses (located at http://cwcb.state.co.us/environment/instream-flow-program/Pages/2019ProposedISFRecommendations.aspx) form the basis for staff's ISF recommendation to be considered by the Board. This report provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury.

Natural Environment

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information is used to provide the Board with a basis for determining that a natural environment exists.

Trout Creek is a cold water, moderate gradient stream. The reach that is the subject of this recommendation flows through a valley that ranges from 1/8 to 1/2 mile in width. The upper part of the reach flows through agricultural lands used for livestock grazing, while the lower part of the reach flows through a confined canyon that is largely in natural condition. Substrate is generally from medium to large size, ranging from 4-inch cobbles to small boulders. Water quality is good for supporting salmonid fish species, but during July and August, temperatures can approach the maximum temperatures that trout can tolerate.

Fish surveys indicate a diverse and self-sustaining fish community. Trout Creek provides habitat for brook trout, brown trout, Colorado River cutthroat trout, mottled sculpin, speckled dace, and mountain sucker. Spot surveys have indicated abundant populations of stonefly and caddisfly.

Table 1. List of species identified in Trout Creek.

Species Name	Scientific Name	Status
brook trout	*Salvelinus fontinalis*	None
brown trout	*Salmo trutta*	None
Colorado River cutthroat trout	*Oncorhynchus clarkii pleuriticus*	State - Species of Special Concern Federal - Sensitive Species
mottled sculpin	*Cottus bairdii*	None
mountain sucker	*Catostomus platyrhynchus*	State - Species of Special Concern Federal - Sensitive Species
speckled dace	*Rhinichthys osculus*	None

ISF Quantification

CWCB staff relies upon the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

Methodology

BLM staff used the R2Cross methodology to develop the initial ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996). Riffles are most easily visualized as the stream habitat types that would dry up first should streamflow cease. The field data collected consists of streamflow measurements and surveys of channel geometry at a transect and of the longitudinal slope of the water surface.

The field data is used to model three hydraulic parameters: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic macro-invertebrates (Nehring, 1979). BLM staff interprets the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on meeting 3 of 3 hydraulic criteria. The winter flow recommendation is based on meeting 2 of 3 hydraulic criteria. The model’s suggested accuracy range is 40% to 250% of the streamflow measured in the field. Recommendations that fall outside of the accuracy range may not give an accurate estimate of the hydraulic parameters necessary to determine an ISF rate.

The R2Cross methodology provides the biological quantification of the amount of water needed for summer and winter periods based on empirical studies of fish species preferences. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree, or withdraws the recommendation.

Data Analysis

R2Cross data was collected at two transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a winter flow of 7.53 cfs, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model. The R2Cross model results in a summer flow of 13.04 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model.

Table 2. Summary of R2Cross transect measurements and results for Trout Creek.

Entity	Date	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
BLM	08/12/2017 #1	9.43	3.77 - 23.58	9.27	13.28
BLM	08/12/2017 #2	8.58	3.43 - 21.45	5.79	12.80
			Mean	7.53	13.04

ISF Recommendation

The BLM recommends the following flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

8.0 cubic feet per second increase is recommended during the snowmelt runoff period and early summer, from April 1 to July 31. This recommendation is driven by the average depth criteria. In many locations, the Trout Creek channel is wide with large substrate, so meeting the depth criteria is important for passage between rocks and between pools. Implementing this recommendation would increase the instream flow rate during this time period to a total of 13.0 cubic feet per second.

7.0 cubic feet per second increase is recommended during late summer and early fall, from August 1 to October 31. This recommendation is driven by limited water availability. This flow rate will maintain sufficient physical habitat in the creek for the fish population to complete important parts of their life cycle before cold temperatures reduce fish activity for the winter. Implementing this recommendation would increase the instream flow rate during this time period to a total of 12.0 cubic feet per second.

2.0 cubic feet per second increase is recommended during the cold temperature portion of the year, from November 1 through March 31. This recommendation is driven by limited water availability but comes very close to meeting the wetted perimeter criteria and the velocity criteria. This flow rate should prevent complete icing of the numerous pools in this reach, allowing the fish population to overwinter. Implementing this recommendation would increase the instream flow rate during this time period to a total of 7.0 cubic feet per second.

The BLM believes an instream flow increase for Trout Creek is warranted because of physical habitat characteristics. The R2Cross data summarized above clearly indicates that the current instream flow water right does not provide sufficient physical habitat during the warm weather portions of the year when the fish populations are feeding, growing, and spawning. When the existing instream flow rights are applied to the cross-sections that were collected, the stream would exhibit 40 percent to 66 percent wetted perimeter. However, this habitat is not highly usable by the fish population, because 5.0 cfs constrains the habitat to an average depth of 0.22 to 0.26 feet. An average habitat depth of 0.22 to 0.26 feet is not sufficient in a stream that averages 35 to 40 feet in top width. During the warm weather season, the fish populations need to have access to as much of the stream channel as possible for feeding, resting, and spawning if they are to survive the pronounced cold winters in this canyon. The increase in flow rates during winter is warranted because the average depths associated with 7.0 cfs make much of the physical habitat in the stream channel less susceptible to freezing.

Water Availability

CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

Methodology

Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc). Although extensive and time-consuming investigations of all variables may be possible, staff takes a pragmatic and cost-effective approach to analyzing water availability. This approach focuses on streamflows and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff’s hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

Basin Characteristics

The drainage basin of the proposed ISF on Trout Creek is 32.2 square miles, with an average elevation of 9,477 ft and average annual precipitation of 33.55 inches (See the Vicinity Map). There are a number of known surface water diversions in the drainage basin tributary to the proposed ISF on Trout Creek. These structures potentially divert approximately 105.5 cfs and include the Sheriff Reservoir (986 AF) and an additional 61 AF in other storage. The Alex Ditch (1.28 cfs, appropriation dates 1912 and 1948) is the only diversion structure located within the proposed reach. This water right is relatively small and has sporadic diversion records.

Available Data

There is not a current or historic daily streamflow gage on Trout Creek. However, the Edna Mine measured streamflow at a location near the proposed lower terminus from 1989 to 2009 (Edna Mine site identifier TR-a). These measurements were reported to the Department of Reclamation, Mining and Safety on an approximately monthly basis for April through October (Edna Mine, 2010).

The Koll Ditch (WDID 5700635, 13.22 cfs, appropriation dates 1894, 1903, and 1949) is the proposed lower terminus. This structure has diversion records between 1938 and 2017.

CWCB staff made two streamflow measurements on the proposed reach of Trout Creek as summarized in Table 3.

Table 3. Summary of Streamflow Measurement Visits and Results for Trout Creek.

Visit Date	Flow (cfs)	Collector
05/07/2018	64.58	CWCB
10/09/2018	9.59	CWCB

Data Analysis

The Edna Mine made 144 streamflow measurements between 1989 and 2009. These measurements were made at various times throughout the month, but typically on the first of the month from 1999 to 2009. All measurements for a given month were used to determine the median measured streamflow for that month.

The Koll Ditch is located near the proposed lower terminus, but does not sweep the stream (personal communication, Brian Romig, November 2018). Therefore, the diversion record is not a good proxy for the total amount of water available at that location. The diversions also typically start in late May and end by early September which limit information during runoff, late fall, and winter. Because of these limitations, the Koll Ditch was not used as a primary source of information about water availability.

Water Availability Summary

The hydrographs (See Complete and Detailed Hydrographs) show the median of monthly measured streamflow values from the Edna Mine data and mean-monthly streamflow from StreamStats. There is good agreement between the mean of the measured values and StreamStats values between April and October. However, StreamStats is generally higher, which is not unexpected given that StreamStats does not explicitly account for water diversions. During the winter, there is little water use in the Trout Creek basin and StreamStats provides an estimate of streamflow conditions. The proposed ISF rate is below the median monthly streamflow measurements from April through October and below the StreamStats mean-monthly flow from November through March. Staff concludes that water is available for appropriation on Trout Creek.

Material Injury

Because the proposed ISF on Trout Creek is a new junior water right, the ISF can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S. (2018), the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

Citations

Capesius, J.P. and V.C. Stephens, 2009, Regional regression equations for estimation of natural streamflow statistics in Colorado, Scientific Investigations Report 2009-5136.

Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

Nehring, B.R., 1979, Evaluation of Instream Flow Methods and Determination of Water Quantity Needs for Streams in the State of Colorado, Colorado Division of Wildlife.

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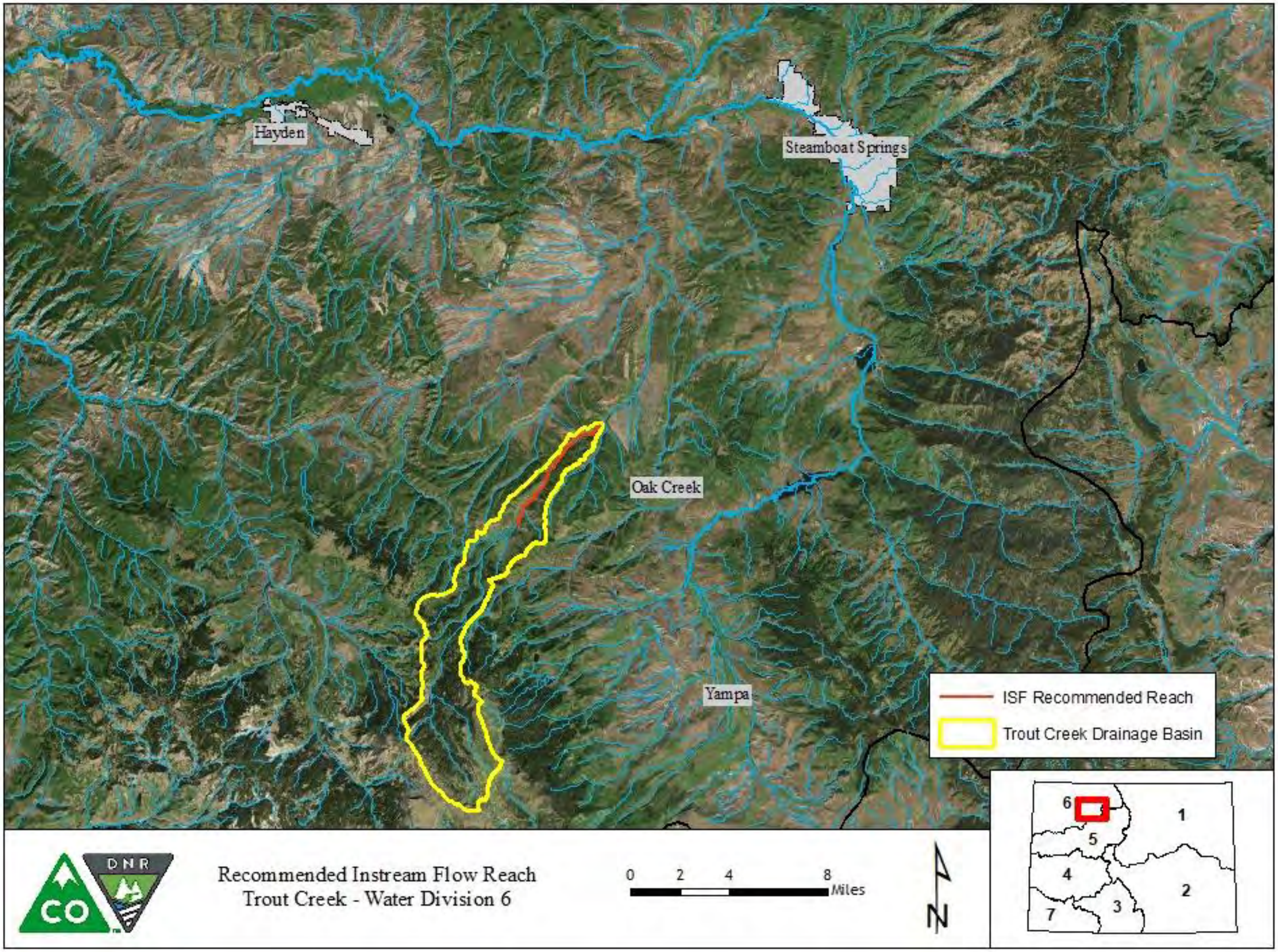
Metadata Descriptions

The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

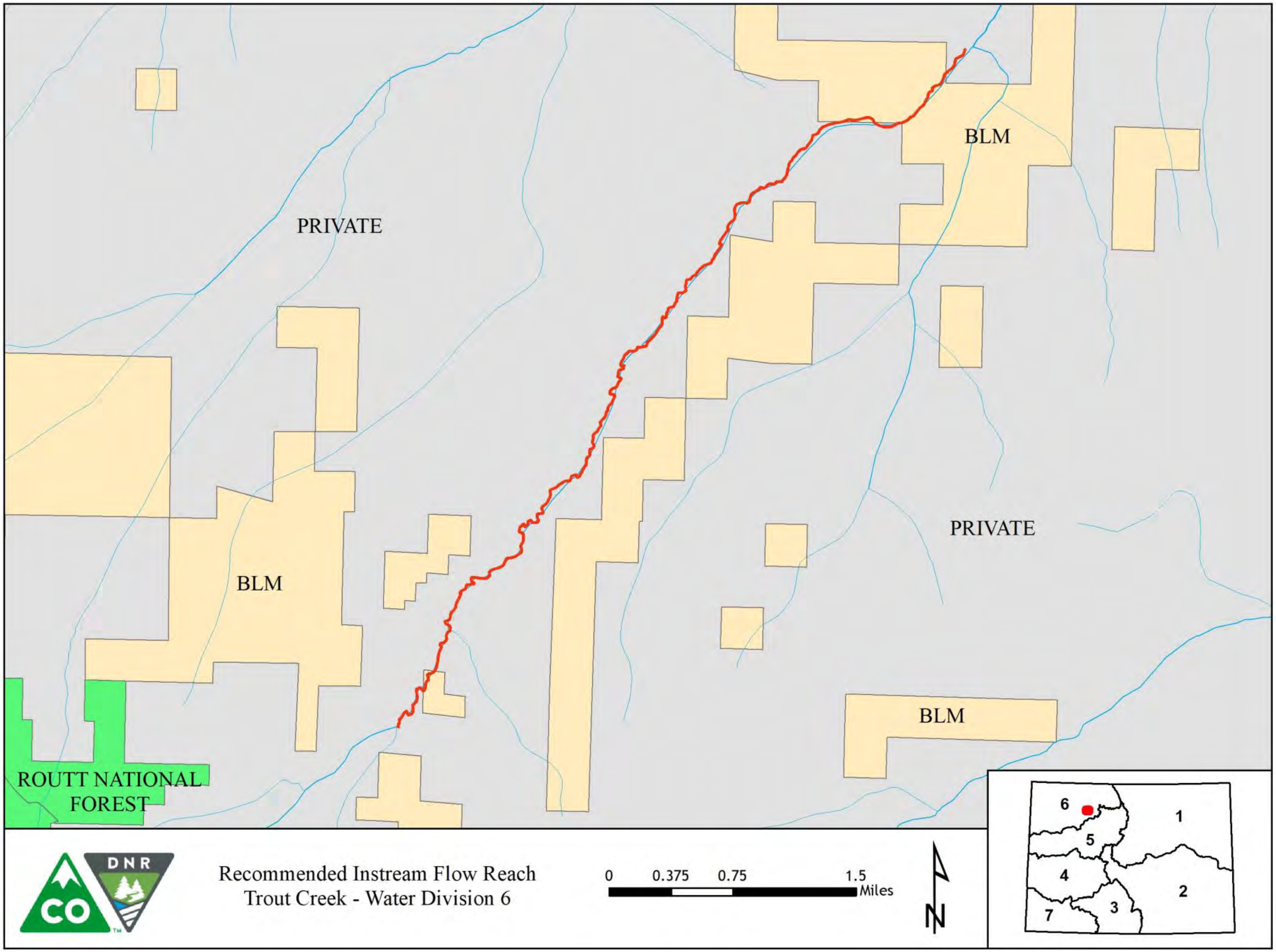
Projected Coordinate System: NAD 1983 UTM Zone 13N.

VICINITY MAP

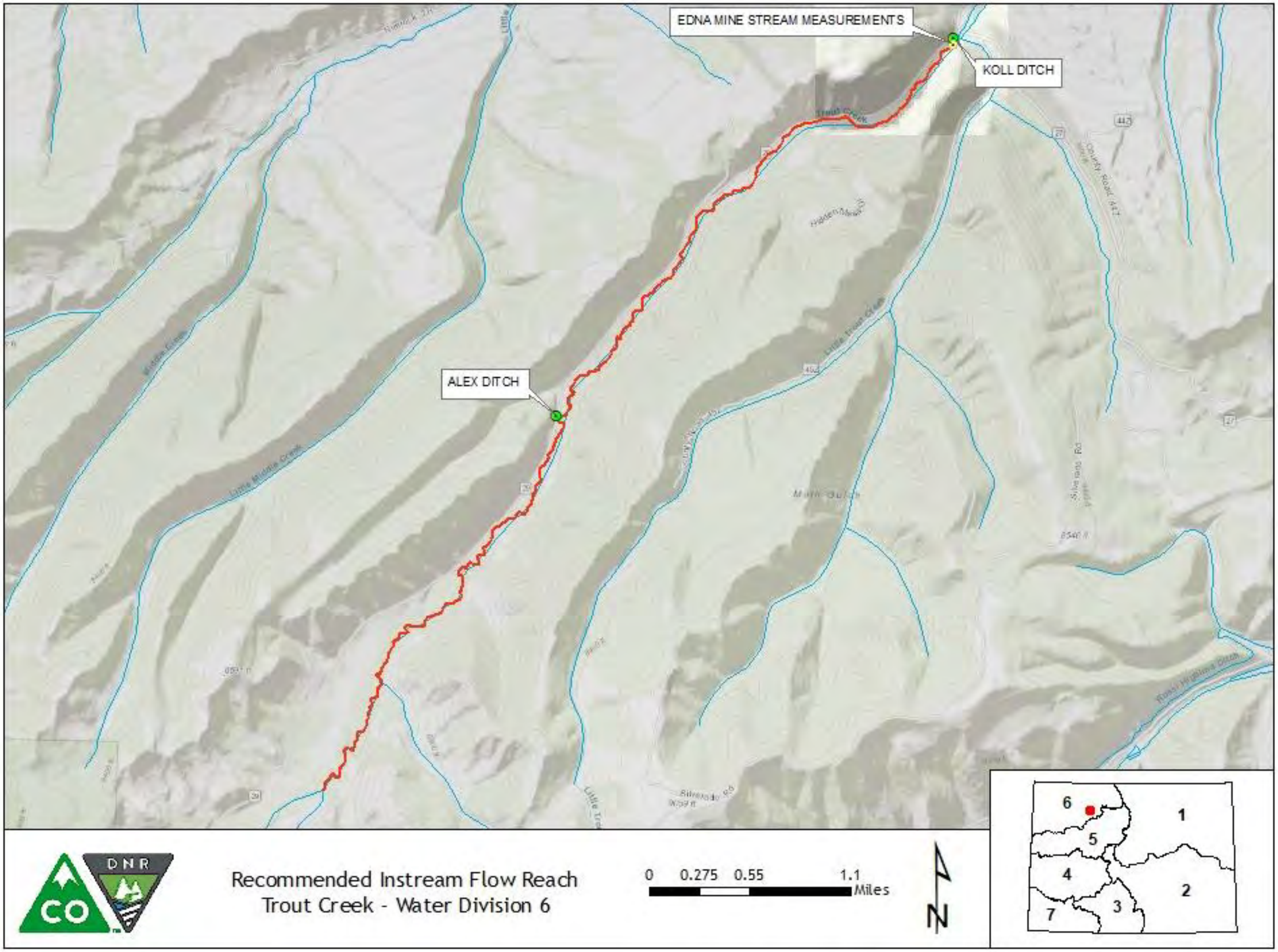


Recommended Instream Flow Reach
Trout Creek - Water Division 6

LAND OWNERSHIP MAP

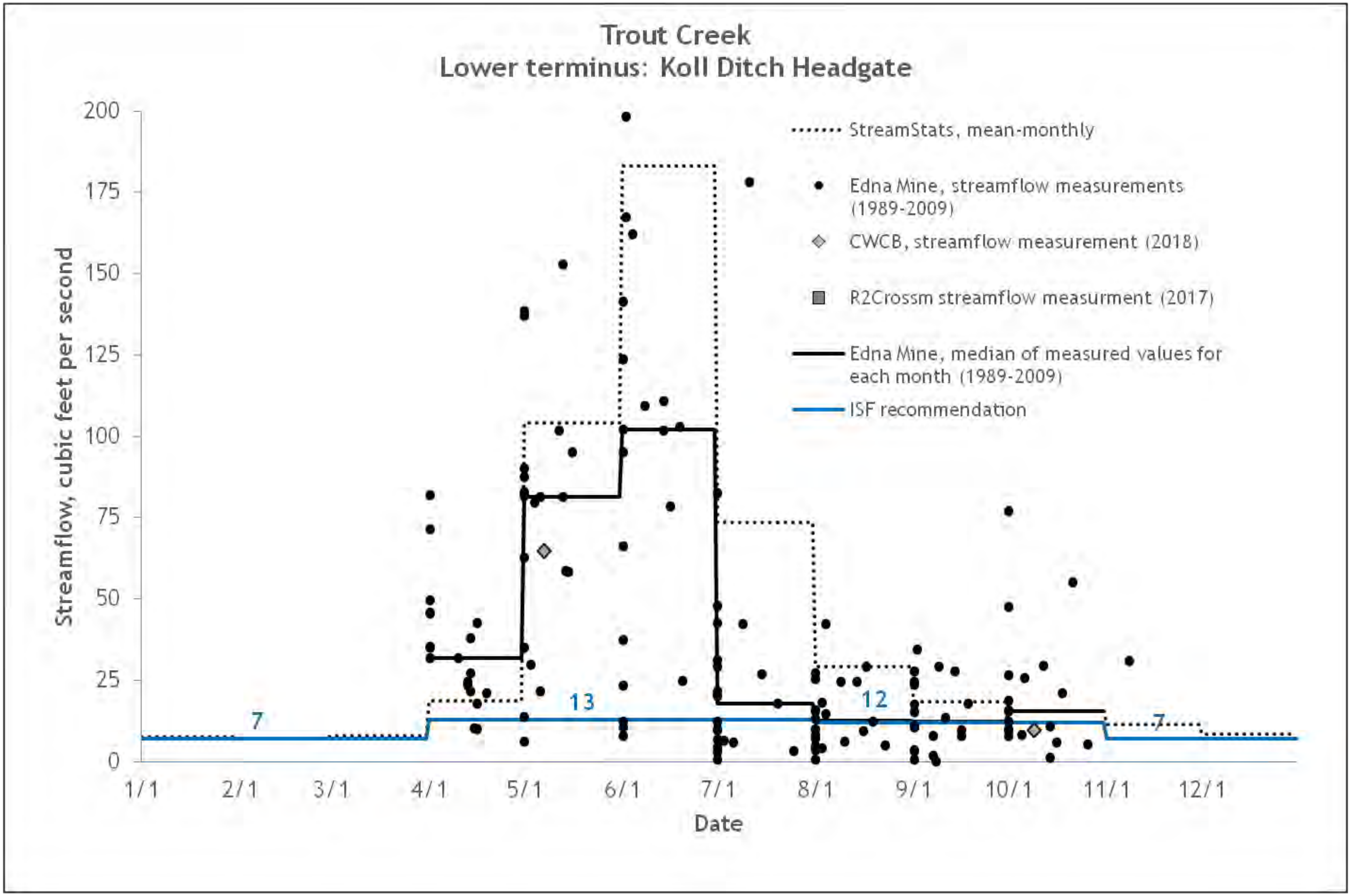


HYDROLOGIC FEATURES MAP



Recommended Instream Flow Reach
Trout Creek - Water Division 6

COMPLETE HYDROGRAPH



DETAILED HYDROGRAPH

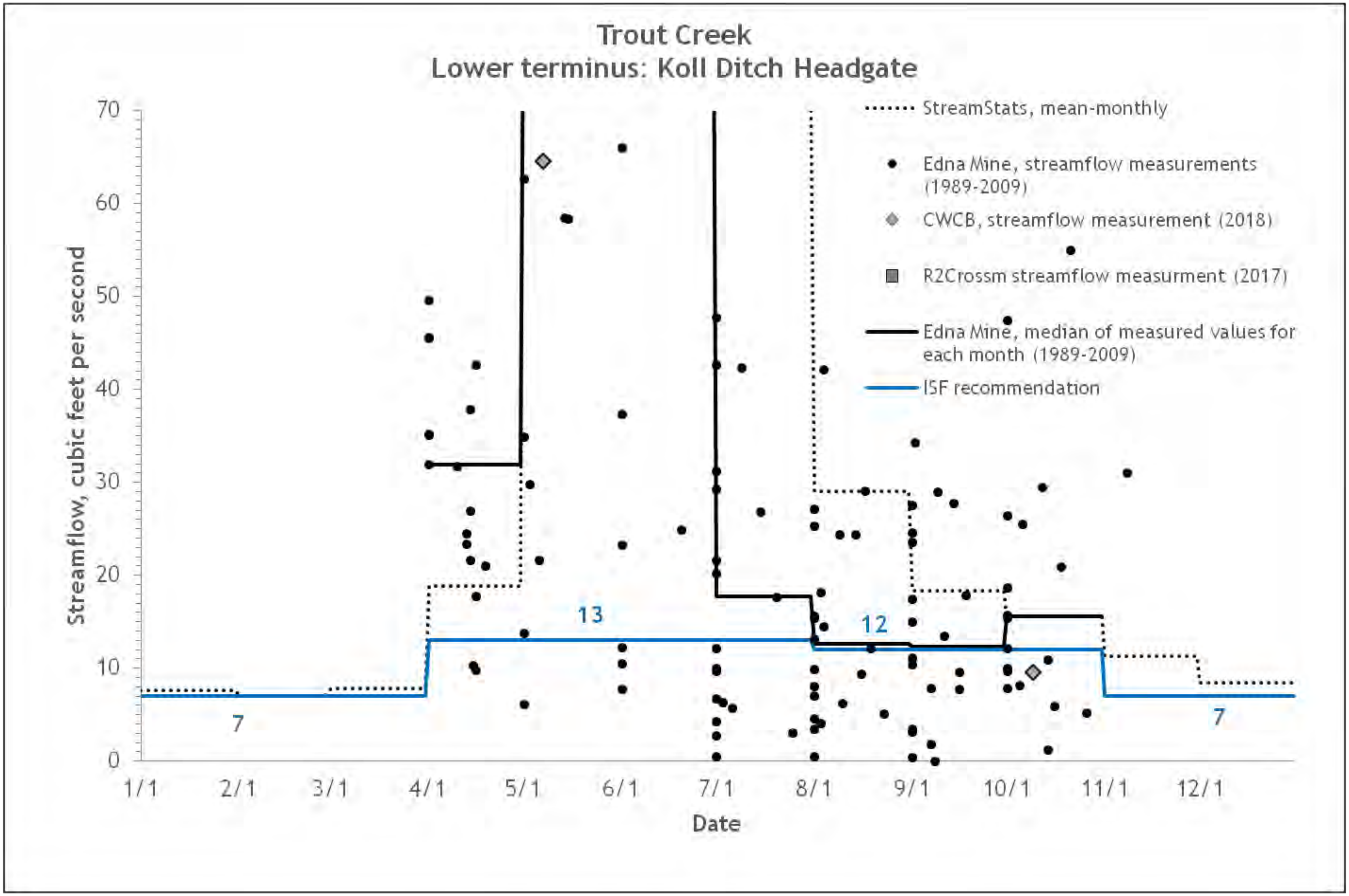


Exhibit 7

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

1313 Sherman Street
Denver, CO 80203

P (303) 866-3441
F (303) 866-4474

Jared Polis, Governor

Dan Gibbs, DNR Executive Director

Rebecca Mitchell, CWCB Director

TO: Colorado Water Conservation Board Members

FROM: Linda Bassi, Chief
Robert Viehl, Water Resource Specialist
Stream and Lake Protection Section

DATE: January 18, 2019

AGENDA ITEM: 22. Instream Flow Appropriations in Water Divisions 2, 3, 4, 6, and 7

Introduction

This memo provides an overview of the technical analyses performed by both the recommending entities and CWCB staff to provide the Board with sufficient information to declare its intent to appropriate instream flow (ISF) water rights in accordance with the Rules Concerning the Colorado Instream Flow and Natural Lake Level Program (ISF Rules). An executive summary for each stream recommendation has been provided to the Board separately, which includes the technical basis for each appropriation and appendices of the supporting scientific data.

Staff Recommendation

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

Background

Staff reviewed each proposed stream segment to ensure that for each ISF recommendation, the dataset is complete and proper methods and procedures were followed. In addition, staff conducted site visits and completed water availability analyses. Staff compiled sufficient information and performed the analyses necessary to provide a basis for the Board to declare its intent to appropriate water rights on these fifteen stream segments. These stream segments are located in Water Divisions; 2 (Fremont and Huerfano Counties), 3 (Saguache County), 4 (Gunnison and Saguache Counties), 6 (Garfield, Rio Blanco, and Routt Counties), and 7 (Dolores and San Miguel Counties).

Technical Investigations

Staff's executive summary and technical analysis of each stream form the basis for staff's recommendations. In addition to the reports, the scientific data and technical analyses performed by the recommending entity are accessible on the Board's website at:

http://cwcb.state.co.us/environment/instream-flow-program/Pages/2019ProposedISFRecommendations.aspx

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Natural Environment Studies

The Bureau of Land Management, Colorado Parks and Wildlife, and High Country Conservation Advocates conducted field surveys of the natural environment resources on these streams and found natural environments that can be preserved. To quantify the resources and to evaluate instream flow requirements, the recommending entities collected biologic and hydraulic data and performed R2CROSS modeling on all segments. CWCB staff reviewed all of the data used to support the recommendations, and worked with the recommending entities to develop final recommendations for the amount of water necessary to preserve the natural environment to a reasonable degree for each of the streams listed on the attached Tabulation of Instream Flow Recommendations.

Water Availability Studies

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

On some of the listed streams, CWCB staff suggested modifications to the R2Cross biological recommendation due to water availability limitations. For these streams, staff met with the recommending entities to review the water availability analyses and discuss whether the modified recommendation would preserve the natural environment to a reasonable degree. After reviewing staff's hydrology, the original R2Cross results, and evaluating the indicator species and other aspects of the natural environment, the recommending entities concluded that the proposed modified recommendations would preserve the natural environment to a reasonable degree on each stream segment.

Stakeholder Outreach

Staff provided public notice of the recommendations in both March and November of 2018 and met with the County Commissioners for each county where the stream segments are located. In addition, staff contacted water commissioners, local landowners, and others when possible to further discuss the recommendations.

Instream Flow Rule 5d.

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

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

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

Board shall direct the Staff to publicly notice the Board's declaration of its intent to appropriate.

(2) After the Board declares its intent to appropriate, notice shall be published in a mailing to the ISF Subscription Mailing Lists for the relevant water divisions and shall include:
  (a) A description of the appropriation (e.g. stream reach, flow amounts, etc.);
  (b) Availability (time and place) for review of Summary Reports and Investigations Files for each recommendation; and,
  (c) Summary identification of any data, exhibits, testimony or other information in addition to the Summary Reports and Investigations Files supporting the appropriation.

(3) Published notice shall also contain the following information:
  (a) The Board may change flow amounts of contested ISF appropriations based on information received during the public notice and comment period.
  (b) Staff will maintain, pursuant to Rule 5e.(3), an ISF Subscription Mailing List for each water division composed of the names of all persons who have sent notice to the Board Office that they wish to be included on such list for a particular water division. Any person desiring to be on the ISF Subscription Mailing List(s) must send notice to the Board Office.
  (c) Any meetings held between Staff and members of the public will be open to the public. Staff may provide Proper Notice prior to any such meetings and may provide notice to persons on the ISF Subscription Mailing List(s).
  (d) Any Notice to Contest must be received at the Board office no later than March 31st, or the first business day thereafter. All Notices of Party status and Contested Hearing Participant status must be received at the Board office no later than April 30th, or the first business day thereafter.
  (e) Staff will announce its Final Staff ISF Recommendation concerning contested appropriations at the September Board meeting and will send notice of the Final Staff Recommendation to all persons on the Contested Hearing Mailing List.
  (f) The Board may take final action on any uncontested ISF appropriations at the May Board meeting.

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

(5) Final action by the Board on ISF appropriations will occur no earlier than the May Board Meeting.

Attachments

Colorado Water Conservation Board
Instream Flow Tabulation - Streams
Water Division 2

Water Court Div.	Case Number	Stream	Watershed	County	Upper Terminus (UTM)	Lower Terminus (UTM)	Length (miles)	Amount(dates) (CFS)	Approp Date
2		Baker Creek	Huerfano	Huerfano	headwaters in the vicinity of E: 485496.58 N: 4134666.58	Forest Service boundary at E: 488637.74 N: 4133589.16	2.13	2.1 (05/01 - 06/30) 1.3 (07/01 - 08/31) 0.5 (09/01 - 03/31) 1 (04/01 - 04/30)	
2		Bonnett Creek	Huerfano	Huerfano	headwaters in the vicinity of E: 486695.74 N: 4138962.59	confl Cucharas River at E: 491728.78 N: 4137528.63	4.05	0.4 (09/01 - 03/31) 1 (04/01 - 06/30) 0.55 (07/01 - 08/31)	
2		Stout Creek	Arkansas Headwaters	Fremont	BLM/USFS Property Boundary at E: 425206.65 N: 4248489.60	confl unnamed tributary at E: 426072.66 N: 4248935.65	0.62	3.5 (05/01 - 06/30) 1.5 (07/01 - 08/31) 0.6 (09/01 - 04/30)	

Totals for Water Division 2

Total # Appropriations = 3
Total # Appropriation Stream Miles = 6.8

Instream Flow Tabulation - Water Division 3

Water Court Div.	Case Number	Stream	Watershed	County	Upper Terminus (UTM)	Lower Terminus (UTM)	Length (miles)	Amount(dates) (CFS)	Approp Date
3		Carnero Creek	Saguache	Saguache	confl SF & MF Carnero Creeks at E: 377513.93 N: 4196212.69	confl Mogotas Arroyo at E: 387851.17 N: 4190411.28	9.81	2.2 (12/01 - 02/29) 2.6 (03/01 - 11/30)	

Totals for Water Division 3

Total # Appropriations = 1
Total # Appropriation Stream Miles = 9.8

Instream Flow Tabulation - Water Division 4

Water Court Div.	Case Number	Stream	Watershed	County	Upper Terminus (UTM)	Lower Terminus (UTM)	Length (miles)	Amount(dates) (CFS)	Approp Date
4		Cold Spring Creek	Tomichi	Saguache	Amalla Spring at E: 343427.98 N: 4223358.35	confl Pauline Creek at E: 345270.75 N: 4223387.43	1.23	0.25 (07/01 - 04/30) 0.4 (05/01 - 06/30)	
4		East Fork Little Cimarron River	Upper Gunnison	Gunnison	headwaters in the vicinity of E: 287899.31 N: 4233197.29	confl Little Cimarron River ar E: 284446.65 N: 4241814.80	6.45	1 (01/01 - 04/30) 2.8 (05/01 - 06/30) 1.2 (07/01 - 12/31)	
4	(increase)	Gold Creek	Tomichi	Gunnison	headwaters in the vicinity of E: 363395.53 N: 4284386.51	Tarkington Ditch hdgt at E: 359675.26 N: 4270404.77	10.32	4 (04/15 - 07/10)	

Totals for Water Division 4

Total # Appropriations = 3
Total # Appropriation Stream Miles = 18

Instream Flow Tabulation - Water Division 6

Water Court Div.	Case Number	Stream	Watershed	County	Upper Terminus (UTM)	Lower Terminus (UTM)	Length (miles)	Amount(dates) (CFS)	Approp Date
6		Marvine Creek	Upper White	Rio Blanco	outlet of Lower Marvine Lake at E: 296243.96 N: 4424055.13	confl West Marvine Creek at E: 291464.01 N: 4432955.16	7.1	5.9 (11/01 - 03/31) 13.1 (04/01 - 10/31)	
6		North Fork White River	Upper White	Garfield	outlet of Trappers Lake at E: 309550.88 N: 4429787.37	confl Skinny Fish Creek at E: 308777.90 N: 4431907.38	1.52	2 (11/01 - 03/31) 3.5 (04/01 - 10/31)	
6		North Fork White River	Upper White	Garfield	confl Skinny Fish Creek at E: 308777.90 N: 4431907.38	confl Big Fish Creek at E: 305702.92 N: 4433402.35	2.47	7.8 (11/01 - 04/30) 34 (05/01 - 10/31)	
6		North Fork White River	Upper White	Garfield Rio Blanco	confl Big Fish Creek at E: 305702.92 N: 4433402.35	confl Ripple Creek at E: 300814.97 N: 4437555.31	4.38	23 (11/16 - 05/10) 74 (05/11 - 09/15) 60 (09/16 - 11/15)	
6	(increase)	Trout Creek	Upper Yampa	Routt	confl unnamed tributary at E: 323578.92 N: 4457645.23	Koll Ditch hdgt at E: 329133.88 N: 4464276.41	6.64	2 (11/01 - 03/31) 8 (04/01 - 07/31) 7 (08/01 - 10/31)	
6		West Marvine Creek	Upper White	Rio Blanco	headwaters in the vicinity of E: 295929.96 N: 4422407.10	West Marvine Ditch hdgt at E: 291578.55 N: 4432396.94	9.08	2.9 (11/01 - 03/31) 4.6 (04/01 - 10/31)	

Totals for Water Division 6

Total # Appropriations = 6
Total # Appropriation Stream Miles = 31.2

Instream Flow Tabulation - Water Division 7

Water Court Div.	Case Number	Stream	Watershed	County	Upper Terminus (UTM)	Lower Terminus (UTM)	Length (miles)	Amount(dates) (CFS)	Approp Date
7		Disappointment Creek	Upper Dolores	Dolores	confl Morrison Creek at E: 202844.92 N: 4194988.94	historic USGS gage at E: 184833.22 N: 4198182.88	21.71	1.8 (01/01 - 01/31) 2.6 (02/01 - 03/15) 14 (03/16 - 06/30) 8 (07/01 - 07/15) 5.8 (07/16 - 07/31) 2.2 (08/01 - 12/31)	
7		Disappointment Creek	Upper Dolores	Dolores San Miguel	historic USGS gage at E: 184833.22 N: 4198182.88	confl Dolores River at E: 162893.62 N: 4214275.33	37.8	5 (03/01 - 03/15) 9.8 (03/16 - 06/15) 5 (06/16 - 06/30)	

Totals for Water Division 7

Total # Appropriations = 2
Total # Appropriation Stream Miles = 59.5

Totals Divisions: 2,3,4,6, & 7

Total # Appropriations = 15
Total # Appropriation Stream Miles = 125.3

Exhibit 8

COLORADO
Colorado Water
Conservation Board
Department of Natural Resources

1313 Sherman Street, Room 718, Denver, Colorado 80203
Phone: (303) 866-3441 * Fax: (303) 866-4474
www.cwcb.state.co.us

NOTICE

To: Instream Flow Subscription Mailing Lists

Subject: Proposed 2019 Instream Flow Appropriations in Water Divisions 2, 3, 4, 6, and 7

Date: February 4, 2019

At its January 28-29, 2019 regular meeting, the Colorado Water Conservation Board (CWCB) declared its intent to appropriate instream flow (ISF) water rights on fifteen stream segments. The attached ISF table provides the water division, stream name, watershed, county, length, upper terminus, lower terminus, and flow rates for all of these stream segments. Copies of the Instream Flow Recommendations and Appendices of data submitted into the Official CWCB Record are available for review by the public during regular business hours (8:00 a.m. - 5:00 p.m.) at the Colorado Water Conservation Board's Office, located at 1313 Sherman Street, Room 718, Denver, Colorado, 80203. In addition to the CWCB office, copies of the Instream Flow Recommendations are available online at:

http://cwcb.state.co.us/environment/instream-flow-program/Pages/2019ProposedISFRecommendations.aspx

In addition to the above Instream Flow Recommendation Summary Reports and Appendices, staff may rely on any additional data, exhibits, testimony, or other information submitted by any party as part of the Official CWCB Record to support its Instream Flow Recommendations. Pursuant to Rule 5d.(3) of the Rules Concerning the Colorado Instream Flow and Natural Lake Level Program adopted by the Colorado Water Conservation Board, it should also be noted that:

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

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

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

(d) Any Notice to Contest must be received at the Board office no later than April 1, 2019. All Notices of Party status and Contested Hearing Participant status must be received at the Board office no later than April 30, 2019.

(e) Staff will announce its Final Staff Instream Flow Recommendation concerning contested appropriations at the September 2019 Board meeting and, prior to that meeting, will send notice of the Final Staff Recommendation to all persons on the Contested Hearing Mailing List.

(f) The Board may take final action on any uncontested ISF appropriations at the May 2019 Board meeting.

A notice to contest an ISF appropriation must be made in writing and contain the following information: (a) identification of the Person(s) requesting the hearing; (b) identification of the ISF at issue; and (c) the contested facts and a general description of the data upon which the Person will rely to the extent known at that time.

Note that section 37-92-102 (3) (b), C.R.S. (2018) provides: “Any such appropriation shall be subject to the present uses or exchanges of water being made by other water users pursuant to appropriation or practices in existence on the date of such appropriation, whether or not previously confirmed by court order or decree.”

Should you wish to comment on the proposed ISF Recommendations or request more information on the applicability of section 37-92-102(3)(b) to present uses of water in or above the proposed instream flow segments, you may do so by writing Rob Viehl of the Board's staff at the address given above or via email to rob.viehl@state.co.us. It should be noted that while your appearance at any meeting is welcome, such an appearance is not necessary for your concerns to be recognized. Staff will take your comments into account and, if you so request, will present them to the Board in your absence. If you are not currently on the Board's Instream Flow Subscription Mailing List and you would like to be, please contact the Board's Office at the address given above.

Instream Flow Recommendations

Div	Stream	Watershed	County	Length (miles)	Upper Terminus	Lower Terminus	Flow (CFS) & Timing
2	Baker Creek	Huerfano	Huerfano	2.13	headwaters	USFS property boundary	2.1 (05/01 - 06/30) 1.3 (07/01 - 08/31) 0.5 (09/01 - 03/31) 1.0 (04/01 - 04/30)
2	Bonnett Creek	Huerfano	Huerfano	4.05	headwaters	confluence Cucharas River	0.4 (09/01 - 03/31) 1.0 (04/01 - 06/30) 0.55 (07/01 - 08/31)
2	Stout Creek	Arkansas Headwaters	Fremont	0.62	BLM/USFS property boundary	confluence unnamed tributary	3.5 (05/01 - 06/30) 1.5 (07/01 - 08/31) 0.6 (09/01 - 04/30)
3	Carnero Creek	Saguache	Saguache	9.81	confluence SF & MF Carnero Creeks	confluence Mogotas Arroyo	2.2 (12/01 - 02/29) 2.6 (03/01 - 11/30)
4	Cold Spring Creek	Tomichi	Saguache	1.23	Amalla Spring	confluence Pauline Creek	0.25 (07/01 - 04/30) 0.4 (05/01 - 06/30)
4	East Fork Little Cimarron River	Upper Gunnison	Gunnison	6.45	headwaters	confluence Little Cimarron River	1.0 (01/01 - 04/30) 2.8 (05/01 - 06/30) 1.2 (07/01 - 12/31)
4	Gold Creek *(Increase)*	Tomichi	Gunnison	10.32	headwaters	Tarkington Ditch headgate	4.0 (04/15 - 07/10)
6	Marvine Creek	Upper White	Rio Blanco	7.10	outlet of Lower Marvine Lake	confluence West Marvine Creek	5.9 (11/01 - 03/31) 13.1 (04/01 - 10/31)
6	West Marvine Creek	Upper White	Rio Blanco	9.08	headwaters	West Marvine Ditch headgate	2.9 (11/01 - 03/31) 4.6 (04/01 - 10/31)
6	Trout Creek *(Increase)*	Upper Yampa	Routt	6.64	confluence unnamed tributary	Koll Ditch headgate	2.0 (11/01 - 03/31) 8.0 (04/01 - 07/31) 7.0 (08/01 - 10/31)
6	North Fork White River	Upper White	Garfield	1.52	outlet of Trappers Lake	confluence Skinny Fish Creek	2.0 (11/01 - 03/31) 3.5 (04/01 - 10/31)
6	North Fork White River	Upper White	Garfield	2.47	confluence Skinny Fish Creek	confluence Big Fish Creek	7.8 (11/01 - 04/30) 34 (05/01 - 10/31)
6	North Fork White River	Upper White	Garfield Rio Blanco	4.38	confluence Big Fish Creek	confluence Ripple Creek	23 (11/16 - 05/10) 74 (05/11 - 09/15) 60 (09/16 - 11/15)
7	Disappointment Creek*	Upper Dolores	Dolores	21.7	confluence Morrison Creek	historic USGS gage	1.8 (01/01 - 01/31) 2.6 (02/01 - 03/15) 14 (03/16 - 06/30)

							8.0 (07/01 - 07/15) 5.8 (07/16 - 07/31) 2.2 (08/01 - 12/31)
7	Disappointment Creek*	Upper Dolores	Dolores San Miguel	37.8	historic USGS gage	confluence Dolores River	5.0 (03/01 - 03/15) 9.8 (03/16 - 06/15) 5.0 (06/16 - 06/30)

*Note: If the CWCB takes final action on the two Disappointment Creek ISF segments, applications in water court will not be filed until December 2019.

Exhibit 9

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Phone: (303) 866-3441 * Fax: (303) 866-4474
www.cwcb.state.co.us

Public Notice

To: All Interested Parties

Subject: Notice of Contested 2019 ISF Appropriations

Date: April 4, 2019

As required by Rule 5k.(4) of the Rules Concerning The Colorado Instream Flow (ISF) and Natural Lake Level (NLL) Program, the Colorado Water Conservation Board hereby provides the subscribers to the ISF Subscription Mailing List with notice of contested ISF appropriations. The contested ISF appropriations are listed below:

Water Division	Stream Segment	County
3	Carnero Creek *(Confluence of South Fork and Middle Fork Carnero Creeks to confluence Mogotas Arroyo)*	Saguache
6	Trout Creek *(Increase)* *(Confluence with Unnamed Tributary to Koll Ditch Headgate)*	Routt
7	Disappointment Creek *(Confluence with Morrison Creek to Historic USGS Gage)*	Dolores
7	Disappointment Creek *(Historic USGS Gage to Confluence with Dolores River)*	Dolores, San Miguel

For more detailed information regarding these ISF appropriations and a copy of the Notices to Contest, please go to CWCB's website at:

http://cwcb.state.co.us/environment/instream-flow-program/Pages/2019ContestedISFAppropriations.aspx

The Rules Concerning the Colorado ISF and NLL Program state the following with regard to Contested ISF Appropriations:

Party status will be granted to any person who timely files a Notice of Party Status with the Staff. Any person filing a Notice to Contest shall be granted Party status and need not also file a Notice of Party Status. **A Notice of Party status must be received by April 30th.** A Notice of Party status shall set forth a brief and plain statement of the reasons for obtaining Party status, the contested facts, the matters that the person claims should be decided and a general description of the data to be presented to the Board. The Board will have discretion to grant or deny Party status to any person who files a Notice of Party Status after April 30th, for good cause shown.

Only a Party may submit for the record technical evidence, technical witnesses or file legal memoranda. Each Party is responsible for mailing copies of all documents submitted for Board consideration to all other Parties and Contested Hearing Participants.

Any person who desires to participate in the process, but not as a Party, may obtain Contested Hearing Participant status by filing a notice thereof at the Board Office prior to April 30th. A person with such status will receive all Party documents specific to the contested appropriation. Contested Hearing Participants may comment on their own behalf, but may not submit for the record technical evidence, technical witnesses or legal memoranda. The Board will have discretion to grant or deny Contested Hearing Participant status to any person who filed a Notice of Contested Hearing Participant Status after April 30th, for good cause shown.

The request for Contested Hearing Participant status must be received by April 30th.

Staff shall notify all Parties and Contested Hearing Participants of the list of Contested Hearing Participants prior to May 31st. Thereafter, Parties shall also mail their prehearing statements and any other documents to Contested Hearing Participants.

A copy of the Rules Concerning the Colorado ISF and NLL Program is available on the CWCB website at:

http://cwcb.state.co.us/legal/Documents/Rules/Final%20Adopted%20ISF%20Rules%201-27-2009.pdf

We encourage you to share the information provided in this notice with any groups or individuals whom you feel would have an interest in the State of Colorado's Instream Flow Program.

Hard copies of notices for Party and Contested Hearing Participant status should be sent to the CWCB's office at 1313 Sherman Street, Room 718, Denver, Colorado 80203 and electronic submissions to rob.viehl@state.co.us. If you have any additional questions regarding this notice, please contact Rob Viehl.

Exhibit 10

RULES
CONCERNING THE COLORADO INSTREAM FLOW AND NATURAL LAKE LEVEL PROGRAM

Adopted by the
Colorado Water Conservation Board
January 27, 2009

Statement of Basis and Purpose

In 1973, the General Assembly enacted Senate Bill 97, creating the Colorado Instream Flow and Natural Lake Level Program ("ISF Program"), to be administered by the Colorado Water Conservation Board ("Board"). The statutory authority for these Rules is found at sections 37-60-108 and 37-92-102(3), C.R.S. (2008). The purpose of these Rules, initially adopted in 1993, is to codify and establish procedures for the Board to implement the ISF Program.

The Board has amended the Rules several times since 1993 to reflect changes in the statutes related to the ISF Program. Notably, in 1999, the Board repealed the existing Rule 5 in its entirety, and, among other things, adopted a new Rule 5 to establish a public notice and comment process for instream flow water right appropriations. In 2003, the Board amended Rule 6 to implement the provisions of Senate Bill 02-156 by identifying factors that the Board will consider when determining whether to acquire water, water rights, or interests in water, and by establishing procedures for notice, public input, and, if necessary, hearings. In 2004, the Board amended Rule 6 to implement House Bill 03-1320, codified at section 37-83-105, C.R.S. (2003), to allow for emergency loans of water for instream flows. The Board also amended Rule 6 to enable the Board to finalize an acquisition within a two-meeting time frame, if necessary. In 2005, the Board amended Rule 6 to implement House Bill 05-1039, establishing how the Board and its staff will respond to offers of water for temporary instream flow use and expedite use of loaned water for instream flow purposes.

In 2009, the Board amended Rule 6 to adopt criteria specified in House Bill 08-1280 (codified at sections 37-92-102(3), 37-92-103 and 37-92-305, C.R.S.) for evaluating proposed leases or loans of water, and to incorporate H.B. 1280's requirements for: (1) specific conditions that must be met as part of the CWCB's approval of a proposed loan or lease of water; (2) provisions that must be included in all agreements for loans or leases of water under section 37-92-102(3); and (3) actions that the Board must take in connection with loans or leases of water. Rule 6 does not incorporate those provisions of H.B. 1280 that direct the water courts or the Division of Water Resources to take certain actions in regard to water acquisitions by the Board for instream flow use.

Specifically, the 2009 Rules 6a., 6c., 6e, 6j., 6k., 6l., and 6m. clarify the Board's evaluation process, Board funding for water leases and purchases, and public input for proposed acquisitions of water, water rights or interests in water for instream flow use. Rule 6f. identifies additional factors for loans and leases of water, and Rules 6g. and 6h. describe recording requirements and water reuse provisions to be included in contracts or agreements for water acquisitions. Rule 6i. incorporates H.B 1280's requirements regarding water court applications filed by the Board to obtain a decreed right to use acquired water for instream flow purposes. Regarding the historical consumptive use quantification referred to in Rule 6i.(1), the Board will not object to a water rights owner requesting a term and condition from the water court that the historical consumptive use determination shall not apply to the water right at the expiration of the lease or loan.

In 2009, the Board also amended Rules 8e.—h. (De Minimis Rule) to recognize priority administration of the CWCB's instream flow water rights and clarify that the decision not to file a statement of opposition under this Rule does not constitute: (1) acceptance by the CWCB of injury to any potentially affected instream flow water right; or (2) a waiver of the CWCB's right to place an administrative call for any instream flow water right. Rule 8e.(1) sets forth what type of notice the CWCB will provide to water court applicants and to the Division Engineer when it elects not to file a statement of opposition to a water court application under this Rule.

Finally, in 2009, the Board amended Rule 8i.(3) (Injury Accepted with Mitigation) to provide notice to water users of: (1) the information they must submit to the CWCB when requesting that the CWCB enter into a pretrial resolution under which it will accept injury with mitigation; (2) the factors the CWCB will consider in evaluating an injury with mitigation proposal; and (3) the terms and conditions the CWCB will require in decrees incorporating injury with mitigation.

In general, it is the policy of the CWCB to consider injury with mitigation proposals only when no other reasonable water supply alternatives can be implemented. Exceptions to the policy may be granted when the proponent can demonstrate that the proposed mitigation will result in significant and permanent enhancements to the natural environment of the subject stream or lake existing at the time the proponent proposes the injury with mitigation.

DEPARTMENT OF NATURAL RESOURCES

Colorado Water Conservation Board

RULES CONCERNING THE COLORADO INSTREAM FLOW AND NATURAL LAKE LEVEL PROGRAM

2 CCR 408-2

1. TITLE.

Rules Concerning the Colorado Instream Flow and Natural Lake Level Program, hereafter referred to as the Instream Flow (“ISF”) Program as established in §37-92-102 (3) C.R.S., shall be hereinafter referred to as the “ISF Rules.”

2. PURPOSE OF RULES.

The purpose of the ISF Rules is to set forth the procedures to be followed by the Board and Staff when implementing and administering the ISF Program. By this reference, the Board incorporates the Basis and Purpose statement prepared and adopted at the time of rulemaking. A copy of this document is on file at the Board office.

3. STATUTORY AUTHORITY.

The statutory authority for the ISF Rules is found at §37-60-108, C.R.S. and §37-92-102 (3), C.R.S. Nothing in these rules shall be construed as authorizing the Board to deprive the people of the state of Colorado of the beneficial use of those waters available by law and interstate compact.

4. DEFINITIONS.

4a. Agenda Mailing List.

The agenda mailing list consists of all Persons who have sent a notice to the Board Office that they wish to be included on such list. These Persons will be mailed a Board meeting agenda prior to each scheduled Board meeting.

4b. Board.

Means the Colorado Water Conservation Board as defined in §§37-60-101, 103 and 104, C.R.S.

4c. Board Office.

The Colorado Water Conservation Board's office is located at 1313 Sherman Street, 7th Floor, Denver, CO 80203. The phone number is (303) 866-3441. The facsimile number is (303) 866-4474. The Board's website is http://www.cwcb.state.co.us.

4d. Contested Hearing Mailing List.

The Contested Hearing Mailing List shall consist of all Persons who have received Party status or Contested Hearing Participant status pursuant to Rules 5l. or 5m. This mailing list is specific to a contested appropriation.

4e. Contested Hearing Participant.

Any Person who desires to participate in the contested ISF process, but not as a Party, may obtain Contested Hearing Participant status pursuant to Rule 5m. A Person with such status will receive all Party documents. Contested Hearing Participants may comment on their own behalf, but may not submit for the record technical evidence, technical witnesses or legal memoranda.

4f. CWCB Hearing Officer.

The Hearing Officer is appointed by the Board and is responsible for managing and coordinating proceedings related to contested ISF appropriations, acquisitions or modifications, such as setting prehearing conferences and adjusting deadlines and schedules to further the Parties' settlement efforts or for other good cause shown. The Hearing Officer does not have the authority to rule on substantive issues.

4g. Final Action.

For purposes of Rule 5, final action means a Board decision to (1) file a water right application, (2) not file a water right application or (3) table action on an ISF appropriation; however, tabling an action shall not be construed as abandonment of its intent to appropriate.

4h. Final Staff ISF Recommendation.

Staff's ISF recommendation to the Board is based on Staff's data and report, and public comments and data contained in the official record.

4i. ISF.

Means any water, or water rights appropriated by the Board for preservation of the natural environment to a reasonable degree, or any water, water rights or interests in water acquired by the Board for preservation or improvement of the natural environment to a reasonable degree. “ISF” includes both instream flows between specific points on a stream and natural surface water levels or volumes for natural lakes.

4j. ISF Subscription Mailing List(s).

The ISF Subscription Mailing List(s) are specific to each water division. The ISF Subscription Mailing List(s) shall consist of all Persons who have subscribed to the list(s) by sending notice(s) to the Board Office that they wish to be included on such list for a particular water division. The Staff shall, at such times as it deems appropriate, mail to all Persons on the water court resume mailing list in each water division an invitation to be included on the ISF Subscription Mailing List for that water division. Persons on the list are responsible for keeping Staff apprised of address changes. Persons on the ISF Subscription Mailing List(s) shall receive agendas and other notices describing activities related to ISF recommendations, appropriations and acquisitions in the particular water division. Persons may be required to pay a fee in order to be on the ISF Subscription Mailing List(s).

4k. Mail.

For the purposes of the ISF Rules, mail refers to regular or special delivery by the U.S. Postal Service or other such services, electronic delivery (e-mail), or delivery by FAX transmission.

4l. Party.

Any Person may obtain Party status pursuant to Rule 5l. Only a Person who has obtained Party status may submit, for the record, technical evidence, technical witnesses or legal memoranda. Each Party is responsible for mailing copies of all documents to all other Parties and Contested Hearing Participants.

4m. Person.

Means any human being, partnership, association, corporation, special district, water conservancy district, water conservation district, municipal entity, county government, state government or agency thereof, and federal government or agency thereof.

4n. Proper Notice.

Means the customary public notice procedure that is provided each year by the Board in the preamble to the Board's January Board meeting agenda. This customary public notice procedure may include posting of the agenda at the Board office, filing legal notices when required, mailing to Persons on the Board mailing lists and posting notices on the Board's website.

4o. Stacking.

As used in Rule 6, the terms “stack” or “stacking” refer to an instance in which the Board holds more than one water right for the same lake or reach of stream and exercises the rights independently according to their decrees.

4p. Staff.

Means the Director of the Colorado Water Conservation Board (“CWCB Director”) and other personnel employed by the Board.

5. ORIGINAL APPROPRIATION PROCEDURE.

5a. Recommendation of Streams and Lakes for Protection.

All Persons interested in recommending certain stream reaches or natural lakes for inclusion in the ISF Program may make recommendations to the Board or Staff at any time. Staff will provide a preliminary response to any Person making such a recommendation within 30 working days after receipt of the recommendation at the Board Office. Staff will collaborate with State and Federal agencies and other interested Persons to plan and coordinate collection of field data necessary for development of ISF recommendations. The Staff shall advise the Board, at least annually, of all new recommendations received and of streams and lakes being studied for inclusion in the ISF Program.

5b. Method of Making Recommendations.

All recommendations transmitted to the Board or Staff for water to be retained in streams or lakes to preserve the natural environment to a reasonable degree must be made with specificity and in writing.

5c. Board Approval Process.

Periodically, after studying streams and lakes for inclusion in the ISF Program, Staff will recommend that the Board appropriate ISF rights. The Board and Staff will use the following annual schedule for initiating, processing and appropriating ISF water rights:

January

- The January Board meeting agenda will list proposed ISF appropriations to be appropriated that year.
- Staff will provide data, engineering and other information supporting each proposed ISF appropriation to the Board prior to or at the January Board meeting.

- Staff will present its information and recommendation for each proposed ISF appropriation at the January Board meeting.

- The Board will take public comment on the proposed ISF appropriations at the January Board meeting.

- The Board may declare its intent to appropriate for each proposed ISF appropriation at the January Board meeting, provided that the particular ISF appropriation has been listed as being under consideration in a notice, mailed at least 60 days prior to the January Board meeting, to the ISF Subscription Mailing List for the relevant water division(s).

- Notice of the Board having declared its intent to appropriate will be distributed through the ISF Subscription Mailing List for the relevant water division(s).

March

- The Board will take public comment on all ISF appropriations at the March Board meeting.

- Notice to Contest an ISF appropriation, pursuant to Rule 5k, must be submitted to the Board Office by March 31st, or the first business day thereafter.

April

- Staff will notify all Persons on the ISF Subscription Mailing List(s) of contested ISF appropriations by April 10th, or the first business day thereafter.

- Notice of Party status or Contested Hearing Participant status, pursuant to Rules 5l. or 5m., must be submitted to the Board Office by April 30th, or the first business day thereafter.

May

- Staff will report to the Board which ISF appropriations are being contested.

- The Board may set hearing dates for contested ISF appropriations.

- At the May Board meeting, the Board may take final action on all uncontested ISF appropriations.

July

- A prehearing conference will be held prior to the July Board meeting for all contested ISF appropriations (Date specific to be determined by the Hearing Officer).

- Five working days before the prehearing conference, all Parties shall file at the Board office, for the record, any and all legal memoranda, engineering data, biological data and reports or other information upon which the Party will rely.

August

- All Parties must submit written rebuttal statements, including testimony and exhibits, by August 15th, or the first business day thereafter. Except for such rebuttal and testimony provided at the hearing pursuant to Rule 5p.(2), the Board will not accept any statements, related documentation or exhibits submitted by any Party after the prehearing conference, except for good cause shown or as agreed upon by the Parties.

September

- Staff will make its final recommendations to the Board, based upon its original report, all public comments, documents submitted by the Parties and all data contained in the official record, at the September Board meeting.
- Notice of the Final Staff ISF Recommendations will be sent to all Persons on the Contested Hearing Mailing List prior to the September Board meeting.
- Parties may choose to continue or withdraw their Notice to Contest an ISF appropriation at or before the September Board Meeting.
- The Board will hold hearings on all contested ISF appropriations.

November

- The Board shall update the public on the results of any hearings through its agenda and may take final action on contested ISF appropriations.

When necessary, the Board may modify or delay this schedule or any part thereof as it deems appropriate.

5d. Board's Intent to Appropriate.

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

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

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

  (a) A description of the appropriation (e.g. stream reach, lake location, amounts, etc.);

  (b) Availability (time and place) for review of Summary Reports and Investigations Files for each appropriation; and,

  (c) Summary identification of any data, exhibits, testimony or other information in addition to the Summary Reports and Investigations Files supporting the appropriation.

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

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

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

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

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

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

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

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

(5) Final action by the Board on ISF appropriations will occur no earlier than the May Board meeting.

5e. Public Comment.

(1) The Board will hear comment on the recommended action to declare its intent to appropriate at the January Board Meeting.

(2) ISF appropriations will be noticed in the Board agenda for each regularly scheduled subsequent meeting until the Board takes final action. Prior to March 31st, at each regularly scheduled Board meeting, time will be allocated for public comment. Subsequent to March 31st, the Board will accept public comment on any contested ISF appropriations or lake levels only at the hearings held on those appropriations pursuant to Rule 5j.

(3) Staff will maintain an ISF Subscription Mailing List for each water division. Any Person desiring to receive information concerning proposed ISF appropriations for that water division must contact the Board Office to request inclusion on that ISF Subscription Mailing List.

5f. Date of Appropriation.

The Board may select an appropriation date that may be no earlier than the date the Board declares its intent to appropriate. The Board may declare its intent to appropriate when it concludes that it has received sufficient information that reasonably supports the findings required in Rule 5i.

5g. Notice.

Agenda and ISF Subscription Mailing List(s) notice shall be given pursuant to Rule 5d. and the public shall be afforded an opportunity to comment pursuant to Rule 5e. Notice of the date of final action on uncontested ISF appropriations shall be mailed to Persons on the ISF Subscription Mailing Lists for the relevant water divisions, maintained pursuant to Rule 5e.(3).

5h. Final Board Action on an ISF Appropriation.

The Board may take final action on any uncontested ISF appropriation(s) at the May Board meeting or any Board meeting thereafter. If a Notice to Contest has been filed, the Board shall proceed under Rules 5j. - 5q.

5i. Required Findings.

Before initiating a water right filing to confirm its appropriation, the Board must make the following determinations:

(1) Natural Environment.

That there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted.

(2) Water Availability.

That the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made.

(3) Material Injury.

That such environment can exist without material injury to water rights.

These determinations shall be subject to judicial review in the water court application and decree proceedings initiated by the Board, based on the Board's administrative record and utilizing the criteria of §§24-4-106(6) and (7), C.R.S.

5j. Procedural Rules for Contested ISF Appropriations.

(1) Whenever an ISF appropriation is contested, the Board shall hold a hearing at which any Party may present evidence, witnesses and arguments for or against the appropriation and any Contested Hearing Participant or member of the public may comment. The hearing shall be a notice and comment hearing as authorized in §37-92-102(4)(a), C.R.S., and shall not be a formal agency adjudication under §24-4-105, C.R.S.

(2) These rules are intended to assure that information is received by the Board in a timely manner. Where these rules do not address a procedure or issue, the Board shall determine the procedures to be followed on a case-by-case basis. The Board may waive the requirements of these rules whenever the Board determines that strict adherence to the rules is not in the best interests of fairness, unless such waiver would violate applicable statutes. For any such waiver, the Board shall provide appropriate justification, in writing, to Persons who have Party or Contested Hearing Participant status.

(3) In a hearing on a contested ISF appropriation, a Party may raise only those issues relevant to the statutory determinations required by §37-92-102(3)(c), C.R.S. and the required findings in Rule 5i.

5k. Notice to Contest.

(1) To contest an ISF appropriation, a Person must comply with the provisions of this section. The Board must receive a Notice to Contest the ISF appropriation by March 31st, or the first business day thereafter.

(2) A Notice to Contest an ISF appropriation shall be made in writing and contain the following information:

(a) Identification of the Person(s) requesting the hearing;

(b) Identification of the ISF appropriation(s) at issue; and,

(c) The contested facts and a general description of the data upon which the Person will rely to the extent known at that time.

(3) After a Party has filed a Notice to Contest an ISF appropriation, any other Person may participate as a Party or a Contested Hearing Participant pursuant to Rules 5l. or 5m.

(4) Staff will notify all Persons on the relevant ISF Subscription Mailing List(s) of contested ISF appropriations by April 10th, or the first business day thereafter.

5l. Party Status.

(1) Party status will be granted to any Person who timely files a Notice of Party Status with the Staff. Any Person filing a Notice to Contest shall be granted Party status and need not also file a Notice of Party Status. A Notice of Party status must be received by April 30th, or the first business day thereafter. A Notice of Party status shall set forth a brief and plain statement of the reasons for obtaining Party status, the contested facts, the matters that the Person claims should be decided and a general description of the data to be presented to the Board. The Board will have discretion to grant or deny Party status to any Person who files a Notice of Party Status after April 30th or the first business day thereafter, for good cause shown.

(2) Only a Party may submit for the record technical evidence, technical witnesses or file legal memoranda. Each Party is responsible for mailing copies of all documents submitted for Board consideration to all other Parties and Contested Hearing Participants.

(3) The Staff shall automatically be a Party in all proceedings concerning contested ISF appropriations.

(4) Where a contested ISF appropriation is based fully or in part on another agency's recommendation pursuant to Rule 5a., that agency shall automatically be a Party in any proceeding.

(5) All Parties, whether they achieved such status by filing a Notice to Contest or a Notice of Party Status, shall be afforded the same rights in the contested ISF appropriation proceedings. Specifically, but without limiting the generality of the foregoing sentence, any Person who filed a Notice of Party Status is entitled to raise issues not raised by any Person who filed a Notice to Contest.

5m. Contested Hearing Participant Status.

(1) Any Person who desires to participate in the process, but not as a Party, may obtain Contested Hearing Participant status by filing a notice thereof at the Board Office prior to April 30th. A Person with such status will receive all Party documents specific to the contested appropriation. Contested Hearing Participants may comment on their own behalf, but may not submit for the record technical evidence, technical witnesses or legal memoranda. The Board will have discretion to grant or deny Contested Hearing Participant status to any Person who filed a Notice of Contested Hearing Participant Status after April 30th or the first business day thereafter, for good cause shown.

(2) The request for Contested Hearing Participant status must be received by April 30th, or the first business day thereafter.

(3) Staff shall notify all Parties and Contested Hearing Participants of the list of Contested Hearing Participants prior to May 31st. Thereafter, Parties shall also mail their prehearing statements and any other documents to Contested Hearing Participants.

5n. Prehearing Conference.

(1) The Board will designate a Hearing Officer, who shall schedule and preside over prehearing conferences and assist the Parties with procedural matters, such as setting prehearing conferences and adjusting deadlines and schedules to further the Parties' settlement efforts or for other good cause shown. All prehearing conferences will be scheduled and held prior to the July Board meeting.

(2) On or before five working days before the prehearing conference, each Party shall file 25 copies of its prehearing statement with the Board, and provide an electronic version when possible. The prehearing statement shall identify all exhibits, engineering data, biological data and reports or other information that the Party will rely upon at the hearing and shall contain:

(a) A specific statement of the factual and legal claims asserted (issues to be resolved) and the legal basis upon which the Party will rely;

(b) Copies of all exhibits to be introduced at the hearing;

(c) A list of witnesses to be called and a brief description of their testimony;

(d) Any alternative proposal to the proposed ISF appropriation;

(e) All written testimony to be offered into evidence at the hearing;

and

(f) Any legal memoranda.

Each Party shall deliver a copy of its prehearing statement to all other Parties, Contested Hearing Participants, the Hearing Officer and directly to the Assistant Attorneys General representing Staff and the Board five working days before the prehearing conference. The Board will not consider information, other than rebuttal statements and testimony provided at the hearing pursuant to Rule 5p.(2), submitted by the Parties after this deadline except for good cause shown or as agreed upon by the Parties.

(3) Any Contested Hearing Participant may also submit written comments 5 working days prior to the prehearing conference. Contested Hearing Participants who submit written comments for the Board's consideration shall provide 25 copies to the Board, and a copy to all other Contested Hearing Participants, Parties, the Hearing Officer and the Assistant Attorneys General representing Staff and Board, and provide an electronic version when possible.

(4) The prehearing conference will afford the Parties the opportunity to address such issues as time available for each Party at the hearing, avoiding presentation of duplicative information, consolidation of concerns, etc. The Parties may formulate stipulations respecting the issues to be raised, witnesses and exhibits to be presented, and/or any other matters which may be agreed to or admitted by the Parties. At the prehearing conference, the Parties shall make known any objections to the procedures or evidence that they may raise at the hearing unless such objections could not have been reasonably determined at that time.

(5) August 15th, or the first business day thereafter, is the last day for submission of written rebuttal statements, including testimony, legal memoranda, and exhibits. Twenty-five copies of such

materials must be provided to the Board, and an electronic version also provided, when possible. Except for such rebuttal and testimony provided at the hearing pursuant to Rule 5p.(2), the Board will not accept any statements, related documentation or exhibits submitted by any Party after the deadline set forth in Rules 5n.(2) and 5n.(3), except for good cause shown or as agreed upon by the Parties. The scope of rebuttal is limited to issues and evidence presented in the prehearing statements. Any documentation to be submitted pursuant to this subsection (5) shall be delivered to the Board and mailed to all Parties and Contested Hearing Participants by August 15th, or the first business day thereafter, unless the Parties agree otherwise.

5o. Notice of Hearings on Contested ISF Appropriations.

(1) Staff shall mail notice of prehearing conference(s) on contested ISF appropriations to all Persons on the Contested Hearing Mailing List for the particular ISF appropriation. The notice shall specify the time and place of the prehearing conference and any procedural requirements that the Board deems appropriate.

(2) The Board may postpone a hearing to another date by issuing written notice of the postponement no later than 7 calendar days prior to the original hearing date.

5p. Conduct of Hearings.

(1) In conducting any hearing, the Board shall have authority to: administer oaths and affirmations; regulate the course of the hearing; set the time and place for continued hearing; limit the number of technical witnesses; issue appropriate orders controlling the subsequent course of the proceedings; and take any other action authorized by these Rules.

(2) At the hearing, the Board shall hear arguments, concerns or rebuttals from Parties, Contested Hearing Participants and interested members of the public. The Board may limit testimony at the hearing. Without good cause, the Board will not permit Parties or Contested Hearing Participants to introduce written material at the hearing not previously submitted pursuant to these Rules. The Board, in making its determinations, need not consider any written material not timely presented.

(3) Only the Board may question witnesses at the hearing except where the Board determines that, for good cause shown, allowing the parties to question witnesses may materially aid the Board in reaching its decision, or where such questioning by the Parties relates to the statutory findings required by §37-92-102(3)(c), C.R.S. The Board may terminate questioning where the Board determines that such questioning is irrelevant or redundant or may terminate such questioning for other good cause.

(4) The hearing shall be recorded by a reporter or by an electronic recording device. Any Party requesting a transcription of the hearing shall be responsible for the cost of the transcription.

5q. Final Board Action.

The Board may take final action at the hearing or at a later date.

5r. Statement of Opposition.

In the event that any Person files a Statement of Opposition to an ISF water right application in Water Court, the Staff may agree to terms and conditions that would prevent injury. Where the resolution of the Statement of Opposition does not involve a change regarding the Board's determinations under Rule 5i. (including but not limited to the amount, reach, and season), the Board is not required to review and ratify the resolution. Staff may authorize its counsel to sign any court documents necessary to finalize this type of pretrial resolution without Board ratification.

5s. Withdrawal of Filing.

If the Board elects to withdraw a Water Court filing, notice shall be given in the agenda of the Board meeting at which the action is expected to occur.

6. ACQUISITION OF WATER, WATER RIGHTS OR INTERESTS IN WATER FOR INSTREAM FLOW PURPOSES.

The Board may acquire water, water rights, or interests in water for ISF purposes by the following procedures:

6a. Means of Acquisition.

The Board may acquire, by grant, purchase, donation, bequest, devise, lease, exchange, or other contractual agreement, from or with any Person, including any governmental entity, such water, water rights, or interests in water that are not on the Division Engineer's abandonment list in such amounts as the Board determines are appropriate for stream flows or for natural surface water levels or volumes for natural lakes to preserve or improve the natural environment to a reasonable degree.

6b. 120 Day Rule.

At the request of any Person, including any governmental entity, the Board shall determine in a timely manner, not to exceed one hundred twenty days, unless further time is granted by the requesting Person, what terms and conditions the Board will accept in a contract or agreement for the acquisition. The 120-day period begins on the day the Board first considers the proposed contract or agreement at a regularly scheduled or special Board meeting.

6c. Stacking Evaluation.

The Board shall evaluate whether to combine or stack the acquired water right with any other ISF appropriation or acquisition, based upon the extent to which the acquired water will provide flows or lake levels to preserve or improve the natural environment to a reasonable degree.

If the Board elects to combine or stack the acquired water right, the details of how the water rights are to be combined or stacked with other existing ISF appropriations or acquisitions must be set forth in the application for a decree to use the acquired right for instream flow purposes.

6d. Enforcement of Acquisition Agreement.

Pursuant to section 37-92-102(3), C.R.S., any contract or agreement executed between the Board and any Person which provides water, water rights, or interests in water to the Board shall be enforceable by either party thereto as a water matter in the water court having jurisdiction over the water right according to the terms of the contract or agreement.

6e. Appropriateness of an Acquisition.

The Board shall evaluate the appropriateness of any acquisition of water, water rights, or interests in water to preserve or improve the natural environment. Such evaluation shall include, but need not be limited to consideration of the following factors:

(1) The reach of stream or lake level for which the use of the acquired water is proposed, which may be based upon any one or a combination of the following: the historical location of return flow; the length of the existing instream flow reach, where applicable; whether an existing instream flow water right relies on return flows from the water right proposed for acquisition; the environment to

be preserved or improved by the proposed acquisition; or such other factors the Board may identify;

(2) The natural flow regime;

(3) Any potential material injury to existing decreed water rights;

(4) The historical consumptive use and historical return flows of the water right proposed for acquisition that may be available for instream flow use;

(5) The natural environment that may be preserved or improved by the proposed acquisition, and whether the natural environment will be preserved or improved to a reasonable degree by the water available from the proposed acquisition;

(6) The location of other water rights on the subject stream(s);

(7) The effect of the proposed acquisition on any relevant interstate compact issue, including whether the acquisition would assist in meeting or result in the delivery of more water than required under compact obligations;

(8) The effect of the proposed acquisition on the maximum utilization of the waters of the state;

(9) Whether the water acquired will be available for subsequent use or reuse downstream;

(10) The cost to complete the transaction or any other associated costs; and

(11) The administrability of the acquired water right when used for instream flow purposes.

The Board shall determine how to best utilize the acquired water, water rights or interest in water to preserve or improve the natural environment.

6f. <u>Factors Related to Loans and Leases.</u>

In addition to considering the factors listed above, for loans and leases of water, water rights and interests in water for ISF purposes under section 37-92-102(3),

(1) The Board shall consider the extent to which the leased or loaned water will preserve or improve the natural environment to a reasonable degree, including but not limited to:

    (a) Whether the amount of water available for acquisition is needed to provide flows to meet a decreed ISF amount in below average years; and

    (b) Whether the amount of water available for acquisition could be used to and would improve the natural environment to a reasonable degree, either alone or in combination with existing decreed ISF water rights.

(2) In considering the extent to which the leased or loaned water will preserve or improve the natural environment to a reasonable degree, the Board will request and review a biological analysis from the Colorado Division of Wildlife, and will review any other biological or scientific evidence presented to the Board.

(3) If other sources of water are available for acquisition on the subject stream reach(es) by purchase or donation, the Board shall fully consider each proposed acquisition and give preference first to the donation and then to a reasonable acquisition by purchase.

(4) The Board shall obtain confirmation from the Division Engineer that the proposed lease or loan is administrable and is capable of meeting all applicable statutory requirements.

(5) The Board shall determine, through negotiation and discussion with the lessor, the amount of compensation to be paid to the lessor of the water based, in part, upon the anticipated use of the water during and after the term of the lease.

(6) The Board shall consider evidence of water availability based upon the historical record(s) of diversion, the beneficial use of the subject water right, the location and timing of where return flows have historically returned to the stream, and the reason(s) the water is available for lease or loan.

6g. Recording Requirements.

(1) All contracts or agreements for leases or loans of water, water rights or interests in water under section 37-92-102(3) shall require the Board to:

  (a) Maintain records of how much water the Board uses under the contract or agreement each year it is in effect; and

  (b) Install any measuring device(s) deemed necessary by the Division Engineer (1) to administer the lease or loan of water, (2) to measure and record how much water flows out of the reach after use by the Board under the lease or loan; and (3) to meet any other applicable statutory requirements.

(2) All contracts or agreements for leases or loans of water shall provide for the recording of the actual amount of water legally available and capable of being diverted under the leased or loaned water right during the term of the lease or loan, with such records provided to the Division of Water Resources for review and publication.

6h. Water Reuse.

All contracts or agreements for the acquisition of water, water rights or interests in water under section 37-92-102(3) shall provide that the Board or the seller, lessor, lender or donor of the water may bring about beneficial use of the historical consumptive use of the acquired water right downstream of the ISF reach as fully consumable reusable water, pursuant to the water court decree authorizing the Board to use the acquired water.

(1) The bringing about of beneficial use of the historical consumptive use of the water may be achieved by direct use, sale, lease, loan or other contractual arrangement by the Board or the seller, lessor, lender or donor.

(2) The contract or agreement also shall provide that the Division Engineer must be notified of any agreement for such beneficial use downstream of the ISF reach prior to the use.

(3) Prior to any beneficial use by the Board of the historical consumptive use of the acquired water right downstream of the ISF reach, the Board shall find that such use:

  (a) Will be consistent with the Board's statutory authority and with duly adopted Board policies and objectives; and

  (b) Will not injure vested water rights or decreed conditional water rights.

6i. Applications for a Decreed Right to Use Water for ISF Purposes.

The Board shall file a change of water right application or other applications as needed or required with the water court to obtain a decreed right to use water for ISF purposes under all contracts or agreements for acquisitions of water, water rights or interests in water under section 37-92-102(3), including leases and loans of water. The Board shall file a joint application with the Person from whom the Board has acquired the water or a Person who has facilitated the acquisition, if requested by such Person. The Water Court shall determine matters that are within the scope of section 37-92-305, C.R.S. In a change of water right proceeding, the Board shall request the Water Court to:

(1) Verify the quantification of the historical consumptive use of the acquired water right;

(2) Verify the identification, quantification and location of return flows to ensure that no injury will result to vested water rights and decreed conditional water rights;

(3) Include terms and conditions providing that:

  (a) The Board or the seller, lessor, lender, or donor of the water may bring about the beneficial use of the historical consumptive use of the changed water right downstream of the ISF reach as fully consumable reusable water, subject to such terms and conditions as the water court deems necessary to prevent injury to vested water rights and decreed conditional water rights; and

  (b) When the Board has not identified such downstream beneficial use at the time of the change of water right, the Board may amend the subject change decree, if required by the Division Engineer, to add such beneficial use(s) of the historical consumptive use downstream of the ISF reach at the time the Board is able to bring about such use or reuse, without requiring requantification of the original historical consumptive use calculation;

and

(4) Decree the method by which the historical consumptive use should be quantified and credited during the term of the agreement for the lease or loan of the water right pursuant to section 37-92-102(3), C.R.S.

6j. Limitation on Acquisitions.

The Board may not accept a donation of water rights that were acquired by condemnation, or that would require the removal of existing infrastructure without approval of the current owner of such infrastructure.

6k. Temporary Loans of Water to the Board.

The Board may accept temporary loans of water for instream flow use for a period not to exceed 120 days in any one year, in accordance with the procedures and subject to the limitations set forth in section 37-83-105, C.R.S.

(1) Within 5 working days after receiving an offer of a temporary loan of water to the Board for temporary instream flow use, the Director will provide a response to the proponent and, unless the proposed loan has no potential value for instream flow use, staff will coordinate with the proponent on preparing and submitting the necessary documentation to the State and Division Engineers required by sections 37-83-105(2)(a)(I) and (2)(b)(I), C.R.S., and providing the public notice required by section 37-83-105(2)(b)(II), C.R.S.

(2) Provided that the State Engineer has made a determination of no injury pursuant to section 37-83-105(2)(a)(III), C.R.S., the Board hereby delegates authority to the CWCB Director to accept temporary loans of water for instream flow use in accordance with the procedures and subject to

the limitations set forth in section 37-83-105 and to take any administrative action necessary to put the loaned water to instream flow use.

(3) Provided that the State Engineer's determination of non-injury is still in effect, the Director shall notify the proponent and the State Engineer whether the temporary loan is to be exercised in subsequent years. Such notification shall be provided within 5 working days of the Director being notified by the proponent that the water is available for use under the temporary loan. The CWCB's use of loaned water for instream flows shall not exceed the CWCB's decreed instream flow amount or extend beyond the CWCB's decreed instream flow reach at any time during the loan term, and shall comply with any terms and conditions imposed by the State Engineer to prevent injury. The purpose of this delegation is to expedite use of temporarily loaned water for instream flows by the Board.

(4) At the first regular or special Board meeting after the Director accepts or rejects an offer of a loan of water to the Board for temporary instream flow use under (1) or (2) above, the Board shall vote either to ratify or overturn the Director's decision.

(5) The Board, Director and staff will expedite all actions necessary to implement Rule 6k.

6l. Funds for Water Right Acquisitions.

The Board may use any funds available to it for costs of the acquisition of water rights and their conversion to ISF use. The Board shall spend available funds for such costs in accordance with section 37-60-123.7, C.R.S. and any other applicable statutory authority, and with applicable Board policies and procedures.

6m. Public Input on Proposed Acquisitions.

The Board shall follow the public review process in Rules 11a. - 11c. when acquiring water, water rights or interests in water, except for temporary loans or leases as provided in Rule 6k. above and except as provided below.

(1) Prior to Board consideration of any proposed acquisition, Staff shall mail notice of the proposed acquisition to all Persons on the ISF Subscription Mailing List and the State Engineer's Substitute Supply Plan Notification List for the relevant water division, and shall provide Proper Notice. Such notice shall include:

    (a) The case number adjudicating the water right proposed to be acquired, and the appropriation date, adjudication date, priority, decreed use(s), and flow amount of the water right proposed to be acquired, and approximately how much of the water right the Board will consider acquiring;

    (b) The location of the stream reach or lake that is the subject of the proposal, including, when available, the specific length of stream reach to benefit from the proposed acquisition;

    (c) Any available information on the purpose of the acquisition, including the degree of preservation or improvement of the natural environment to be achieved;

    (d) Any available scientific data specifically supporting the position that the acquisition will achieve the goal of preserving or improving the natural environment to a reasonable degree; and

    (e) In addition to (a) - (d) above, for leases and loans of water, water rights or interests in water under section 37-92-102(3), such notice shall include the proposed term of the lease or loan and the proposed season of use of the water under the lease or loan.

(2) At every regularly scheduled Board meeting subsequent to the mailing of notice, and prior to final Board action, Staff will report on the status of the proposed acquisition and time will be reserved for public comment.

(3) Any Person may address the Board regarding the proposed acquisition prior to final Board action. Staff shall provide any written comments it receives regarding the proposed acquisition directly to the Board.

(4) Any Person may request the Board to hold a hearing on a proposed acquisition. Such a request must be submitted to the Board in writing within twenty days after the first Board meeting at which the Board considers the proposed acquisition, and must include a brief statement, with as much specificity as possible, of why a hearing is being requested.

(5) At its next regularly scheduled meeting after receipt of the request for a hearing, or at a special meeting, the Board will consider the request and may, in its sole discretion, grant or deny such a request. All hearings scheduled by the Board shall be governed by the following procedures:

    (a) A hearing on a proposed acquisition must be held within the 120 day period allowed for Board consideration of an acquisition pursuant to Rule 6b., unless the Person requesting the Board to consider the proposed acquisition agrees to an extension of time.

    (b) The Board shall appoint a Hearing Officer to establish the procedures by which evidence will be offered.

    (c) At least thirty days prior to the hearing date(s), the Board shall provide written notice of the hearing(s) to the Person proposing the acquisition, all interested parties known to the Board, and all Persons on the ISF Subscription Mailing List and the State Engineer’s Substitute Supply Plan Notification List for the relevant water division. The Board also shall provide Proper Notice, as defined in ISF Rule 4n.

    (d) Any Person who desires party status shall become a Party upon submission of a written Notice of Party Status to the Board Office. The Notice shall include the name and mailing address of the Person and a brief statement of the reasons the Person desires party status. The Board Office must receive Notice of Party Status within seven days after notice of the hearing is issued.

    (e) The Hearing Officer shall set timelines and deadlines for all written submissions. Prehearing statements will be required, and shall include, but not be limited to, the following: 1) a list of all disputed factual and legal issues; 2) the position of the Party regarding the factual and legal issues; 3) a list identifying all of the witnesses that will testify for the Party, and a summary of the testimony that those witnesses will provide; and 4) copies of all exhibits that the Party will introduce at the hearing(s).

    (f) Any Party may present testimony or offer evidence identified in its prehearing statement regarding the proposed acquisition.

    (g) The Hearing Officer shall determine the order of testimony for the hearing(s), and shall decide other procedural matters related to the hearing(s). The Hearing Officer does not have authority to rule on substantive issues, which authority rests solely with the Board.

(h) The Board will not apply the Colorado Rules of Evidence at hearings on proposed acquisitions.

(i) The Board may permit general comments from any Person who is not a Party; however, the Board may limit these public comments to five minutes per Person.

(j) The Board may take final action at the hearing(s) or continue the hearing and/or deliberations to a date certain.

(k) Board hearings may be recorded by a reporter or by an electronic recording device. Any Party requesting a transcription of the hearing(s) shall be responsible for the cost of the transcription.

(l) When necessary, the Board may modify this hearing procedure schedule or any part thereof as it deems appropriate.

6n. Board Action to Acquire Water, Water Rights or Interests in Water.

The Board shall consider the acquisition during any regular or special meeting of the Board. At the Board meeting, the Board shall consider all presentations or comments of Staff or any other Person. After such consideration, the Board may acquire, acquire with limitations, or reject the proposed acquisition.

7. INUNDATION OF ISF RIGHTS.

Inundation of all or a portion of an ISF stream reach or lake may be an interference with the Board's usufructuary rights that have been acquired by Board action. “Inundation” as used in this section is the artificial impoundment of water within an ISF or natural lake; “inundation” does not refer to the use of a natural stream as a conveyance channel as long as such use does not raise the waters of the stream above the ordinary high watermark as defined in §37-87-102 (1)(e), C.R.S.

7a. Small Inundations.

Staff may file a Statement of Opposition to inundations described in this section if it determines that the ISF right or natural environment will be adversely affected by the inundation. The Staff shall not be required to file a Statement of Opposition to applications proposing small inundations. Small inundations are those in which the impoundment is 100 acre-feet or less, or the surface acreage of the impoundment is 20 acres or less, or the dam height of the structure is 10 feet or less. The dam height shall be measured vertically from the elevation of the lowest point of the natural surface of the ground, where that point occurs along the longitudinal centerline of the dam up to the flowline crest of the spillway of the dam.

(1) All structures proposed by any applicant on a stream reach shall be accumulated for the purpose of determining whether the inundations proposed by the applicant are small inundations. In the event the cumulative surface acreage, volume impounded, or dam height of all impoundments exceed the definition of a small inundation, Staff may file a Statement of Opposition to that application.

(2) In the event that no Statement of Opposition is filed pursuant to the terms of this section, the Board shall be deemed to have approved the inundation proposed without a request by the applicant.

7b. Application of Rule 7.

The provisions of this rule will not be applied to the following water rights:

(1) any absolute or conditional water right that is senior to an ISF right;

(2) any senior conditional water right that seeks a finding of reasonable diligence;

(3) any junior absolute or conditional water right which was decreed prior to July 10, 1990, or had an application for decree pending prior to July 10, 1990, unless the Board had filed a Statement of Opposition to the absolute or conditional water right application prior to July 10, 1990; or

(4) any inundation of an ISF reach by water that does not have an absolute or conditional water right if the inundation occurred prior to July 10, 1990.

7c. Request to Inundate.

Any Person seeking permission to inundate shall timely submit a written request for permission to inundate to the Board Office. No requests for inundation will be considered or approved until the Person seeking permission to inundate files a water court application outlining their storage plans or files plans and specifications with the State Engineer for a jurisdictional dam pursuant to §37-87-105, C.R.S. The Board will consider the request to inundate in a timely manner.

7d. Staff Investigation.

After receiving the request to inundate, the Staff may seek the recommendations from the Division of Wildlife, Division of Parks and Outdoor Recreation, Division of Water Resources, United States Department of Agriculture and United States Department of Interior.

7e. Required Information.

In any written request to inundate, the requesting Person shall at a minimum include information on the following factors: the location of the inundation, the size of the inundation, impact of the inundation on the natural environment, any unique or rare characteristics of the ISF water right to be inundated, any regulatory requirements or conditions imposed upon the applicant by federal, state and/or local governments, all terms and conditions included in applicant's water court decree, and any compensation or mitigation offered by the Person proposing the inundation.

7f. Determination of Interference.

In response to the request to inundate, the Board shall determine whether the proposed inundation interferes with an ISF right. When making this determination, the Board shall consider, without limitation, the extent of inundation proposed and the impact of the proposed inundation on the natural environment existing prior to the inundation.

7g. Consideration of Request to Inundate.

If the Board determines that a proposed inundation interferes with an ISF right, the Board may then approve, approve with conditions, defer, or deny the request to inundate. In making this decision, the Board shall consider all relevant factors, including, but not limited to (1) the extent of inundation proposed; (2) the impact of the proposed inundation on the natural environment existing prior to the inundation; (3) the degree to which the beds and banks adjacent to the ISF right subject to the inundation are publicly or privately owned; (4) the economic benefits arising from the inundation; (5) the benefits to recreation and downstream ISF segments arising from the inundation; (6) the degree to which the proposed inundation will allow development of Colorado's allotment of interstate waters as determined by compact or adjudication; and, (7) any mitigation or compensation offered to offset adverse impacts on the ISF right. After considering all relevant factors, the Board shall take one of the actions set forth in Rules 7h. - 7k. below.

7h. Approval.

If the Board approves the request to inundate, any Statement of Opposition filed by the Board shall be withdrawn.

7i. Conditional Approval.

The Board may require certain conditions to be performed prior to approval. Failure to perform any condition will be a reason for denial.

7j. Deferral.

When it appears that other governmental agencies may impose terms and conditions upon the issuance of a permit to construct a facility which will cause an inundation, the Board may defer consideration of the request to inundate until all other governmental bodies have finalized the permit or approval conditions.

7k. Denial of Request to Inundate.

Requests for permission to inundate may be denied if in the discretion of the Board the request is inconsistent with the goals of the ISF Program. The Board may decide to deny a request for permission to inundate if it finds:

(1) No compensation or mitigation would be adequate for the injury caused by the inundation; or

(2) No compensation or mitigation acceptable to the Board has been proposed by applicant; or

(3) The proposed inundation is inconsistent with the goals of the ISF Program.

7l. Remedies.

The Board may seek any administrative, legal or equitable remedy through state courts (including water courts), federal courts, city, county, state or federal administrative proceedings to resolve actual or proposed inundation of its ISF rights.

7m. Board Has Sole Right to Protect ISF Rights from Interference.

Only the Board may seek to prevent interference with an ISF right by inundation and only the Board may seek compensation or mitigation for such interference.

7n. Public Review Process.

The Board shall follow the public review process in Rules 11a. - 11c. prior to any Board decision on a request to inundate an ISF right.

8. PROTECTION OF ISF APPROPRIATIONS.

The Board delegates the day-to-day management and administration of the ISF Program to Staff. Staff shall seek ratification of its decisions as set forth in Rules 8c., 8e.(2), 8i., and 8j.

8a. Resume Review.

Staff shall review the monthly resumes of all water divisions. The Staff shall evaluate each resume entry for the possibility of injury or interference to an ISF right.

8b. Statement of Opposition.

In the event Staff identifies a water right application in the resume that may injure an ISF right, Staff shall file a Statement of Opposition to that application. In the event Staff identifies a water right application in the resume that may interfere with an ISF right as contemplated in Rule 7, Staff may file a Statement of Opposition to that application.

8c. Ratification of Statements of Opposition.

At a Board meeting following the filing of the Statement of Opposition, Staff shall apprise the Board of the filing of a Statement of Opposition and the factual basis for the Staff action. At that time, the Board shall ratify the filing, disapprove the filing, or table the decision to a future meeting if more information is needed prior to making a decision.

8d. Notice.

Prior to ratification of a Statement of Opposition, the Staff shall mail the applicant a copy of the Board memorandum concerning the ratification and a copy of the agenda of the meeting in which the ratification will be considered. Following a Board action considering a Statement of Opposition, the Staff shall notify the applicant and/or its attorney in writing of the Board's action.

8e. De Minimis Rule.

In the event that Staff determines a water court application would result in a 1 percent depletive effect or less on the stream reach or lake subject of the ISF right, and the stream reach or lake has not been excluded from this rule pursuant to Rules 8f. or 8h., Staff shall determine whether to file a Statement of Opposition. Staff's decision not to file a Statement of Opposition does not constitute: (1) acceptance by the Board of injury to any potentially affected ISF water right; or (2) a waiver of the Board's right to place an administrative call for any ISF water right.

(1) If Staff does not file a Statement of Opposition, Staff shall notify the Division Engineer for the relevant water division that it has not filed a Statement of Opposition, but that it may place an administrative call for the potentially affected ISF water right(s). Such a call could be enforced against the water right(s) subject of the application by the Division Engineer in his or her enforcement discretion. Staff also shall mail a letter to the applicant at the address provided on the application notifying the applicant: (a) of Staff's decision not to file a Statement of Opposition pursuant to this Rule; (b) that the CWCB may place a call for its ISF water rights to be administered within the prior appropriation system; and (c) that the Division Engineer's enforcement of the call could result in curtailment or other administration of the subject water right(s).

(2) If Staff files a Statement of Opposition, Staff shall seek Board ratification by identifying and summarizing the Statement of Opposition on the Board meeting consent agenda pursuant to Rule 8c.

8f. Cumulative Impact.

In determining existence of a de minimis impact, Staff shall consider the existence of all previous de minimis impacts on the same stream reach or lake. If the combined total of all such impacts exceeds 1 percent, then Staff will file a Statement of Opposition regardless of the individual depletive effect of an application.

8g. Notification of Staff Action.

At a Board meeting following a Staff determination to apply the De Minimis rule, the Staff shall notify the Board about the factual basis leading to its application of the De Minimis rule.

8h. Exclusion from De Minimis Rule.

The Board may at any time exclude any stream reach or lake, or any portion thereof, from application of the De Minimis rule.

8i. Pretrial Resolution.

Staff may negotiate a pretrial resolution of any injury or interference issue that is the subject of a Statement of Opposition. The Board shall review the pretrial resolution pursuant to the following procedures:

(1) No Injury.

In the event the pretrial resolution includes terms and conditions preventing injury or interference and does not involve a modification, or acceptance of injury or interference with mitigation, the Board is not required to review and ratify the pretrial resolution. Staff may authorize its counsel to sign any court documents necessary to finalize this type of pretrial resolution without Board ratification.

(2) No Injury/Modification.

In the event the pretrial resolution addresses injury or interference through modification of the existing ISF decree, the process set forth in Rule 9 shall be followed prior to any Board decision to ratify the pretrial resolution.

(3) Injury Accepted with Mitigation.

In the event a proposed pretrial resolution will allow injury to or interference with an ISF or natural lake level (NLL) water right, but mitigation offered by the applicant could enable the Board to accept the injury or interference while continuing to preserve or improve the natural environment to a reasonable degree, and if the proposed pretrial resolution does not include a modification under ISF Rule 9, the Board shall:

(a) Conduct a preliminary review of the proposed pretrial resolution during any regular or special meeting to determine whether the natural environment could be preserved or improved to a reasonable degree with the proposed injury or interference if applicant provided mitigation; and

(b) At a later regular or special meeting, take final action to ratify, refuse to ratify or ratify with additional conditions.

(c) No proposed pretrial resolution considered pursuant to this Rule 8i.(3) may receive preliminary review and final ratification at the same Board meeting.

(d) The Board shall not enter into any stipulation or agree to any decretal terms and conditions under this Rule that would result in the Division of Water Resources being unable to administer the affected ISF or NLL water right(s) in accordance with the priority system or with Colorado water law.

(e) To initiate CWCB staff review of an Injury with Mitigation proposal, the proponent must provide the following information in writing:

  i. Location of injury to ISF or NLL water right(s) (stream(s) or lake(s) affected, and length of affected reach(es));

  ii. Quantification of injury (amount, timing and frequency);

iii. Type of water use that would cause the injury;

iv. Analysis showing why full ISF or NLL protection is not possible;

v. Detailed description of the proposed mitigation, including all measures taken to reduce or minimize the injury;

vi. Detailed description of how the proposed mitigation will enable the Board to continue to preserve or improve the natural environment of the affected stream of lake to a reasonable degree despite the injury;

vii. Identification and feasibility analysis of: (1) all water supply alternatives considered by the proponent in the context of this proposal; (2) all alternatives evaluated by the proponent to fully protect the potentially affected ISF or NLL water right, but rejected as infeasible; and (3) all alternatives evaluated by the proponent and designed to mitigate the injury to or interference with the affected ISF or NLL water right. This information shall address the environmental and economic benefits and consequences of each alternative; and

viii. A discussion of the reasonableness of each alternative considered.

(f) After receipt and review of the required information, staff will consult with the DOW and with the entity that originally recommended the affected ISF or NLL water rights(s) (if other than DOW) to determine whether additional field work is necessary and to identify any scheduling concerns. Staff will request a recommendation from the DOW as to whether the proposed mitigation will enable the Board to continue to preserve or improve the natural environment of the affected stream or lake to a reasonable degree despite the injury, including a discussion of the reasonableness of the alternatives considered. CWCB staff will use best efforts to consult with affected land owners and managers regarding the proposal.

(g) Prior to bringing the proposal to the Board for preliminary consideration, staff will consult with the Division of Water Resources on whether the proposal would result in the Division of Water Resources being unable to administer the affected ISF or NLL water right(s) in accordance with the priority system or with Colorado water law.

(h) At the first meeting of the two-meeting process required by this Rule, staff will bring the proposal to the Board for preliminary consideration after completing its review of the proposal and its consultation with DOW. Staff will work with the proponent and interested parties to address any preliminary concerns prior to bringing a proposal to the Board. Preliminary consideration by the Board may result in requests for more information or for changes to the proposal. Staff will work with the proponent and interested parties to finalize the proposal and bring it back to the Board for final action at a subsequent Board meeting.

(i) The Board will consider the following factors when evaluating Injury with Mitigation proposals. Because Injury with Mitigation proposals may involve unique factual situations, the Board may consider additional factors in specific cases. Further, evaluation of each Injury with Mitigation proposal will require the exercise of professional judgment regarding the specific facts of the proposal.

i. Extent of the proposed injury:

1. Location of injury – affected stream(s) or lake and length of affected reach(es);

        2. Amount, timing and frequency of shortage(s) or impacts to the affected ISF of NLL water right(s); and

        3. Potential impact to the natural environment of the affected stream reach(es) or lake from the proposed injury.

    ii. Benefits of the mitigation to the natural environment:

        1. The nature and extent of the benefits the mitigation will provide to the existing natural environment of the affected stream or lake;

        2. The scientific justification for accepting the mitigation; and

        3. Whether the mitigation will enable the Board to continue to preserve or improve the natural environment of the subject stream or lake to a reasonable degree.

(j) Evaluation of proposed alternatives. The Board shall evaluate: (1) all water supply alternatives considered by the proponent in the context of this proposal; (2) all alternatives evaluated by the proponent to fully protect the potentially affected ISF or NLL water right, but rejected as infeasible; and (3) all alternatives evaluated by the proponent and designed to mitigate the injury to or interference with the affected ISF or NLL water right. In its evaluation, the Board shall consider the following factors:

    i. Availability of on-site mitigation alternatives;

    ii. Technical feasibility of each alternative;

    iii. Environmental benefits and consequences of each alternative;

    iv. Economic benefits and consequences of each alternative;

    v. Reasonableness of alternatives;

    vi. Administrability of proposed alternatives by the Board and the Division Engineer; and

    vi. For mitigation alternatives, whether the mitigation was or will be put in place to satisfy a requirement or need unrelated to the Injury with Mitigation proposal.

(k) The Board will consider mitigation on a different reach of stream or another stream (“off-site mitigation”) as a last resort and will only consider mitigation in an area other than the affected stream reach if no reasonable alternative exists for mitigation on the affected stream reach. The Board only will consider off-site mitigation on stream(s) located in the same drainage as the affected stream. Factors that the Board may consider in looking at such a proposal include, but are not limited to, the degree and frequency of impact to the affected stream; the environmental benefits provided to the off-site stream by the mitigation; whether the proposal could, in effect, constitute a modification of the ISF water right on the affected stream; or whether the proposal could result in the Division of Water Resources being unable to administer the affected ISF water right(s) in accordance with the priority system or with Colorado water law.

(l) Stipulations and water court decrees that incorporate Injury with Mitigation shall include, but not be limited to inclusion of, the following terms and conditions:

  i. A provision that the proponent will not divert water or take any other action that would reduce flows in the affected stream or levels in the affected lake below the decreed ISF or NLL amount until the agreed-upon mitigation measures are in place and fully operational;

  ii. A requirement that the structural components of the mitigation be maintained permanently;

  iii. A provision allowing CWCB or DOW staff access to the property on which structural components of the mitigation are located to inspect the structures at certain time intervals, and, if necessary, to perform biological stream or lake monitoring. This provision shall clearly define the reasonable nature, extent and timing of such access (i.e, advance notice, dates, times or season of access, coordination with proponent, and location and routes of access);

  iv. A term providing that if the proponent ceases to provide the agreed upon mitigation (such as removing structural components or failing to maintain them to a specified level, or ceasing to implement non-structural components), that the proponent will not divert water or take any other action that would reduce flows in the affected stream or levels in the affected lake below the decreed ISF or NLL amount because the Board will no longer accept the injury based upon the mitigation no longer being in effect -- in such case, if the Board places a call for the affected ISF or NLL water right, the Board will notify the Division Engineer that this provision of the decree now is in effect and that the Board is not accepting the injury;

  v. A requirement that the proponent install and pay operation and maintenance costs of (or commit to pay operation and maintenance costs if the CWCB installs) any measuring devices deemed necessary by the Division Engineer to administer the terms of the stipulation and decree implementing the Injury with Mitigation pretrial resolution; and

  vi. A term providing that the water court will retain jurisdiction to enforce the terms and conditions set forth above in subsections (i) - (vi), and any other terms and conditions specific to the Injury with Mitigation pretrial resolution, as a water matter.

8j. Authorization to Proceed to Trial.

In the event that a Statement of Opposition filed by the Board is not settled prior to the last regularly scheduled Board meeting prior to the trial date, Staff shall seek Board authorization to proceed to trial. In the event that Staff is authorized to proceed to trial, the Board may adjourn to executive session to discuss settlement parameters with its counsel. Staff is authorized to settle any litigation without Board ratification if the settlement terms are consistent with instructions given by the Board to its counsel.

8k. Public Review Process.

The Board shall follow the public review process in Rules 11a. - 11c. prior to consideration of a request to ratify a pretrial resolution pursuant to Rule 8i.(3).

8l. Notice.

At any time Staff verifies that an ISF water right is not being fulfilled as a result of water use against which the ISF water right is entitled to protection, the Staff shall provide Proper Notice, including a description of what the Board is doing in response to the situation.

9. MODIFICATION OF ISF RIGHTS.

The Board may modify any existing decreed ISF right according to the procedures set forth in this Rule. “Modification” of an ISF right within the meaning of this Rule includes a decrease in the rate of flow described in the existing ISF decree, segmenting an existing ISF reach into shorter reaches with the result of decreasing the rate of flow in any portion of an ISF reach, or subtracting water from an ISF right during any particular time period or season.

9a. Need for Modification.

Modification may be requested by the Staff or by any Person who has filed a water right application on an ISF reach or who has applied for any governmental permit for facilities located in or near an ISF reach and who complies with Rules 9b. and 9c. Any request for modification, except by staff, shall be made in writing, submitted to Staff and such writing shall contain the following information:

(1) name, address and telephone number of the Person seeking modification;

(2) stream or lake subject of request;

(3) modification requested;

(4) reason for modification; and

(5) the scientific data supporting the request.

9b. Need for Water.

Any Person who requests a modification of an ISF right must, as a precondition to the Board's consideration of the request, establish a need for the water made available by the modification. Staff does not have to comply with this rule and any governmental entity seeking to implement the terms of an agreement specified in Rule 9f. does not have to comply with this section.

9c. Grounds for Modification.

No request for modification may be considered until the applicant establishes that one of the following reasons for modification exists:

(1) Mistake.

An ISF right may be considered for modification if the requesting Person establishes that an error was made in the calculations upon which the original or supplemental appropriation or enlargement to an original appropriation was made.

(2) Excessive Flow.

An ISF right may be considered for modification if the requesting Person establishes that the ISF flow rate is in excess of the amount of water necessary to accomplish the purpose of the original, supplemental or enlarged ISF right when that right was appropriated.

9d. Recovery Implementation or Other Intergovernmental Agreement.

An ISF right may be modified if such modification was agreed upon by the Board as part of the Recovery Implementation Program for the Endangered Fishes of the Colorado River Basin or any other agreement between the Board and another governmental entity. Modifications made as a part of the Recovery Implementation Program for the Endangered Fishes of the Colorado River Basin need not be subject to the public review process in Rule 9e. Criteria for modifications made in the ISF rights decreed as part of the Recovery Implementation Program for the Endangered Fishes of the Colorado River Basin will be established in the decrees governing such appropriations.

9e. Public Review Process of Requests for Modification.

The Board shall adhere to the following public review process when considering requests for modification:

(1) Notice.

Notice of the proposed modification and the date of the public meeting at which it will first be considered shall be printed in the resume in the Water Court having jurisdiction over the decree that is the subject of the modification. The first public meeting of the Board at which the modification is to be considered shall occur at least sixty days after the month in which the resume is published. Notice shall also be published in a newspaper of statewide distribution within thirty to forty-five days prior to such first public meeting.

(2) Public Meeting.

If the Board decides at such first public meeting to give further consideration to the proposed modification, the Board shall announce publicly the date of a subsequent public meeting for such purpose. If the Board decides that it will not give further consideration to the proposed modification, it shall state, in writing, the basis for its decision.

(3) Request for Delay.

On the written request of any Person made within thirty days after the date of the first public meeting, the Board shall delay the subsequent public meeting for up to one year to allow such Person the opportunity for the collection of scientific data material to the proposed modification. The Board need not grant the request if it determines that the request is made solely to delay the proceedings.

(4) Procedures.

On the written request of any Person made within thirty days after the date of the first public meeting, the Board shall, within sixty days after such request, establish fair and formal procedures for the subsequent public meeting, including the opportunity for reasonable disclosure, discovery, subpoenas, direct examination, and cross examination. Subject to these rights and requirements, where a meeting will be expedited and the interests of the participants will not be substantially prejudiced thereby, the Board may choose to receive all or part of the evidence in written form.

(5) Final Determination.

The Board shall issue a final written determination regarding the modification that shall state its effective date, be mailed promptly to the Persons who appeared by written or oral comment at the Board's proceeding, and be filed promptly with the water court.

10. ENFORCEMENT AGREEMENTS.

The Board may attach conditions to an appropriation, decreased appropriation, or acquisition, and may enter into any enforcement agreements that it determines will preserve or improve the natural environment to a reasonable degree. The Board may enter into enforcement agreements that limit the

Board's discretion in the protection, approval of inundation, modification or disposal of ISF right, and/or may delegate limited authority to act on the Board's behalf.

10a. Ratification of Enforcement Agreements.

No enforcement agreement shall be effective to limit the discretion of the Board until that agreement and all of its terms are reviewed and ratified by the Board. Upon ratification, the Director may execute the agreement and the agreement shall be binding upon the Board for the term set forth in the enforcement agreement.

10b. Public Review Process.

The Board shall follow the public review process set forth in Rules 11a. - 11c. prior to any Board decision to ratify an Enforcement Agreement.

11. PUBLIC REVIEW PROCESS.

Except as otherwise provided in the ISF Rules, the Board shall follow the public review process set forth below prior to any Board decision requiring public review.

11a. Public Notice.

Public notice of all Board actions under these Rules shall be provided through the agenda of each regular or special Board meeting.

11b. Public Comment.

Except as otherwise provided in Rules 5k. and 6m., at a regular or special meeting, the Board shall consider public comment on the recommended ISF action prior to the Board action on the recommendation in any or all of the following manners:

(1) Oral and/or written comments may be directed to Staff. When such comments are made, Staff may summarize these comments to the Board.

(2) Oral and/or written comments, subject to reasonable limitations established by the Board, may be made directly to the Board during the public meeting.

11c. Public Agency Recommendations.

Prior to taking an ISF action pursuant to Rules 5 or 6, the Board shall request recommendations from the Division of Wildlife and the Division of Parks and Outdoor Recreation. The Board shall also request recommendations from the United States Department of Agriculture and the United States Department of Interior. The Board may also request comments from other interested Persons or agencies as it deems appropriate.

Prior to taking an ISF action pursuant to Rules 7, 8, 9, or 10, the Board may request recommendations from the Division of Wildlife, the Division of Parks and Outdoor Recreation, the Division of Water Resources, the United States Department of Agriculture, the United States Department of Interior or other Persons as it deems appropriate.

11d. Board Procedures.

At a regular or special Board meeting, the Board may, as necessary, adopt or amend procedures to supplement these rules.

12. SEVERABILITY.

In the event that any section or subsection of these Rules are judged to be invalid by a court of law or are allowed to expire by the General Assembly, the remaining Rules shall remain in full force and effect.

Exhibit 11

Development of Instream Flow Recommendations In Colorado Using

R2CROSS

Colorado Water Conservation Board
Department of Natural Resources
1313 Sherman Street, Room 721
Denver, Colorado 80203

Water Rights Investigations Section

January 1996

Development of Instream Flow Recommendations In Colorado Using

R2CROSS

By Gregory D. Espegren
Senior Water Resource Specialist

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Colorado Water Conservation Board
Department of Natural Resources
1313 Sherman Street, Room 721
Denver, Colorado 80203

Water Rights Investigations Section

January 1996

Abstract

In 1973, the Colorado State Legislature vested the Colorado Water Conservation Board with the authority to appropriate instream flow water rights in the State of Colorado. Today, the Board holds 1,326 instream flow water rights covering approximately 7,982 miles of Colorado streams. Standardized field and office procedures help to ensure that instream flow recommendations reflect the amount of water required to "preserve the natural environment to a reasonable degree", as prescribed by state statute. R2CROSS is one of the standard techniques employed by state and federal agencies to model instream hydraulic parameters. R2CROSS was chosen because it is time and labor efficient and produces comparable results to more costly techniques, i.e., the Instream Flow Incremental Methodology. This manuscript provides an overview of Colorado's Instream Flow Program and documentation for the Board's R2CROSS Lotus macro. The R2CROSS macro runs efficiently on an IBM-compatible 80486 personal computer equipped with a hard disk drive, and DOS 6.O, Windows 3.1, and Lotus 1-2-3 Release 4 for Windows software.

Acknowledgments

The Colorado Water Conservation Board would like to thank everyone involved in the development of the Board's R2CROSS Lotus macro. In addition, the author wishes to acknowledge the persons involved in the review and testing of the R2CROSS macro including R. Barry Nehring and Jay Skinner of the Colorado Division of Wildlife, Dr. Eric P. Bergersen, Dr. Kurt Fausch, and Charles Gowan of Colorado State University, Dennis Murphy of the Bureau of Land Management, Dave Gerhardt of the United States Forest Service, Dan Merriman, Anne Janicki, and Margaret Langdon of the Colorado Water Conservation Board, and Steven O. Sims of the State Attorney General's Office. The Board is very grateful to all of those who participated in the development of the R2CROSS macro and this document.

Disclaimer

The R2CROSS macro is in the public domain, and the recipient may not assert any proprietary rights thereto nor represent it to anyone as other than a Colorado State Government-produced program. R2CROSS is provided "as-is" without warranty of any kind, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. The user assumes all responsibility for the accuracy and suitability of this program for a specific application. In no event will the Colorado Water Conservation Board or the Colorado Division of Wildlife be liable for any damages, including lost profits, lost savings, or other incidental or consequential damages arising from the use of or the inability to use this program.

The CWCB staff verified the calculations preformed in its R2CROSS program with hand-held calculators and by comparison with other Manning's equation-based hydraulic streamflow models. Based upon this verification process, the staff believes that the instream hydraulic parameters summarized in the R2CROSS staging table are accurate calculations of Manning's equation. However, the CWCB does not suggest that the predicted hydraulic parameters will necessarily be realized at any particular stream discharge.

On November 10, 1993, the Colorado Water Conservation Board adopted Rules and Regulations that codified the procedures the Board follows in appropriating instream flow water rights. This document is intended to conform to the procedures presented in the Rules and Regulations.

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Tables

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Introduction

Colorado's Instream Flow Program originated in 1973 with the passage of Senate Bill 97 (SB 97). Under SB 97, the Colorado Water Conservation Board (CWCB) was vested with the authority to appropriate instream flow water rights in the State of Colorado (§ 37-92-102(3), C.R.S. (1990)). Instream flow water rights are held by the CWCB on behalf of the people of the State of Colorado to "preserve the natural environment to a reasonable degree." Today, the CWCB holds 1,326 instream flow water rights covering approximately 7,982 miles of Colorado streams.

Determining the quantity of water required to preserve the natural environment to a reasonable degree can be a difficult task. The CWCB, in cooperation with the Colorado Division of Wildlife (DOW), has developed standard field and office procedures to ensure that each instream flow appropriation is necessary and reasonable and that the amount of water recommended is available for appropriation.

The R2CROSS methodology described in this document is a valuable tool in developing these instream flow recommendations. The CWCB uses R2CROSS because it is time and labor efficient and produces results which are comparable to more data intensive techniques (Nehring 1979).

This manuscript is divided into two sections. The first section describes Colorado's Instream Flow Program, including some of the statutory guidelines that have shaped the program. It also describes the standard field techniques and office procedures that are used by the CWCB staff in the development of R2CROSS-based instream flow recommendations. This section is intended to provide an understanding of the procedural and technical aspects of Colorado's Instream Flow Program.

The second section of the manuscript is a users' manual for the CWCB's R2CROSS macro. The CWCB has received many requests for its R2CROSS macro from both the public and private sectors but has been hesitant to release the program without proper documentation. The second section of the manuscript is intended to provide that documentation.

Colorado's Instream Flow Program

Instream Flow Legislation

The CWCB was created in 1937 to serve as the State's chief water planning agency (§ 37-60-101 through 123, C.R.S. (1990)). Today, the CWCB is responsible for the administration of the State's Instream Flow Program, protection of endangered aquatic species, identification of flood plains, funding of new water development and water conservation projects, and negotiation of inter- and intra-state water planning issues.

The CWCB is a fourteen-member board. The board consists of one Governor-appointee from each of the eight major river drainages in the State and one from the City and County of Denver. Each Governor-appointee must also be confirmed by the Colorado State Senate. Ex-officio members of the board include the

Executive Director of the Department of Natural Resources, the Directors of the CWCB and DOW, the State Attorney General, and the State Engineer. The diverse backgrounds of its board members provides the CWCB with an excellent representation of Colorado's various water interests.

Colorado's Instream Flow Program was created in 1973 when the Colorado State Legislature recognized "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" through the passage of SB 97. Within SB 97, the definition of beneficial use was changed to include minimum stream flows and the CWCB was vested with the authority to appropriate "waters of natural streams and lakes ... as may be required ... to preserve the natural environment to a reasonable degree." SB 97 was amended by Senate Bill 414 in 1981, Senate Bill 91 in 1986, Senate Bill 212 in 1987, and Senate Bill 54 in 1994. These changes and amendments are consolidated within § 37-92-102(3), C.R.S. (1990), the Instream Flow statute.

The Instream Flow statute sets forth the guidelines for the administration of Colorado's Instream Flow Program. The statute vests the CWCB with the exclusive authority to appropriate and acquire instream flow and natural lake level water rights. In order to encourage other entities to participate in Colorado's Instream Flow Program, the statute directs the CWCB to request instream flow recommendations from other state and federal agencies prior to initiating an instream flow appropriation. The CWCB routinely requests instream flow recommendations from the DOW, Colorado Division of Parks and Outdoor Recreation, United States Department of Agriculture, and United States Department of Interior (the "cooperating agencies").

Prior to appropriating an instream flow water right, the statute requires the CWCB to: (1) "determine that the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made; (2) determine that there is a natural environment that can be preserved to a reasonable degree with the CWCB's water right, if granted; and (3) determine that such environment can exist without material injury to water rights" (§ 37-92-102(3c), C.R.S. (1990)). The CWCB makes these determinations based upon a review of the supporting technical data and a final instream flow recommendation prepared by the CWCB staff.

Standardized field and office procedures have been developed to help ensure that final instream flow recommendations meet statutory guidelines and are consistent. The standard field procedures that were established concern selection of transect sites and collection of hydraulic and biologic data. Standard office procedures have been established for determining biological instream flow recommendations using output from R2CROSS and for analyzing water availability.

Field Procedures

Instream flow recommendations are typically based on hydraulic and biologic data collected during a single field visit. Hydraulic data collection consists of setting up a transect, surveying stream channel geometry, and measuring stream discharge. Biologic data is gathered to document the existence of a natural environment. The biologic data usually consists of a fish sample, collected by electrofishing, and an aquatic invertebrate sample.

Field Data Site Selection

The R2CROSS method requires that stream discharge and channel profile data be collected in a riffle stream habitat-type. A riffle is a stream segment that is controlled by channel geometry rather than a downstream flow control. Riffles are most easily visualized as the stream reaches which would dry up most quickly should streamflow cease.

Biologically, riffles are essential to the production of benthic invertebrates and the passage, spawning, egg incubation, feeding, and protective cover of fish. Riffles are also the stream habitat-type most sensitive to changes in hydraulic parameters with variation in discharge (Nehring 1979). Riffles are critical to a healthy aquatic environment because small reductions in streamflow may result in large reductions in water depth and the amount of wetted perimeter available for aquatic habitat. Maintaining adequate streamflow in riffles also preserves the natural environment in other important stream habitat-types such as pools and runs (Nehring 1979).

Hydraulic engineers have developed several mathematical models and equations to predict instream hydraulic parameters (Chow 1959). Manning's equation is one such model that is well-suited to the riffle stream habitat-type (Grant et al. 1992). In order to maximize the reliability of Manning's equation, transects are placed within a riffle so that streamflow is uniform across the transect (Grant et al. 1992). The transect represents the average stream width, depth, and cross-sectional area within the riffle being characterized. Transects should be located in areas that exhibit natural banks or grasslines and concentrated water flow, free from braiding. They should not be located on eroded or undercut streambanks.

Hydraulic Data Collection

Stream discharge is measured using standardized procedures established by the United States Geological Survey (USGS) (Buchanan and Somers 1969). On streams less than 50 feet in width, channel geometry is typically measured using sag-tape methodology (Silvey 1976; Ray and Megahan 1979). Larger streams typically require the use of a land survey level and stadia rod (Benson and Dalrymple 1967). A list of required field equipment for making streamflow measurements is provided in Table 1.

The sag-tape methodology consists of suspending a steel tape from bank to bank across the stream channel, perpendicular to the streamflow (Figure A). Metal cross section stakes are driven into the ground above the grassline. The steel tape is suspended by attaching the zero-end of the tape to one of the metal stakes, stretching the tape across the stream, and then attaching the other end to a tape clamp and spring scale fastened to the metal stake on the opposite streambank. A minimum of 15 pounds of tension is applied to the tape, as the tape is drawn up and clamped. A survey level and stadia rod are used to adjust the ends of the tape up or down until they are level, thereby producing a consistent datum from which vertical distance measurements can be read.

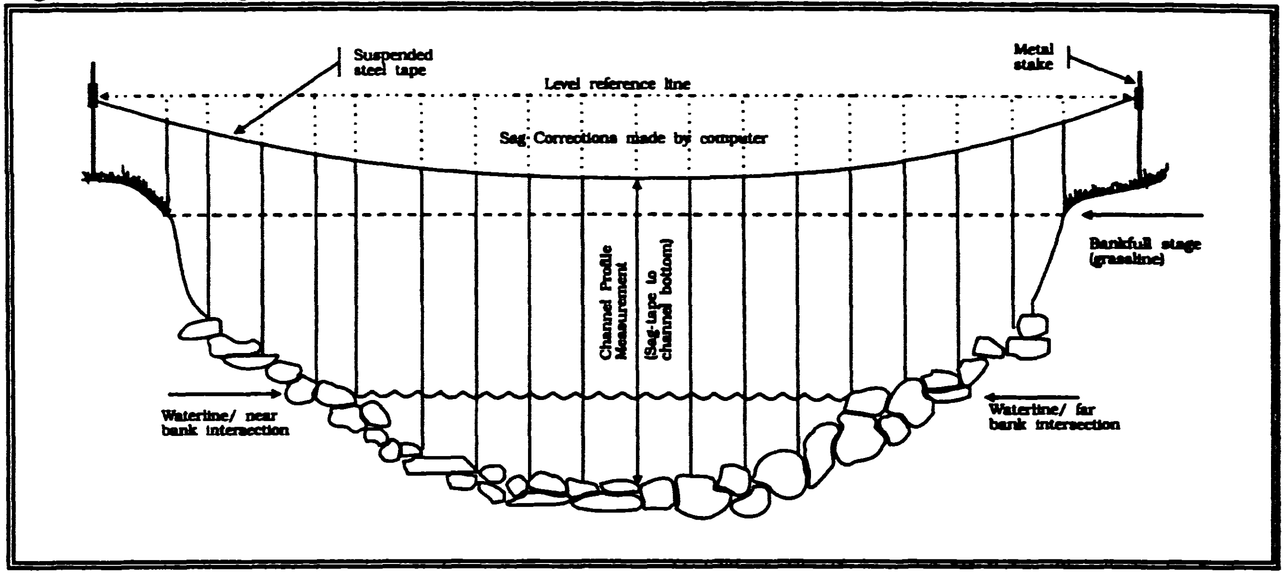
The R2CROSS program uses the standard weight of a one-foot section of the steel tape, tape tension, and the length of tape in suspension to correct horizontal distance and vertical depth measurements made from the sagging tape. The program adjusts the coordinates at each cross section vertical so that the corrected measurements correspond to a level datum from stake to stake and not the curved datum created by the sagging tape (Figure A).

On larger streams, vertical measurements between the suspended tape and the stream channel may be replaced with readings using a survey level and stadia rod. The suspended tape is then used to measure only the horizontal location of each cell vertical. There is no need to precisely level the ends of the suspended tape or to record the tape tension as no sag corrections are required.

Table 1. Field equipment list for making streamflow measurements

Equipment	Description
100' Steel Survey tape	Stretched between cross section stakes. (Obtain standard weight of a 1.0 foot section of tape from manufacturer)
Spring Tension Scale	Used to measure pounds of tension on steel tape when stretched between stakes.
Tape Clamp Handle	Holds tape in tension.
Cross Section Stakes	Two 24"-36" metal stakes used to maintain tape tension and to level steel tape. Must be strong enough to be driven into rocky stream bank.
Discharge Wading Rod (or Stadia Rod)	Used to measure vertical depths from suspended tape to stream channel.
Level, Tripod, and Stadia Rod	Used to level ends of suspended tape and to measure slope.
Current Meter	Pygmy, Price AA, Marsh-McBirney or similar devise used to measure stream velocity.
Hand Sledge Hammer	Used to drive cross section stakes into streambank.
Staging Pin	Used to detect changes in discharge during the streamflow measurement.
100' Fiberglass Tape	Used to measure horizontal distance from suspended tape to water-slope stadia rod readings.
Field Forms and Clipboard	Standardized form to ensure complete set of field data.
Miscellaneous Items	Camera, film, maps, waders, stopwatch and calculator.

Figure A. Typical stream cross section



Biologic Data Collection

Biologic sampling is conducted to document the existence of a natural environment. Coldwater fish species, particularly salmonids, have been used to indicate the existence of such a natural environment in the majority of the CWCB's instream flow appropriations to date. Warmwater fish species and other aquatic life forms may be used to document the existence of a natural environment in more downstream, low-elevation stream segments. In addition to salmonids, the CWCB has used amphibians, such as frogs and salamanders, and warmwater fish species, including the endangered fishes of the Colorado River basin, as the biologic basis for instream flow appropriations.

Biologic data typically consists of a fish sample, collected by electrofishing, and an aquatic invertebrate sample. Captured fish are identified and measured and a length-frequency distribution is constructed for each species. The sample is not tied directly to the R2CROSS hydraulic modeling but it may be used to refine the biologic instream flow recommendation to meet the specific habitat requirements of unique populations.

The Field Form

The CWCB and DOW use a standardized field form to record all field data. The use of this form helps to ensure that all instream flow recommendations are based upon a uniform set of field data. The front page of the form provides space for cross section "Location Information", "Supplemental Data", "Channel Profile Data", an "Aquatic Sampling Summary", and "Comments" (Figure B). The back page is dedicated to "Discharge/Cross Section Notes" (Figure C).

The "Location Information" section of the field form is used to describe the location of the cross section as well as the date and names of the members of the field crew. Geographic information can be obtained from either USGS or United States Forest Service (USFS) maps. Water divisions and DOW water codes can be obtained from the State Engineers' Office, the CWCB, or the DOW.

The "Supplemental Data" section is used to provide supporting documentation of the field data collection effort. Most importantly, this section is used to record the tape manufacturer's standard weight (lbs/ft) and tape tension (lbs). The R2CROSS program uses this information, together with the length of tape in suspension, to adjust vertical distances measured from the sagging tape to a level reference datum.

The "Channel Profile Data" section of the form is used to establish the relationship between the sag-tape cross section and the stream. Stadia rod readings are taken at each end of the suspended tape and at the water surface on the right and left streambanks. These readings are recorded within the "Rod Reading (ft)" column. They are used to assure that the ends of the tape are level and to quantify the vertical distance between the suspended tape and the water surface. Water surface readings and horizontal distances are also recorded upstream and downstream of the suspended tape. These observations are used to establish the water surface slope for input into Manning's equation.

The right side of the "Channel Profile Data" section is used to graphically depict the relative locations of the suspended tape and survey level, the direction of streamflow, and any photographic documentation of the field data collection effort. Photographs of the suspended tape are taken looking up, down, and across the stream.

Biologic sampling is summarized in the "Aquatic Sampling Summary" portion of the field form. Biologic data typically consists of a fish sample, collected by electrofishing, and an aquatic invertebrate sample. Captured fish are identified by species and measured to the nearest inch. A species-specific length-frequency distribution is created by placing a hashmark in the appropriate cell of the table as each fish is measured. Aquatic invertebrate sampling is summarized within the space provided at the bottom of this section.

All other pertinent field data is recorded in the "Comments" section of the field form. This section is often used to record weather conditions, water turbidity, or species-specific biomass estimates. This additional information helps characterize the field data when it is being analyzed in the office.

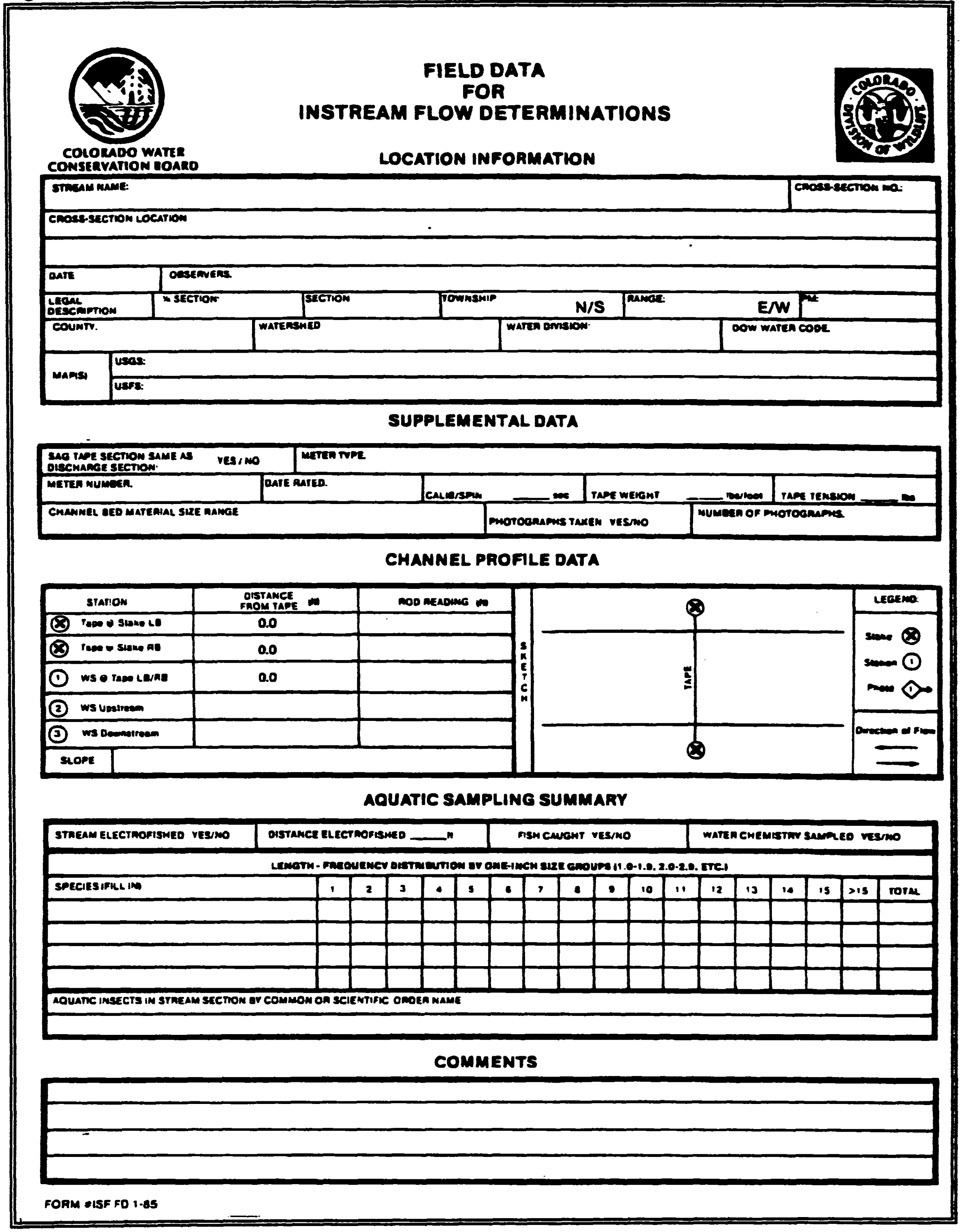
The "Discharge/Cross Section Notes" portion of the field form is used to record all of the hydraulic measurements associated with the discharge measurement (Figure C). A heading is provided to record the stream name, cross section number, date, edge of water looking downstream, the staging pin reading, and time at the beginning of the stream discharge measurement. The table below the heading is used to record "Features", "Distance From Initial Point", "Width", "Total Vertical Depth From Tape/Inst(rument)", and "Water Depth" channel geometry parameters at each cell vertical. Stream velocity measurements are recorded under the columns labeled "Depth of Observation", "Revolutions", "Time", and "Velocity" for each wet cell. All discharge measurement procedures are as outlined by Buchanan and Somers (1969).

The first and last channel geometry measurements are always taken at the cross section stakes. Channel geometry measurements should also be taken at the grassline-streambank and streambank-waterline intersections and at all distinguishable slope breaks between these two intersection points. The horizontal locations of the grassline-streambank and streambank-waterline intersections are also documented by placing a "G" and a "W" in the appropriate row of the "Features" column of the field form. Grassline is identified at the normal high water line, not flood stage, and is generally located below sedges and other plants that may survive submerged under high flows. The "Features" column is also used to document the horizontal locations of the two cross section stakes ("S") and any rocks ("R") or other features that may have an impact on the discharge measurement.

In streams with uniform bottom profiles (i.e., sand, cobble, etc.), channel geometry and discharge measurements are taken at fixed intervals within the wetted portion of the channel. The interval is varied in streams with boulder substrates to more accurately reflect changes in the velocity distribution with changes in channel bottom profile. The stream discharge measurement is divided into a minimum of 20 to 30 discharge cells, depending upon wetted stream width, with a minimum cell width of 0.3 feet. Sufficient measurements are taken to ensure that no more than 10% of the total streamflow occurs within a single discharge cell. Horizontal and vertical distances are taken from the suspended tape and recorded to the nearest tenth of a foot. Stream velocity (ft/sec) within each cell is averaged and recorded.

The bottom of the "Discharge/Cross Section Notes" section is used to summarize the discharge measurement. Space is also provided to record the names of the persons responsible for the field data calculations, the staging pin reading, and time at the end of the stream discharge measurement.

Figure B. Field data input sheet (Front Page)



COLORADO WATER CONSERVATION BOARD

FIELD DATA FOR INSTREAM FLOW DETERMINATIONS

LOCATION INFORMATION

STREAM NAME:

CROSS-SECTION NO.:

CROSS-SECTION LOCATION

DATE

OBSERVERS.

LEGAL DESCRIPTION

¼ SECTION:

SECTION

TOWNSHIP N/S

RANGE: E/W

PM:

COUNTY.

WATERSHED

WATER DIVISION:

DOW WATER CODE.

MAP(S) USGS:

USFS:

SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES / NO

METER TYPE.

METER NUMBER.

DATE RATED.

CALIB/SPIN ______ sec

TAPE WEIGHT ______ lbs/foot

TAPE TENSION ______ lbs

CHANNEL BED MATERIAL SIZE RANGE

PHOTOGRAPHS TAKEN YES/NO

NUMBER OF PHOTOGRAPHS.

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	
⊗ Tape @ Stake RB	0.0	
① WS @ Tape LB/RB	0.0	
② WS Upstream		
③ WS Downstream		
SLOPE		

AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED YES/NO

DISTANCE ELECTROFISHED ______ ft

FISH CAUGHT YES/NO

WATER CHEMISTRY SAMPLED YES/NO

LENGTH - FREQUENCY DISTRIBUTION BY ONE-INCH SIZE GROUPS (1.0-1.9, 2.0-2.9, ETC.)

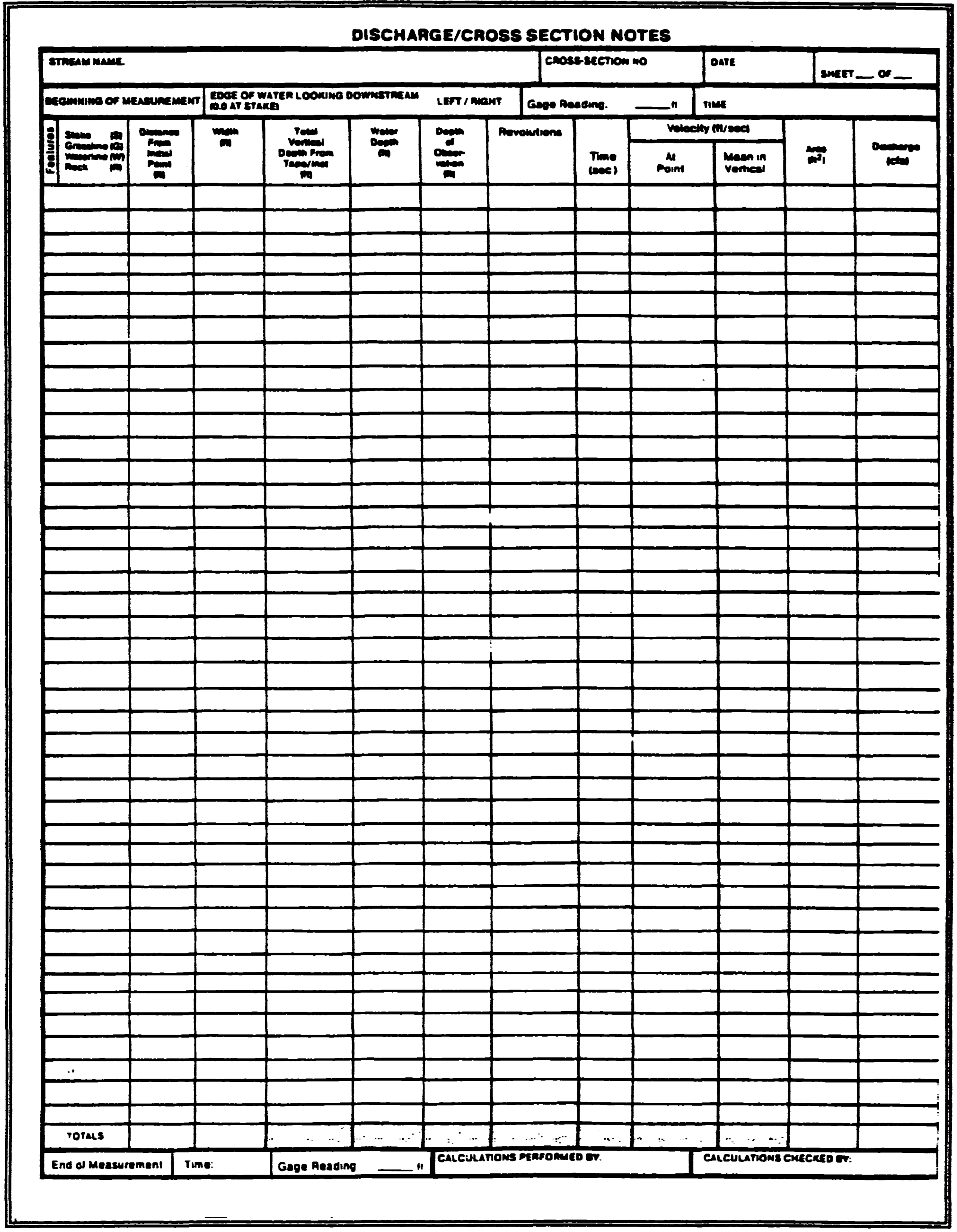
SPECIES (FILL IN)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>15	TOTAL

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME

COMMENTS

FORM #ISF FD 1-85

Figure C. Field data input sheet (Back Page)



DISCHARGE/CROSS SECTION NOTES

STREAM NAME

CROSS-SECTION NO

DATE

SHEET ___ OF ___

BEGINNING OF MEASUREMENT

EDGE OF WATER LOOKING DOWNSTREAM (0.0 AT STAKE) LEFT / RIGHT

Gage Reading. ______ ft

TIME

Features Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec)		Area (ft^2)	Discharge (cfs)
								At Point	Mean in Vertical		
TOTALS											

End of Measurement

Time:

Gage Reading ______ ft

CALCULATIONS PERFORMED BY:

CALCULATIONS CHECKED BY:

Office Procedures

The CWCB uses a Lotus 1-2-3 macro, called R2CROSS, to process the field data and model instream hydraulic parameters at streamflows above and below the field-measured discharge. The CWCB relies upon the biologic expertise of the cooperating agencies to interpret the output from R2CROSS and develop an initial, biologic instream flow recommendation. This initial recommendation is designed to address the unique biologic requirements of each stream without regard to water availability. After receiving the cooperating agencies' biologic recommendation, the CWCB staff evaluates stream hydrology to determine whether water is physically available for an instream flow appropriation.

Background on the R2CROSS Methodology

Three instream hydraulic parameters, average depth ($\bar{x}_d$), average velocity ($\bar{x}_v$), and percent wetted perimeter (*%WP*), are used to develop biologic instream flow recommendations in Colorado. The DOW has determined that by maintaining these three hydraulic parameters at adequate levels across riffle habitat-types, aquatic habitat in pools and runs will also be maintained for most life stages of fish and aquatic invertebrates (Nehring 1979).

The R2CROSS methodology uses Manning's equation to predict $\bar{x}_d$, $\bar{x}_v$, *%WP*, and other instream hydraulic parameters, at discharges both above and below the field-measured stream discharge. The methodology is both time and labor efficient, requires data from only a single stream transect, and has been found to produce similar results to more data intensive techniques (Nehring 1979) such as the Instream Flow Incremental Methodology (IFIM) developed by the U.S. Fish and Wildlife Service (Bovee 1982).

In 1973, the CWCB staff performed all Manning's equation calculations with a hand-held calculator. In 1981, the USFS released "*Program Documentation for R2-CROSS-81*" (Weatherred et al. 1981). This Fortran-based, mainframe computer program automated the repetitive task of manipulating and recalculating Manning's equation by hand. The CWCB used the USFS version of R2CROSS on the Colorado State University mainframe computer until 1985.

In 1986, the CWCB staff began development of a personal computer version of R2CROSS using the macro capabilities of Lotus 1-2-3. The CWCB found the R2CROSS macro to be advantageous because it ran on a personal computer and it could be customized to the specific needs of the CWCB. The most recent version of R2CROSS is menu-driven (Figure D) and requires very little experience with Lotus 1-2-3. The macro formats the R2CROSS worksheet, initiates data entry, and performs all calculations and printing automatically.

Figures E through K provide an example of R2CROSS output from a typical Colorado stream. Figure E is a "Proof Sheet" that is printed and inspected for data entry errors prior to performing final R2CROSS calculations. Final output consists of a five page printout (Figures F through J). Page one summarizes most of the stream location information, supplemental data, and channel profile data from the field form (Figure F). Page two summarizes the channel geometry/discharge field data set and values computed from the raw field data, including an estimate of Manning's "n" (Figure G). Page three consists of a water line comparison table which the program uses to interpolate the single water surface elevation that results in a calculated cross-sectional area equal to the field-measured cross-sectional area (Figure H). Page four is the staging table that is used by the cooperating agency to develop an initial, biologic instream flow recommendation

(Figure I). The staging table provides estimates of modeled instream hydraulic parameters at stages above and below the measured discharge. Page five summarizes measured and calculated flows, waterlines, and depths (Figure J). It also presents estimates of mean velocity, Manning's "n", water slope, and upper and lower streamflow limits within which the instream flow recommendation should fall. In general, hydraulic models based upon Manning's equation are most accurate when predicted flows fall within a range of 0.4 to 2.5 times measured flow (Bovee and Milhous 1978; Bovee 1982). Space is also provided for a narrative describing the basis for the initial instream flow recommendation and for the signatures of the personnel involved in making the recommendation. The macro can also be used to generate a plot of the stream cross section (Figure K).

Figure D. The R2CROSS Menu

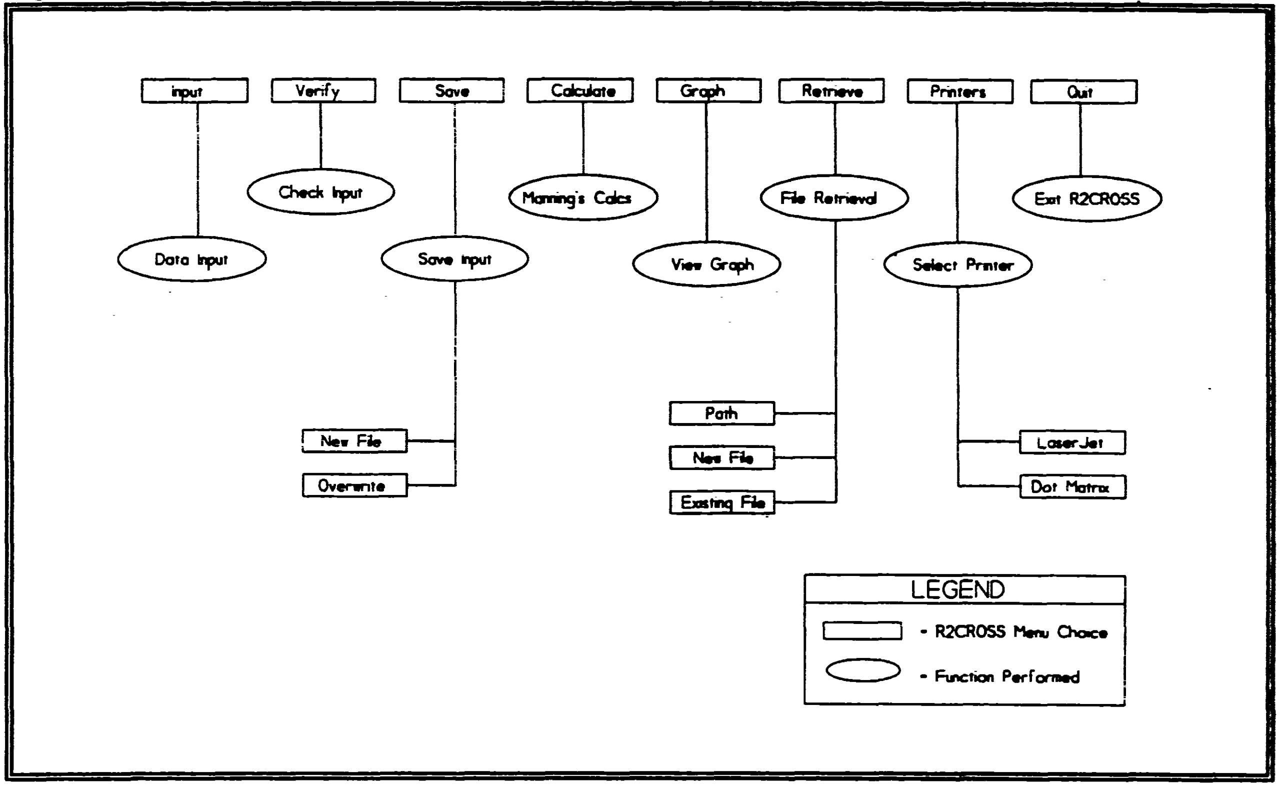
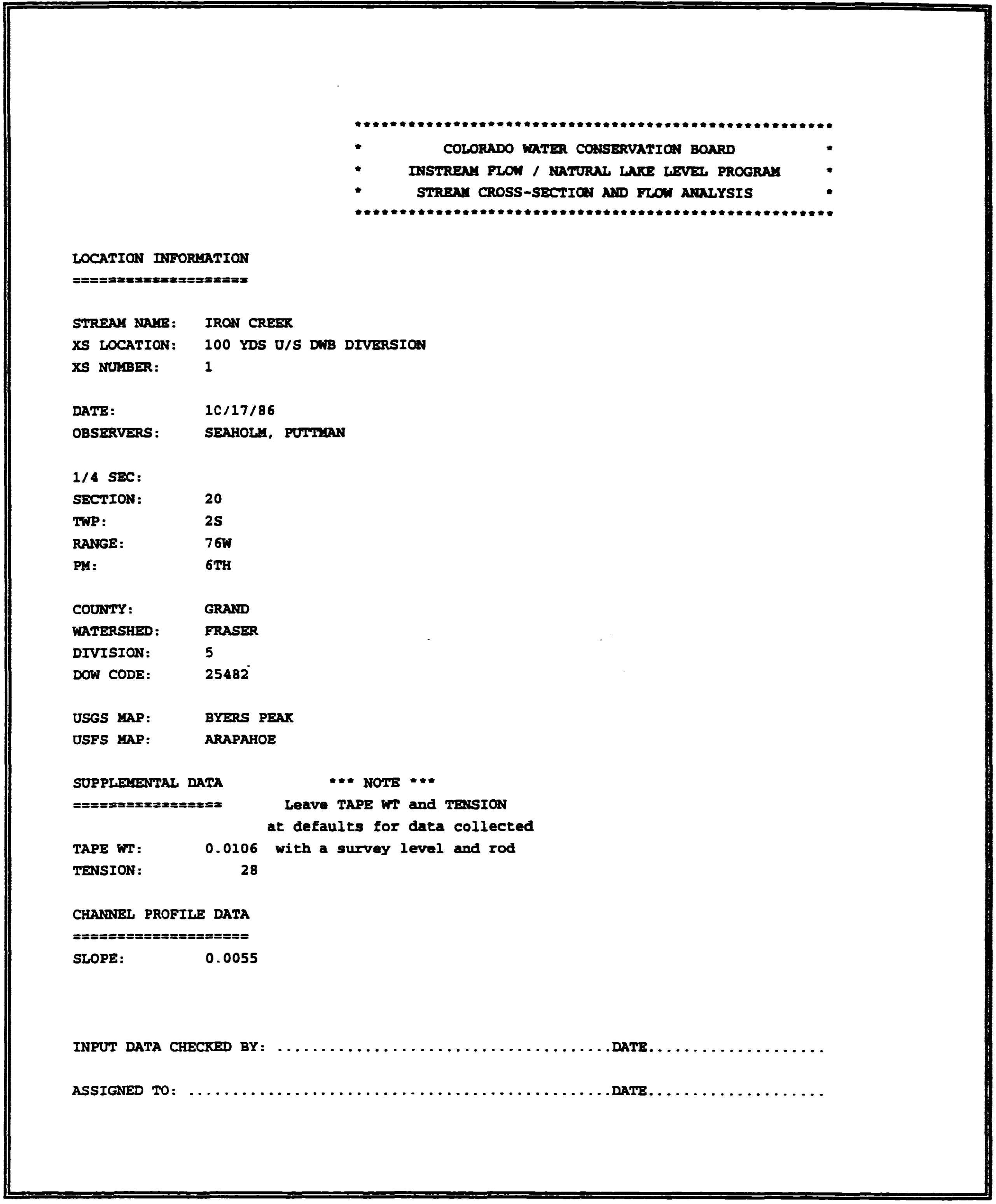


Figure E. R2CROSS proof sheet

```
                                                       PROOF SHEET
                                                       ===========

LOCATION INFORMATION                           INPUT DATA       # DATA POINTS=          34
====================                           ======================================================================
                                               FEATURE             VERT     WATER                             TAPE TO
STREAM NAME:      IRON CREEK                               DIST    DEPTH    DEPTH      VEL        A        Q    WATER
XS LOCATION:      100 YDS U/S DWB DIVERSION    ======================================================================
XS NUMBER:        1                            S           0.00     1.10     0.00     0.00     0.00     0.00     0.00
                                                           0.50     1.30     0.00     0.00     0.00     0.00     0.00
DATE:             10/17/86                   1 G           1.00     1.40     0.00     0.00     0.00     0.00     0.00
OBSERVERS:        SEAHOLM, PUTTMAN                         2.00     1.80     0.00     0.00     0.00     0.00     0.00
                                                           2.50     1.95     0.00     0.00     0.00     0.00     0.00
1/4 SEC:                                                   3.00     2.00     0.00     0.00     0.00     0.00     0.00
SECTION:          20                           R           3.50     1.90     0.00     0.00     0.00     0.00     0.00
TWP:              2S                                       4.00     2.45     0.00     0.00     0.00     0.00     0.00
RANGE:            76W                                      4.50     2.45     0.00     0.00     0.00     0.00     0.00
PM:               6TH                          W           5.00     2.60     0.00     0.00     0.00     0.00     0.00
                                                           5.70     3.00     0.40     0.80     0.20     0.16     2.61
COUNTY:           GRAND                                    6.00     3.10     0.45     0.45     0.13     0.06     2.66
WATERSHED:        FRASER                                   6.30     3.00     0.40     1.10     0.12     0.13     2.61
DIVISION:         5                                        6.60     3.00     0.40     0.95     0.12     0.11     2.61
DOW CODE:         25482                                    6.90     2.95     0.35     0.95     0.11     0.10     2.61
                                                           7.20     2.85     0.25     0.70     0.07     0.05     2.61
USGS MAP:         BYERS PEAK                               7.50     3.10     0.50     0.75     0.15     0.11     2.61
USFS MAP:         ARAPAHOE                                 7.80     3.10     0.50     0.65     0.15     0.10     2.61
                                                           8.10     3.10     0.50     0.85     0.15     0.13     2.61
SUPPLEMENTAL DATA                                          8.40     3.20     0.60     0.95     0.18     0.17     2.61
=================                                          8.70     3.20     0.60     1.10     0.18     0.20     2.61
                                                           9.00     3.20     0.60     1.35     0.18     0.24     2.61
TAPE WT:            0.0106                                 9.30     3.15     0.55     1.40     0.16     0.23     2.61
TENSION:                28                                 9.60     3.25     0.65     1.50     0.19     0.29     2.61
                                                           9.90     3.30     0.70     1.55     0.21     0.33     2.61
CHANNEL PROFILE DATA                                      10.20     3.30     0.70     1.60     0.21     0.34     2.61
====================                                      10.50     3.30     0.70     1.25     0.12     0.15     2.61
SLOPE:              0.0055                     W          10.55     2.60     0.00     0.00     0.00     0.00     0.00
                                             1 G          11.00     1.30     0.00     0.00     0.00     0.00     0.00
                                                          11.50     0.85     0.00     0.00     0.00     0.00     0.00
                                                          12.00     0.60     0.00     0.00     0.00     0.00     0.00
                                                          12.50     0.55     0.00     0.00     0.00     0.00     0.00
                                                          13.00     0.55     0.00     0.00     0.00     0.00     0.00
                                               S          13.50     0.50     0.00     0.00     0.00     0.00     0.00
                                                                                          ===========================
                                                                                  TOTALS       2.65     2.91
```

Figure F.   Final output from R2CROSS (Page 1)



```
                              ****************************************************
                              *          COLORADO WATER CONSERVATION BOARD        *
                              *       INSTREAM FLOW / NATURAL LAKE LEVEL PROGRAM  *
                              *        STREAM CROSS-SECTION AND FLOW ANALYSIS     *
                              ****************************************************

LOCATION INFORMATION
====================

STREAM NAME:    IRON CREEK
XS LOCATION:    100 YDS U/S DWB DIVERSION
XS NUMBER:      1

DATE:           10/17/86
OBSERVERS:      SEAHOLM, PUTTMAN

1/4 SEC:
SECTION:        20
TWP:            2S
RANGE:          76W
PM:             6TH

COUNTY:         GRAND
WATERSHED:      FRASER
DIVISION:       5
DOW CODE:       25482

USGS MAP:       BYERS PEAK
USFS MAP:       ARAPAHOE

SUPPLEMENTAL DATA           *** NOTE ***
=================       Leave TAPE WT and TENSION
                       at defaults for data collected
TAPE WT:        0.0106  with a survey level and rod
TENSION:            28

CHANNEL PROFILE DATA
====================
SLOPE:          0.0055


INPUT DATA CHECKED BY: ......................................DATE...................

ASSIGNED TO: ................................................DATE...................
```

Figure G. Final output from R2CROSS (Page 2)

```
   STREAM NAME:    IRON CREEK
   XS LOCATION:    100 YDS U/S DWB DIVERSION
   XS NUMBER:      1

   INPUT DATA      # DATA POINTS=    34        VALUES COMPUTED FROM RAW FIELD DATA
   ===================================         ========================================
   FEATURE            VERT   WATER              WETTED   WATER     AREA      Q       % Q
              DIST   DEPTH   DEPTH    VEL       PERIM.   DEPTH     (Am)    (Qm)     CELL
   ===================================         ========================================
   S          0.00    1.10    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
              0.50    1.30    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
 1 G          1.00    1.40    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
              2.00    1.80    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
              2.50    1.95    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
              3.00    2.00    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
   R          3.50    1.90    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
              4.00    2.45    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
              4.50    2.45    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
   W          5.00    2.60    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
              5.70    3.00    0.40   0.80        0.81     0.40     0.20    0.16      5.5%
              6.00    3.10    0.45   0.45        0.32     0.45     0.13    0.06      2.1%
              6.30    3.00    0.40   1.10        0.32     0.40     0.12    0.13      4.5%
              6.60    3.00    0.40   0.95        0.30     0.40     0.12    0.11      3.9%
              6.90    2.95    0.35   0.95        0.30     0.35     0.11    0.10      3.4%
              7.20    2.85    0.25   0.70        0.32     0.25     0.07    0.05      1.8%
              7.50    3.10    0.50   0.75        0.39     0.50     0.15    0.11      3.9%
              7.80    3.10    0.50   0.65        0.30     0.50     0.15    0.10      3.4%
              8.10    3.10    0.50   0.85        0.30     0.50     0.15    0.13      4.4%
              8.40    3.20    0.60   0.95        0.32     0.60     0.18    0.17      5.9%
              8.70    3.20    0.60   1.10        0.30     0.60     0.18    0.20      6.8%
              9.00    3.20    0.60   1.35        0.30     0.60     0.18    0.24      8.4%
              9.30    3.15    0.55   1.40        0.30     0.55     0.16    0.23      7.9%
              9.60    3.25    0.65   1.50        0.32     0.65     0.19    0.29     10.1%
              9.90    3.30    0.70   1.55        0.30     0.70     0.21    0.33     11.2%
             10.20    3.30    0.70   1.60        0.30     0.70     0.21    0.34     11.6%
             10.50    3.30    0.70   1.25        0.30     0.70     0.12    0.15      5.3%
   W         10.55    2.60    0.00   0.00        0.70     0.00     0.00    0.00      0.0%
 1 G         11.00    1.30    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
             11.50    0.85    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
             12.00    0.60    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
             12.50    0.55    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
             13.00    0.55    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
   S         13.50    0.50    0.00   0.00        0.00     0.00     0.00    0.00      0.0%
                                               ========================================
            TOTALS ----------------------        6.49      0.7     2.65    2.91    100.0%
                                                         (Max.)

                                                        Manning's n =     0.0552
```

Figure H. Final output from R2CROSS (Page 3)

```
STREAM NAME:    IRON CREEK
XS LOCATION:    100 YDS U/S DWB DIVERSION
XS NUMBER:      1

WATER LINE COMPARISON TABLE
============================
  WATER   MEAS   COMP   AREA
   LINE   AREA   AREA  ERROR
============================

   2.36   2.65   4.21   59.0%
   2.38   2.65   4.07   53.9%
   2.40   2.65   3.94   48.8%
   2.42   2.65   3.81   43.8%
   2.44   2.65   3.67   38.8%
   2.46   2.65   3.54   33.8%
   2.48   2.65   3.42   29.2%
   2.50   2.65   3.30   24.7%
   2.52   2.65   3.18   20.2%
   2.54   2.65   3.07   15.8%
   2.56   2.65   2.95   11.4%
   2.57   2.65   2.89    9.3%
   2.58   2.65   2.84    7.1%
   2.59   2.65   2.78    5.0%
   2.60   2.65   2.72    2.9%
   2.61   2.65   2.67    0.8%
   2.62   2.65   2.61   -1.3%
   2.63   2.65   2.56   -3.4%
   2.64   2.65   2.50   -5.5%
   2.65   2.65   2.45   -7.6%
   2.66   2.65   2.39   -9.6%
   2.68   2.65   2.28  -13.7%
   2.70   2.65   2.18  -17.8%
   2.72   2.65   2.07  -21.9%
   2.74   2.65   1.96  -25.9%
   2.76   2.65   1.86  -29.9%
   2.78   2.65   1.75  -33.9%
   2.80   2.65   1.65  -37.8%
   2.82   2.65   1.54  -41.8%
   2.84   2.65   1.44  -45.6%
   2.86   2.65   1.34  -49.5%
============================
        WATERLINE AT ZERO
        AREA ERROR =  2.611
```

Figure I. Final output from R2CROSS (Page 4)

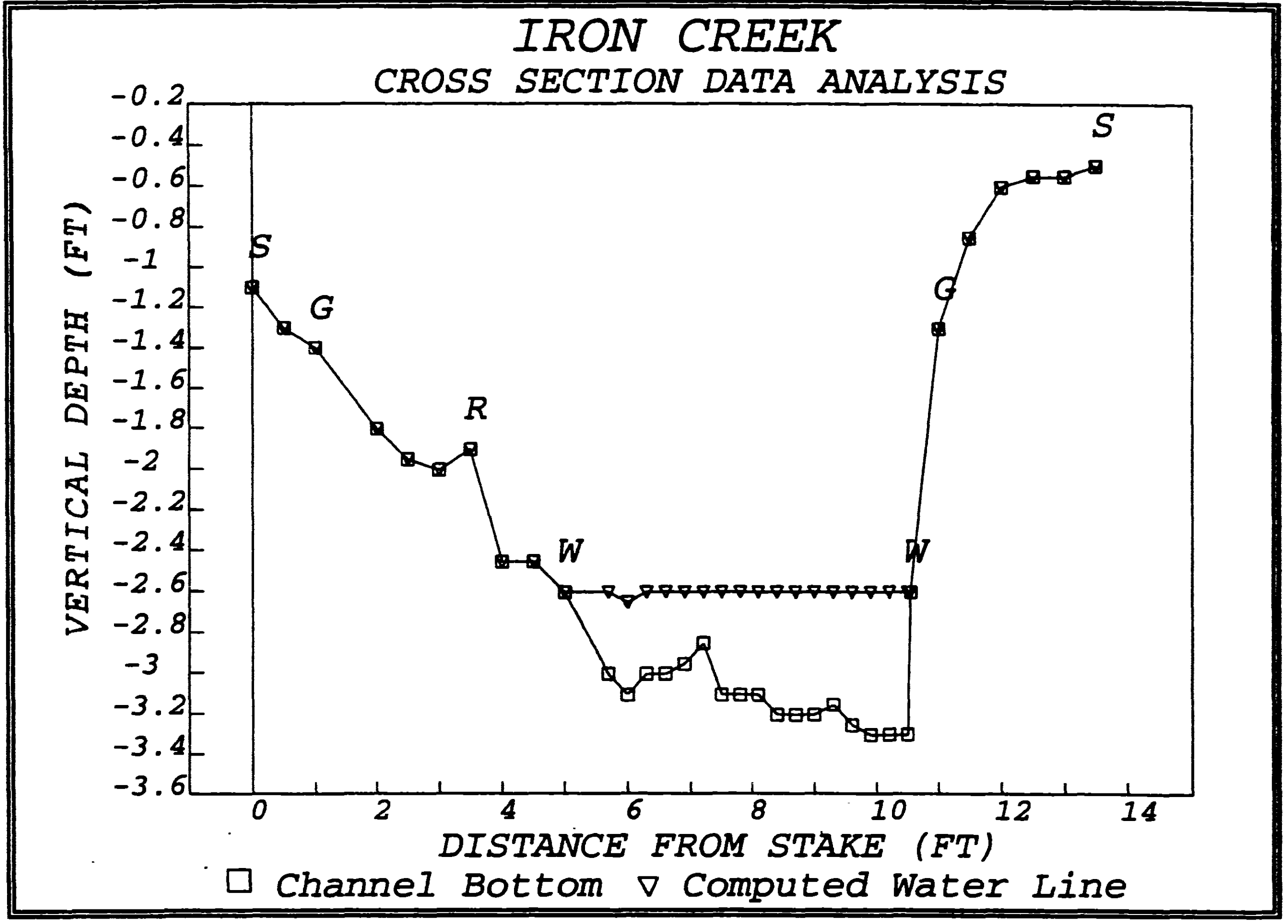
```
STREAM NAME:        IRON CREEK
XS LOCATION:        100 YDS U/S DWB DIVERSION
XS NUMBER:          1

                    *GL* = lowest Grassline elevation corrected for sag
STAGING TABLE       *WL* = Waterline corrected for variations in field measured water surface elevations and sag
========================================================================================================================
       DIST TO     TOP       AVG.      MAX.                WETTED    PERCENT    HYDR                  AVG.
        WATER     WIDTH     DEPTH     DEPTH      AREA      PERIM.    WET PER   RADIUS      FLOW     VELOCITY
        (FT)      (FT)      (FT)      (FT)     (SQ FT)     (FT)       (%)       (FT)      (CFS)    (FT/SEC)
========================================================================================================================

*GL*    1.40      9.97      1.21      1.90      12.09     12.14     100.0%     1.00      24.07       1.99
        1.61      9.38      1.07      1.70      10.08     11.37      93.6%     0.89      18.57       1.84
        1.66      9.23      1.04      1.65       9.61     11.18      92.0%     0.86      17.36       1.81
        1.71      9.09      1.01      1.60       9.15     10.99      90.5%     0.83      16.18       1.77
        1.76      8.95      0.97      1.55       8.70     10.80      89.0%     0.81      15.04       1.73
        1.81      8.80      0.94      1.50       8.26     10.61      87.4%     0.78      13.95       1.69
        1.86      8.62      0.91      1.45       7.82     10.39      85.5%     0.75      12.93       1.65
        1.91      8.41      0.88      1.40       7.40     10.13      83.5%     0.73      11.97       1.62
        1.96      7.90      0.88      1.35       6.99      9.55      78.6%     0.73      11.33       1.62
        2.01      7.16      0.92      1.30       6.61      8.75      72.0%     0.76      10.96       1.66
        2.06      7.10      0.88      1.25       6.26      8.63      71.0%     0.73      10.08       1.61
        2.11      7.04      0.84      1.20       5.90      8.51      70.0%     0.69       9.24       1.57
        2.16      6.97      0.80      1.15       5.55      8.39      69.1%     0.66       8.42       1.52
        2.21      6.91      0.75      1.10       5.21      8.27      68 1%     0.63       7.64       1.47
        2.26      6.85      0.71      1.05       4.86      8.15      67.1%     0.60       6.88       1.42
        2.31      6.79      0.67      1.00       4.52      8.02      66.1%     0.56       6.16       1.36
        2.36      6.72      0.62      0.95       4.18      7.90      65.1%     0.53       5.47       1.31
        2.41      6.66      0.58      0.90       3.85      7.78      64.1%     0.49       4.81       1.25
        2.46      6.09      0.58      0.85       3.52      7.16      58.9%     0.49       4.38       1.24
        2.51      5.91      0.55      0.80       3.22      6.93      57.1%     0.46       3.86       1.20
        2.56      5.72      0.51      0.75       2.93      6.70      55.2%     0.44       3.37       1.15
*WL*    2.61      5.55      0.48      0.70       2.65      6.48      53.4%     0.41       2.91       1.10
        2.66      5.45      0.43      0.65       2.37      6.33      52.1%     0.37       2.46       1.04
        2.71      5.36      0.39      0.60       2.10      6.18      50.9%     0.34       2.04       0.97
        2.76      5.27      0.35      0.55       1.84      6.03      49.7%     0.30       1.66       0.90
        2.81      5.18      0.30      0.50       1.57      5.88      48.4%     0.27       1.31       0.83
        2.86      5.08      0.26      0.45       1.32      5.72      47.1%     0.23       0.99       0.75
        2.91      4.78      0.22      0.40       1.07      5.33      43.9%     0.20       0.73       0.68
        2.96      4.47      0.19      0.35       0.84      4.94      40.7%     0.17       0.51       0.61
        3.01      3.73      0.17      0.30       0.63      4.11      33.8%     0.15       0.36       0.57
        3.06      3.36      0.13      0.25       0.45      3.66      30.2%     0.12       0.22       0.49
        3.11      2.41      0.12      0.20       0.29      2.63      21.6%     0.11       0.14       0.46
        3.16      2.22      0.08      0.15       0.18      2.39      19.7%     0.07       0.06       0.35
        3.21      1.05      0.08      0.10       0.08      1.15       9.4%     0.07       0.03       0.34
        3.26      0.88      0.04      0.05       0.03      0.93       7.6%     0.04       0.01       0.22
```

** NOTE**: Bold and underlined text within the Iron Creek staging table was added to facilitate explanation of the procedure for developing biologic instream flow recommendations (see Pages 18-19). Standard R2CROSS staging table printouts will not contain these enhancements.

Figure J. Final output from R2CROSS (Page 5)

```
STREAM NAME:    IRON CREEK
XS LOCATION:    100 YDS U/S DWB DIVERSION
XS NUMBER:      1


                                   SUMMARY SHEET


MEASURED FLOW (Qm)=            2.91 cfs          RECOMMENDED INSTREAM FLOW:
CALCULATED FLOW (Qc)=          2.91 cfs          ==========================
(Qm-Qc)/Qm * 100 =            -0.1 %
                                                 FLOW (CFS)          PERIOD
MEASURED WATERLINE (WLm)=      2.61 ft           ==========          ======
CALCULATED WATERLINE (WLc)=    2.61 ft
(WLm-WLc)/WLm * 100 =         -0.1 %             __________          ______________

MAX MEASURED DEPTH (Dm)=       0.70 ft           __________          ______________
MAX CALCULATED DEPTH (Dc)=     0.70 ft
(Dm-Dc)/Dm * 100               0.6 %             __________          ______________

MEAN VELOCITY=                 1.10 ft/sec       __________          ______________
MANNING'S n=                  0.055
SLOPE=                       0.0055 ft/ft

.4 * Qm =                      1.2 cfs
2.5 * Qm=                      7.3 cfs


RATIONALE FOR RECOMMENDATION:
=============================














RECOMMENDATION BY: .........................AGENCY............... DATE:................

CWCB REVIEW BY: ................................................. DATE:................
```

Figure K. Cross section plot from R2CROSS



Biologic Instream Flow Recommendations

When using R2CROSS, biologic instream flow recommendations are based on maintaining three principal hydraulic criteria, $\bar{x}_d$, $\bar{x}_v$, and *%WP*, at adequate levels across the stream transect (Table 2). The $\bar{x}_d$ and *%WP* criteria are functions of stream top width and grassline-to-grassline wetted perimeter, respectively. A constant $\bar{x}_v$ of 1 ft/sec is recommended for all streams. The DOW has determined that these three parameters are good indices of flow-related stream habitat quality and that maintenance of these parameters at adequate levels across riffle habitat-types will also result in maintenance of adequate aquatic habitat in pools and runs for most life stages of fish and aquatic invertebrates (Nehring 1979).

The three critical hydraulic parameters are estimated within the R2CROSS staging table at various levels of discharge (Figure I). Biologic instream flow recommendations are developed by locating the modeled streamflow(s) in the R2CROSS staging table that satisfy the three hydraulic criteria summarized in Table 2. The streamflow that meets two of the three criteria is considered as an initial winter flow recommendation. Initial summer flow recommendations are based upon satisfying all three criteria (Skinner, pers. comm). Aquatic biologists may modify summer and winter flow recommendations

Table 2. Criteria used to determine minimum flow requirements using the R2CROSS single transect method (Nehring 1979)

Stream Top Width (ft)[1]	Average Depth (ft)	Percent Wetted Perimeter (%)[1]	Average Velocity (ft/sec)
1-20	0.2	50	1.0
21-40	0.2-0.4	50	1.0
41-60	0.4-0.6	50-60	1.0
61-100	0.6-1.0	≥ 70	1.0

[1] At bankfull discharge.

based upon biologic considerations such as stream conditions, species composition, and aquatic habitat quality.

These hydraulic criteria can be applied to the R2CROSS staging table from the Iron Creek example (Figure I) to develop an initial biologic instream flow recommendation. In this example, the grassline top width of Iron Creek is 9.97 ft. Therefore, the DOW criteria for an $\bar{x}_d$ of 0.2 feet would be satisfied at a flow of approximately 0.6 cfs. The *%WP* criterion of 50% would be met at a flow of around 1.75 cfs and an $\bar{x}_v$ of 1 ft/sec at a flow of 2.25 cfs. Based upon this analysis, a winter flow recommendation of 1.75 cfs would meet the $\bar{x}_d$ and *%WP* criteria and a summer flow recommendation of 2.25 cfs would satisfy all three criteria. These initial recommendations may be adjusted up or down based upon biologic judgment and expertise.

Water Availability Requirements

Once an initial biologic instream flow recommendation has been developed, the CWCB staff must determine whether water is physically available to satisfy the biologic recommendation. The staff uses stream gaging records to analyze physical water availability whenever possible. In the absence of a gage record, the staff may use standardized hydrologic techniques, such as areal apportionment or synthetic streamflow modeling (Kircher et al. 1985), to estimate physical water availability. The staff may also conduct a review of the State Engineer's water rights tabulation and consult with Division Engineers and District Water Commissioners to determine the effect of senior diversions on a stream reach.

The water availability analyses may lead the CWCB staff to conclude that sufficient water is not available to meet the biologic recommendation. In that situation, the CWCB staff may request that the cooperating agency reconsider its biologic recommendation and determine whether the natural environment can be preserved with the amount of water available. If the natural environment can be preserved with the available water, the instream flow recommendation may be revised to reflect the lower available flow amounts. If the statutory water availability requirement cannot be satisfied, the CWCB must reject the instream flow recommendation.

Appropriating and Protecting an Instream Flow Water Right

On November 10, 1993, the CWCB adopted the "Statement of Basis and Purpose and Rules and Regulations Concerning the Colorado Instream Flow and Natural Lake Level Program." These Rules and Regulations codified existing CWCB procedures for implementing the Instream Flow Program and established procedures for handling acquisition of water, water rights, and interests in water including conditional rights, modification of instream flows, and inundation of instream flow water rights. The CWCB's procedural requirements for appropriating and protecting instream flow water rights are also described in great detail within these Rules and Regulations.

The procedural aspects of appropriating and protecting an instream flow water right are beyond the intended scope of this manuscript. Individuals who are interested in learning more about these procedures are encouraged to obtain a copy of the above-referenced Rules and Regulations from the CWCB.

Summary

In 1973, the Colorado State Legislature vested the CWCB with the authority to appropriate instream flow water rights to preserve the natural environment to a reasonable degree. Since that time, the CWCB has completed instream flow appropriations on approximately 7,982 miles of Colorado streams, and the Instream Flow Program is expanding.

The CWCB has adopted standardized field and office procedures for developing instream flow recommendations. This standardization helps to ensure that each instream flow recommendation is "necessary" and "reasonable", as required by state statute.

R2CROSS is one of the standard methodologies employed by the CWCB to model instream hydraulic parameters. The CWCB has chosen to use the R2CROSS methodology because it is both time and labor efficient, requiring data from only a single stream transect. It has also been found to produce similar results to more data intensive techniques like the IFIM. The R2CROSS macro is also easy to use and requires very little in the way of computer hardware or software.

Biologic instream flow recommendations based upon output from R2CROSS are designed to maintain $\bar{x}_v$, $\bar{x}_d$, and *%WP* at critical levels across riffle habitat-types. It is assumed that by maintaining these critical hydraulic parameters across riffles, aquatic habitat in pools and runs is also preserved. In addition to biologic considerations, water must be physically available for the CWCB to file for an instream flow water right.

An instream flow water right requires a coordinated effort between various state and federal agencies, the public, and the CWCB. The culmination of these efforts is a decreed instream flow water right that is held by the CWCB on behalf of the people of Colorado to "preserve the natural environment to a reasonable degree."

The Colorado State Legislature enacted SB 97 in 1973. By "recognizing the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (§ 37-92-102(3), C.R.S. (1990)), the Legislature sought to balance traditional water development with some reasonable protection of Colorado's natural environment. This is not a simple task in the semi-arid Western United States where water is a scarce, and extremely valuable resource. The ongoing success of Colorado's Instream Flow Program assures that coordination between water development and protection of the natural environment will continue -- both now and into the future.

R2CROSS Program Documentation

Program documentation for the R2CROSS macro is divided into four sections. The "Setup and Installation" section describes the hardware and software requirements of the R2CROSS macro and installation of the R2CROSS program on a hard disk drive. The "Iron Creek Example" provides an opportunity for the new user to learn the most common procedures for entering and analyzing typical R2CROSS data sets and to verify that a newly installed version of R2CROSS is operating properly. "The R2CROSS Menu" provides detailed program documentation for each of the menu choices within R2CROSS (Figure D). Instructions for "Terminating and reactivating the R2CROSS macro" are described in the final section.

Appendix A provides a brief description of the "Program Calculations" that are performed within the R2CROSS macro. Rather than emphasizing the technical aspects of these calculations, this appendix is intended to provide a fundamental understanding of the operations being performed within the macro.

Output from the R2CROSS macro was verified against several simple hand-calculated examples. More complex cross sections were verified by comparison with output from the MANSQ option of IFIM (Bovee 1982). Based on this verification process, it is our belief that the instream hydraulic parameters summarized in the R2CROSS staging table are accurate estimations based upon Manning's equation.

To date, the majority of the CWCB's instream flow water rights have been based upon recommendations from an R2CROSS analysis. The CWCB chose the R2CROSS methodology because it is both time and labor efficient. It has also been shown to produce similar results to more costly techniques for modeling streamflows (Nehring 1979).

The CWCB hopes that the release of the R2CROSS macro will foster a greater understanding of this technical aspect of Colorado's Instream Flow Program. It is intended to be user-friendly. If you have any problems running the macro or questions regarding its operation, please feel free to contact the CWCB staff.

Setup and Installation

The R2CROSS macro runs efficiently on an IBM-compatible 80486 personal computer equipped with a hard disk drive, and DOS 6.O, Windows 3.1, and Lotus 1-2-3 Release 4 for Windows software.

Copying R2CROSS to a Hard Disk Drive

To begin installation of the R2CROSS program, create an R2CROSS subdirectory on your computer's hard drive using the DOS command:

```
md c:\R2CROSS
```

and press <ENTER>.

Copy the files from the enclosed diskette into this subdirectory using the DOS command:

```
copy a:*.* c:\R2CROSS.
```

Press <ENTER> to execute the command.

Loading Lotus 1-2-3 and Retrieving the R2CROSS Macro

To run the R2CROSS macro, load your copy of Lotus 1-2-3 Version 4 for Windows and open the R2CROSS.WK4 file using the Lotus menu commands "File" and "Open". The R2CROSS macro begins with an introductory message screen. Press <ENTER> to continue.

The data entry and data editing routines of the R2CROSS macro were intended to be very user-friendly. In R2CROSS, the <ENTER> key is used to complete the entry of all data within the "Location Information", "Supplemental Data", and "Channel Profile Data" sections of the data input screen (see Figure E). After entering the stream "Slope", the macro moves into the "Input Data" table. The arrow keys are used to complete the entry of all data within the "Input Data" table. After using the arrow keys to complete the entry of all data within the "Input Data" table, simultaneously press "<Ctrl> G" to exit the data entry routine.

After initial data entry, the arrow keys are used to correct and edit all data entry errors, including corrections to the "Location Information", "Supplemental Data", and "Channel Profile Data" (which were initially entered using the <ENTER> key). Table 3 is intended to help clarify the proper use of the <ENTER> key and the arrow keys within the R2CROSS data entry and data editing routines.

Table 3. Data entry and data editing using the <ENTER> key and arrow keys

	Initial data entry	Data correction/ editing
Location Information Supplemental Data Channel Profile Data	<ENTER> key	Arrow keys
Input Data Table	Arrow keys	Arrow keys

The "Iron Creek Example" which follows is a useful exercise. It is intended to familiarize new users with the data entry nuances of the R2CROSS macro and to verify that the newly installed copy of the R2CROSS macro is operating properly. We recommend that new users take a couple of minutes to work through the "Iron Creek Example" in order to gain hands-on experience with the R2CROSS macro prior to entering individual data sets.

Iron Creek Example

Figure E depicts an actual set of R2CROSS field data collected on Iron Creek, a tributary to the Fraser River in Grand County, Colorado. Assuming that the R2CROSS macro has been installed and initiated as described above, highlight the "Printers" menu choice and select either the LaserJet or Dot Matrix menu choice. Other printer-types may require a customized setup (consult your Lotus 1-2-3 reference manual).

In order to ensure that all subsequent data files are stored in the R2CROSS subdirectory, select the "Retrieve" menu choice, choose the "Path" suboption, key-in:

c:\ R2CROSS

and press <ENTER>.

To initiate data entry, select the "Input" menu option. R2CROSS then prompts you to enter the number of data points collected in the stream cross section. Count the number of data points (Iron Creek has 34), key-in this number at the prompt, and press <ENTER>.

Enter the remainder of the data within the "Location Information", "Supplemental Data", and "Channel Profile Data" sections of the R2CROSS macro. Use the <ENTER> key to complete each data entry and move the cursor through each of the data input cells in sequential order. The final use of the <ENTER> key occurs after keying-in the stream "Slope".

After entering the stream "Slope", use the arrow keys to enter all of the "Feature", "Dist", "Vert Depth", "Water Depth", and "Vel" data from the Input Data table of Figure E. The grasslines on each streambank represent a very important piece of information in the R2CROSS analysis. In the Iron Creek example, these grasslines occur at distances of 1.00 and 11.00 feet. It is imperative that these grasslines be identified within R2CROSS by placing the number "1" in the appropriate cell of Column A in the R2CROSS worksheet. This designation is so important that the R2CROSS macro will not proceed until the two grasslines have been specified. After entering all of the data within the Input Data table, including the two grasslines, simultaneously press "<Ctrl> G" to terminate the data entry routine and return to the main R2CROSS menu.

Select the "Verify" option to print a "Proof Sheet" for comparison with Figure E. If data entry errors are found, return to the "Input" menu option and correct them. When editing data, use the arrow keys to move around the worksheet and correct mistakes. When all data entry errors have been corrected, exit the editing routine by pressing "<Ctrl> G". The data editing routine can be repeated until all data entry errors have been corrected.

Once all data entry errors have been corrected, use the "Save" menu choice to store the input data file to the R2CROSS directory on the hard disk drive. Select the "New File" menu option, type an appropriate eight letter file name for the data set, and press <ENTER>. The file will automatically be saved with a .WK4 file extension. **Caution: do not name the file "R2CROSS".**

Select the "Calculate" option and press <ENTER> to initiate staging table calculations and print the final output from R2CROSS. Verify that the printed output is identical to Figures F through J.

Select the "Graph" option to view the cross section plot. Press <ENTER> to exit the view and print the cross section plot.

Exit the R2CROSS macro by selecting the "Quit" option. Answer "No" to the Lotus prompt to exit R2CROSS and remain in Lotus 1-2-3.

This general procedure can be followed to enter, edit, and analyze almost all R2CROSS datasets. To begin data entry on your own R2CROSS data set, select "Retrieve" a "New file" from the R2CROSS menu.

The R2CROSS Menu

The R2CROSS menu consists of eight main menu choices arranged from left to right across the top of the computer screen (Figure D). Use the arrow keys to move between menu choices and the <ENTER> key to select a highlighted menu choice.

Input

The "Input" menu choice is used to enter data in a new R2CROSS.WK4 worksheet or to correct/edit data in an existing worksheet. As depicted in Table 3, the <ENTER> key is used for the initial entry of the information contained within the "Location Information", "Supplemental Data", and "Channel Profile Data" sections of the field form. The arrow keys are used for the initial entry of the "Discharge/Cross Section Notes" within the "Input Data" table. The arrow keys are also used for all subsequent editing of data. This procedure ensures that the cursor is always located within the appropriate cell of the worksheet during the initial entry of the "Location Information", "Supplemental data" and "Channel Profile Data" (not always a one cell movement) and also allows the greatest flexibility in the initial entry of the discharge notes and subsequent editing of data.

Entering data in a new file

To enter data in a new file:

1. *Select the "Input" menu choice.*
2. *Count the number of data points (cell verticals) collected across the stream channel. Key-in that number and press <ENTER>. R2CROSS automatically sizes the worksheet to the proper number of discharge cells.*
3. *Once the worksheet has been sized, the macro prompts for the entry of a "Stream Name". Key-in the "Stream Name" and press the <ENTER> key to complete the data entry. Follow this same procedure for all of the information contained within the "Location Information", "Supplemental Data", and "Channel Profile Data" data entry cells. The final use of the <ENTER> key occurs after the entry of a stream "Slope". The cursor then moves to the upper left corner of the "Input Data" table (cell C50).*
4. *Use the arrow keys to enter all channel geometry and stream velocity data within the "Input Data" table. Key-in the horizontal distance from the zero stake to the cell vertical in the "Dist" column, vertical distance from the suspended tape to the channel bottom in the "Vert Depth" column, water depth in the "Water Depth" column, and water velocity in the "Vel" column for each cell in the cross section. Use the "Feature" column (Column B) to indicate the horizontal locations of the cross section stakes (S), grasslines (G), waterlines (W), and other features such as rocks (R), etc. Finally, enter a "1" in the appropriate cell of Column A to indicate the location of the grassline/streambank intersection on each streambank. R2CROSS uses the grassline locations to determine bankfull wetted perimeter and top width. These grassline locations are integral to the development of biologic instream flow recommendations in Colorado. The R2CROSS macro will not proceed until the grassline/streambank intersection on each streambank has been depicted with a "1" in Column A of the worksheet.*

5. *When all of the field data has been entered in the "Input Data" table, simultaneously press "<Ctrl> G" to exit from the "Input" routine and return to the main R2CROSS menu.*

Editing data in the current worksheet
To correct data entry errors in the current worksheet:

1. *Select the "Input" option.*
2. *Use the arrow keys to edit data. Data editing begins at the top of the "Input Data" table in cell C50. Move the cursor up from cell C50 to edit "Location Information", Supplemental Data", or "Channel Profile Data". Move down to edit data within the "Input Data" table.*
3. *After correcting all data entry errors, simultaneously press "<Ctrl> G" to terminate the "Input" routine and return to the main R2CROSS menu.*

Editing data in an "Existing file"

Previously-saved files can be retrieved, edited and re-run. Use the R2CROSS menu to "Retrieve" an "Existing file" and then following the instructions under "Editing data in the current worksheet" to edit previously-saved data files.

Verify

The "Verify" option is used to initiate R2CROSS discharge calculations and print a proof sheet (Figure E). Prior to running "Verify", be sure that the proper printer has been initialized (see "Printer" menu option).

Printed output consists of the cross section input data, calculated cross-sectional area, and calculated discharge. The proof sheet should be reviewed to verify accurate entry of all field measurements before continuing to the "Save" option. If data entry errors are discovered, return to the instructions for "Editing data in the current worksheet" and correct the errors. Proceed to "Save" only after all field data has been entered correctly.

Save

Use "Save" to store data input files. Data input files should always be saved prior to running the "Calculate" option because they are generally smaller in size and they can be retrieved, edited, and rerun if necessary. The "Calculate" option can not be run twice on the same file!

Prior to saving data input files, be sure to run the "Retrieve" and "Path" menu options to specify the location of data storage.

There are two suboptions under the "Save" menu choice, "New file" and "Overwrite". Choose your option carefully and do not overwrite the original R2CROSS.WK4 file!

New file

The first suboption, "New file", is used to save a newly created R2CROSS data set. This is accomplished by the following procedure:

1. *Select "Save" and then "New file" from the R2CROSS menu. R2CROSS prompts for the name of a new file.*
2. *Enter a name of up to eight characters and press <ENTER>.*

If a filename is selected that already exists in the default directory, the computer will beep and the file will not be saved. Should this happen, either repeat the above procedure and save under a different file name or go to the "Overwrite" suboption.

Overwrite

The "Overwrite" suboption is designed to overwrite an existing data file. Use the following procedure to perform this task:

1. *Select "Save" and then "Overwrite" from the R2CROSS menu. R2CROSS will list the files in the current directory that you may chose to overwrite.*
2. *Select a file from the list using the arrow keys and overwrite it by pressing <ENTER>. The existing file will be replaced with the current file.* *Do not select the original R2CROSS.WK4 file!*

Calculate

"Calculate" initiates all staging table calculations and prints a five page data summary (Figures F through Figure J). Be sure that you have saved your input data set and that the proper printer type has been specified prior to running "Calculate". This operation may take several minutes depending upon the speed of your computer. A detailed explanation of the four major calculations performed within R2CROSS can be found in “Appendix A - Program Calculations”.

Graph

The "Graph" option allows the user to view and print a cross-section plot of the stream transect (Figure K). The cross section plot is useful for revealing potential problems with the input data set or potential errors in data collection or data entry. Errors, such as misread rod readings on waterlines or ground profiles, are often easily detected on a cross section plot.

Retrieve

The "Retrieve" menu option has three suboptions, "Path", "New file", and "Existing file". These suboptions are used to change the current file storage path and to retrieve data files.

Path

The "Path" suboption changes the current data storage location. A valid storage path may be any drive and/or directory which is in existence on the computer's hard drive. To select a new path, follow these steps:

1. *Select "Retrieve" and then "Path" from the R2CROSS menu.*
2. *Type in the name of an existing directory on your hard drive and press <Enter>.*

Subsequent files will be stored and retrieved within this directory. In the event that a non-existent path is entered, the computer will beep and return to the main menu. The default directory will remain in effect until a valid path has been entered.

The "Path" suboption choice is not frequently used. It may be appropriate if you wish to organize R2CROSS data from different streams into separate subdirectories. However, file organization can also be accomplished by simply using descriptive file names. If you do decide to create separate directories for your R2CROSS output files, you should copy the files from the R2CROSS diskette into each of these subdirectories so that they can be retrieved when you want to create a new data set.

New file

The "New file" suboption is used to initiate data entry on a new cross section. It erases the current worksheet from the screen and replaces it with a blank R2CROSS.WK4 worksheet. Read the introductory message and press <ENTER> to initiate data entry.

Existing file

The final suboption, "Existing file", retrieves a previously-saved R2CROSS data set from storage. Simply select the file to be retrieved. Select the "Input" command on the R2CROSS menu to edit the dataset. Staging table calculations are initiated by selecting the "Calculate" option. Remember, the "Calculate" option cannot be run twice on the same file.

Printers

LaserJet

Dot Matrix

The "Printers" menu option is used to format R2CROSS output for either a LaserJet or Dot Matrix type printer. The proper printer-type should be selected prior to running the "Verify" or "Calculate" menu options. Use the arrow keys to highlight the proper printer and press the <ENTER> key. Experienced Lotus 1-2-3 users can setup additional printers prior to retrieving the R2CROSS.WK4 worksheet if necessary. Consult a Lotus manual for specific instructions on setting up other types of printers.

Quit

Select the "Quit" menu option and answer "No" to the Lotus prompt to de-activate the R2CROSS macro and return to normal Lotus 1-2-3 operations. De-activating the R2CROSS macro allows for the use of standard Lotus 1-2-3 commands on all unprotected cells within the current data file. The R2CROSS menu can be reactivated by simultaneously pressing "<Ctrl> M". Alternatively, a new R2CROSS worksheet can be brought up from within Lotus 1-2-3 by retrieving the original R2CROSS.WK4 file from the computer's hard disk drive (see "Installation" section).

Terminating and Reactivating the R2CROSS Macro

Situations may arise where the macro must be terminated during data entry or calculation routines. To terminate the R2CROSS macro and return to the standard Lotus 1-2-3 menu, press <Ctrl><Break>. Then press the <Esc> key several times to clear the Lotus error message screen.

If the R2CROSS macro was terminated due to a data entry error or a problem with the execution of the macro, the integrity of the worksheet may have been compromised. If so, the current worksheet should be erased and a fresh copy of the R2CROSS.WK4 file retrieved from the computer's hard disk drive. The data should definitely be re-entered if the macro failed during the "Calculate" option of R2CROSS. Trying to rerun a compromised dataset may result in additional problems and unreliable output. It is always safer, albeit more time consuming, to start over.

If you do not believe the data in the current worksheet has been compromised, the R2CROSS macro can be re-activated by simultaneously pressing "<Ctrl> M". Macro operation will begin with the standard R2CROSS menu and data entry or calculations may then resume within the existing file.

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Appendix A - Program Calculations

Some R2CROSS users may be interested in the operation and layout of the Lotus 1-2-3 macro. Figure L depicts the sequence of operations performed within each R2CROSS menu option. Figure M provides the layout of the R2CROSS macro within the Lotus 1-2-3 worksheet. The four major computations performed within the R2CROSS macro are sag-tape corrections, estimation of Manning's "n", calculation of a water line comparison table, and calculation of a staging table.

Sag-Tape Calculations.

Channel geometry measurements that are taken using the sag-tape methodology must be corrected to a level reference. R2CROSS uses catenary curve formulas to compute these corrections from a sagging tape that has been leveled at each end. The use of the catenary curve solution is based on the assumption that the suspended steel tape is analogous to a suspended cable placed under a unidirectionally distributed load (Laursen 1978).

The derivation of the catenary curve solution is beyond the scope of this manuscript. Basically, R2CROSS uses the length of tape in suspension, the tension applied to the tape, and the standard weight of one foot of tape to apply the necessary vertical distance corrections to each cell vertical within the cross section.

When using a level and stadia rod to survey channel geometry, the tape weight and tension defaults, supplied in the original R2CROSS.WK4 worksheet, will simulate an extremely light tape stretched at very high tension. This results in a sag correction of approximately zero at each cell vertical.

Use of Manning's Equation.

Manning's equation is defined as:

$$Q = \frac{1.486*A*R^{2/3}*S^{1/2}}{n}$$

where;

Q = discharge (cfs);

A = cross-sectional area (ft^2);

R = hydraulic radius (ft);

S = slope (ft/ft); and

n = Manning's "n", a dimensionless coefficient of roughness.

Manning's equation is used in two separate R2CROSS calculations. It is first used within the "Verify" option to provide an initial estimate of Manning's "n" using the rearranged equation:

$$n = \frac{1.486*A*R^{2/3}*S^{1/2}}{Q} .$$

The parameters Q, A, R, and S are calculated from the raw field data and used to solve directly for "n" (Figures G and J). Once estimated, Manning's "n" remains constant throughout the remainder of the streamflow modeling.

Manning's equation is also used within the "Calculate" option to solve for Q at each simulated water surface elevation within the staging table (Table 4).

Calculation of the Water Line Comparison Table.

R2CROSS uses two techniques for estimating cross-sectional area. One estimate is obtained by summing the product of "measured" water depth and cell width for all cells in the cross section (A_m). This technique allows independent water surface elevations within each cell and provides the most accurate estimate of cross-sectional area at the time the field measurement was made. However, this technique cannot be used to simulate a single, flat water surface elevation at computer-modeled stream discharges.

The second technique used to estimate cross-sectional area involves projecting a single water surface elevation across the stream channel. Channel bottom elevations are subtracted from this projected water surface elevation to obtain a "computed" water depth at each cell vertical. Cross-sectional area is obtained by summing the product of the "computed" water depth and cell width at each cell vertical (A_c). This technique constrains the water surface to a flat plane and is useful for simulating discharges above and below the field-measured discharge.

The water line comparison table (Figure H) iteratively calculates 31 separate estimates of A_c, using projected waterlines ranging from 0.25 feet above to 0.25 feet below the mean waterline measured in the field. The single water surface elevation that results in A_c equal to A_m is interpolated from the water line comparison table and is used in the staging table as the best estimate of the waterline at the field-measured discharge.

Calculation of the Staging Table.

The final product of the R2CROSS macro is the staging table (Figure I). In addition to the three critical biologic criteria ($\bar{x}_d$, %WP, and $\bar{x}_v$), R2CROSS also calculates incremental estimates of top width (TW), maximum depth (D_{max}), cross-sectional area (A), wetted perimeter (WP), hydraulic radius (R), and flow (Q) at a number of waterline elevations. The upper limit of the model occurs at bankfull discharge which is defined as the lower of the two grassline elevations measured in the field. The lower limit is either 1.75 feet below the waterline calculated in the water line comparison table or stage of zero flow (the lowest field-measured channel profile), whichever is higher in elevation. The formulae for each of the parameters estimated in the staging table are summarized in Table 4.

Figure L. Sequence of operations performed by R2CROSS macro

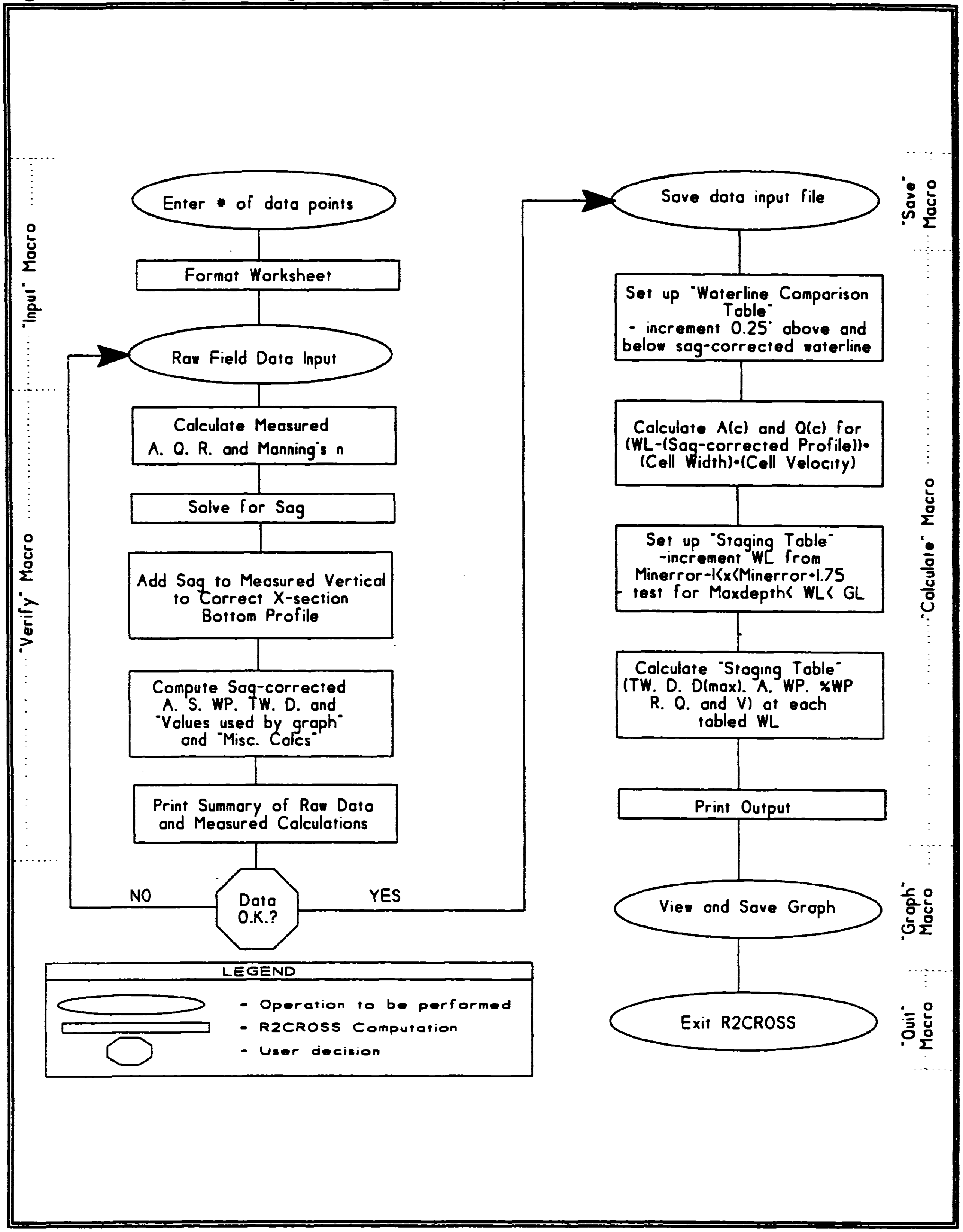

Figure M. Lotus 1-2-3 worksheet layout for R2CROSS macro

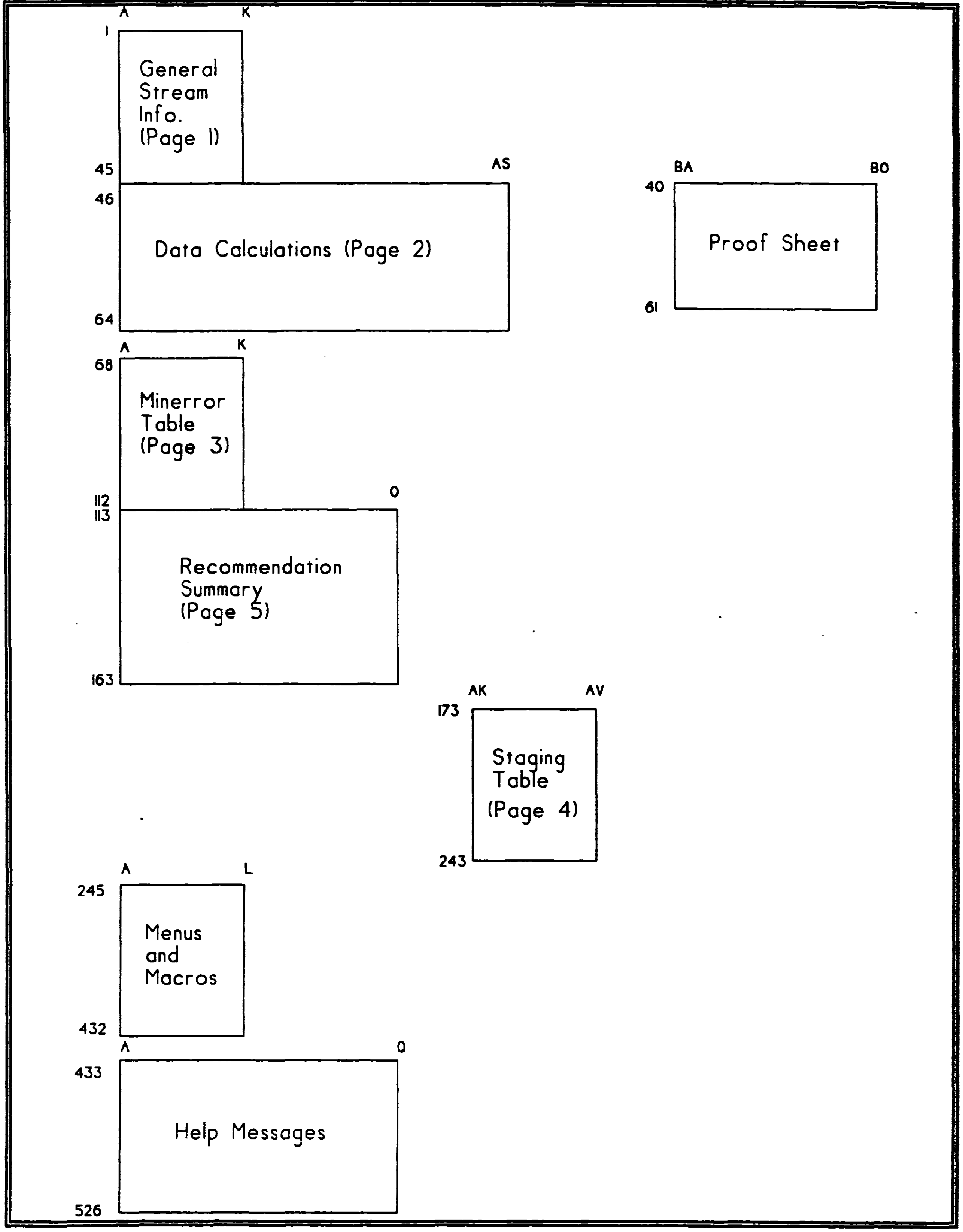

Table 4. Hydraulic Formulas used in R2CROSS staging table

Parameter	Formula
Top Width (TW)	$\sum_{i=1}^{n} TW_i$
Average Depth ($\bar{x}_d$)	$\frac{A}{TW}$
Maximum Depth (D_{max})	$\underset{i=1}{\overset{n}{MAX}}(D_i)$
Area (A)	$\sum_{i=1}^{n} A_i$
Wetted Perimeter (WP)	$\sum_{i=1}^{n} WP_i$
Percent Wetted Perimeter (%WP)	$\frac{WP}{Bankfull\ WP}*100$
Hydraulic Radius (R)	$\frac{A}{WP}$
Flow (Q)	$\frac{1.486*A*R^{\frac{2}{3}}*S^{\frac{1}{2}}}{n}$
Average Velocity ($\bar{x}_v$)	$\frac{Q}{A}$

Exhibit 12

Development of Instream Flow Recommendations In Colorado Using

R2CROSS for Microsoft Excel

For additional copies
Write or call:

:

Colorado Water Conservation Board
Department of Natural Resources
1313 Sherman Street, Room 721
Denver, CO 80203
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Stream and Lake Protection Section

June 2006

Abstract

In 1973, the Colorado State Legislature vested the Colorado Water Conservation Board with the authority to appropriate instream flow water rights in the State of Colorado. Today, the Board holds over 1,500 instream flow water rights covering approximately 8,500 miles of Colorado streams. Standardized field and office procedures help to ensure that instream flow recommendations reflect the amount of water required to" preserve the natural environment to a reasonable degree", as prescribed by state statute. R2CROSS is one of several instream flow assessment techniques employed by state and federal agencies to model instream hydraulic parameters. R2CROSS was chosen by the State of Colorado because it is time and labor efficient and produces comparable results to more costly instream flow assessment techniques, i.e., the Instream Flow Incremental Methodology. This manuscript provides an overview of Colorado's Instream Flow Program and documentation for the Board's R2CROSS computer macro. The R2CROSS macro requires Microsoft Excel for Windows software to operate.

Acknowledgments

The Colorado Water Conservation Board (CWCB) would like to thank everyone involved in the development of the Board's R2CROSS Excel for Windows macro. The macro was written by Mike Kleypas of MaKro Consulting (www.XLhelp.com/).

In addition, CWCB staff wishes to acknowledge the persons involved in the review and testing of the R2CROSS macro including Mark Uppendahl and Jay Skinner of the Colorado Division of Wildlife and Roy Smith of the Bureau of Land Management.

The Board is very grateful to all of those who participated in the development of the R2CROSS macro and this document.

Disclaimer

The R2CROSS macro is in the public domain, and the recipient may not assert any proprietary rights thereto nor represent it to anyone as other than a Colorado State Government-produced program. R2CROSS is provided "as-is" without warranty of any kind, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. The user assumes all responsibility for the accuracy and suitability of this program for a specific application. In no event will the Colorado Water Conservation Board (CWCB) or the Colorado Division of Wildlife be liable for any damages, including lost profits, lost savings, or other incidental or consequential damages arising from the use of or the inability to use this program.

The CWCB staff verified the calculations preformed in its R2CROSS program with hand-held calculators and by comparison with other Manning's equation-based hydraulic streamflow models. Based upon this verification process, the staff believes that the instream hydraulic parameters summarized in the R2CROSS staging table are accurate calculations of Manning's equation. However, the CWCB does not suggest that the predicted hydraulic parameters will necessarily be realized at any particular stream discharge.

On November 10, 1993, the CWCB first adopted Rules that codified the procedures the Board follows in appropriating instream flow water rights. The most recent version of the rules can be found on the CWCB website at:
http://cwcb.state.co.us/Streamandlake/Documents/ADOPTEDRULES11-15-2005.pdf

This document is intended to conform to the procedures presented in the Rules.

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Introduction

Colorado's Instream Flow Program originated in 1973 with the passage of Senate Bill 97 (SB 97). Under SB 97, the Colorado Water Conservation Board (CWCB) was vested with the authority to appropriate instream flow water rights in the State of Colorado (§37-92-102(3), C.R.S. (2002)). Instream flow water rights are held by the CWCB on behalf of the people of the State of Colorado to "preserve the natural environment to a reasonable degree." Today, the CWCB holds over 1,500 instream flow water rights covering approximately 8,500 miles of Colorado streams.

Determining the quantity of water required to preserve the natural environment to a reasonable degree can be a difficult task. The CWCB, in cooperation with the Colorado Division of Wildlife (DOW), has developed standard field and office procedures to ensure that each instream flow appropriation is necessary and reasonable and that the amount of water recommended is available for appropriation.

The R2CROSS methodology described in this document is a valuable tool in developing these instream flow recommendations. The CWCB uses R2CROSS because it is time and labor efficient and produces results which are comparable to more data intensive techniques (Nehring 1979).

This manuscript is divided into two sections. The first section describes Colorado's Instream Flow Program, including some of the statutory guidelines that have shaped the program. It also describes the standard field techniques and office procedures that are used by the CWCB staff in the development of R2CROSS-based instream flow recommendations. This section is intended to provide an understanding of the procedural and technical aspects of Colorado's Instream Flow Program.

The second section of the manuscript is a users' manual for the CWCB's R2CROSS macro. The CWCB has received many requests for its R2CROSS macro from both the public and private sectors but has been hesitant to release the program without proper documentation. The second section of the manuscript is intended to provide that documentation.

Colorado's Instream Flow Program

Instream Flow Legislation

The CWCB was created in 1937 to serve as the State's chief water planning agency (§37-60-101 through 130, C.R.S. (2002)). Today, the CWCB is responsible for the administration of the State's Instream Flow Program, identification of flood plains, funding of new water development and water conservation projects, and negotiation of inter- and intra-state water planning issues.

The CWCB is a fourteen-member board. The board consists of one Governor-appointee from each of the eight major river drainages in the State and one from the City and County of Denver. Each Governor-appointee must also be confirmed by the Colorado State Senate. Ex-officio members of the board include the Executive Director of the Department of Natural Resources, the Directors of the CWCB and DOW, the State Attorney General, and the State Engineer. The diverse backgrounds of its board members provide the CWCB with an excellent representation of Colorado's various water interests.

Colorado's Instream Flow Program was created in 1973 when the Colorado State Legislature recognized "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" through the passage of SB 97. Within SB 97, the definition of beneficial use was changed to include minimum stream flows and the CWCB was vested with the exclusive authority to appropriate "waters of natural streams and lakes ... as may be required ... to preserve the natural environment to a reasonable degree."

The Instream Flow statute sets forth the guidelines for the administration of Colorado's Instream Flow Program. In order to encourage other entities to participate in Colorado's Instream Flow Program, the statute directs the CWCB to request instream flow recommendations from other state and federal agencies prior to initiating an instream flow appropriation. The CWCB routinely requests instream flow recommendations from the DOW, Colorado Division of Parks and Outdoor Recreation, United States Department of Agriculture, and United States Department of Interior (the "cooperating agencies").

Prior to appropriating an instream flow water right, the statute requires the CWCB to: (1) "determine that the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made; (2) determine that there is a natural environment that can be preserved to a reasonable degree with the CWCB's water right, if granted; and (3) determine that such environment can exist without material injury to water rights" (§37-92-102(3c), C.R.S. (2002)). The CWCB makes these determinations based upon a review of the supporting technical data and a final instream flow recommendation prepared by the CWCB staff.

Standardized field and office procedures have been developed to help ensure that final instream flow recommendations meet statutory guidelines and are consistent. The standard field procedures that were established concern selection of transect sites and collection of hydraulic and biologic data. Standard office procedures have been established for determining biological instream flow recommendations using output from the R2CROSS program and for analyzing water availability.

Merriman and Janicki (2005) provide additional information on the state of Colorado’s Instream Flow Program.

Field Procedures

The R2CROSS Method is a “Standard Setting” hydraulic based instream flow assessment technique. R2CROSS instream flow recommendations are typically based on hydraulic and biologic data collected during single or multiple field visits. Hydraulic data collection consists of setting up atransect, surveying stream channel geometry, water surface elevations, and measuring stream discharge. Biologic data is gathered to document the existence of a natural environment.

Field Data Site Selection

The R2CROSS method requires that stream discharge and channel profile data be collected in a riffle stream habitat-type. A riffle is a stream segment that is controlled by channel geometry rather than a downstream flow control. Riffles are most easily visualized as the stream reaches which would dry up most quickly should streamflow cease.

Biologically, riffles are essential to the production of benthic invertebrates and the passage, spawning, egg incubation, feeding, and protective cover of fish. Riffles are also the stream habitat-type most sensitive to changes in hydraulic parameters with variation in discharge (Nehring 1979). Riffles are critical to a healthy aquatic environment because small reductions in streamflow may result in large reductions in water depth and the amount of wetted perimeter available for aquatic habitat. Maintaining adequate streamflow in riffles also preserves the natural environment in other important stream habitat-types such as pools and runs (Nehring 1979).

Hydraulic engineers have developed several mathematical models and equations to predict instream hydraulic parameters (Chow 1959). Manning's equation is one such model that is well-suited to the riffle stream habitat-type (Grant et al. 1992). In order to maximize the reliability of Manning's equation, transects are placed within a riffle so that streamflow is uniform across the transect (Grant et al. 1992). Each transect should represent the average stream width, depth, and cross-sectional area within the riffle being characterized. Transects should be located in areas that exhibit natural banks or grasslines and concentrated water flow, free from braiding. They should not be located on eroded or undercut streambanks.

Hydraulic Data Collection

Stream discharge is measured using standardized procedures established by the United States Geological Survey (USGS) (Buchanan and Somers 1969). Channel geometry can be measured using sag-tape methodology (Silvey 1976; Ray and Megahan 1979) or by the use of a land survey level and stadia rod (Benson and Dalrymple 1967). A list of recommended field equipment for completing the required streamflow measurement and channel geometry measurements is provided in Table 1.

The sag-tape methodology consists of suspending a steel tape from bank to bank across the stream channel, perpendicular to the streamflow (Figure A). Metal cross section stakes are driven into the ground above the grassline. The steel tape is suspended by attaching the zero-end of the tape to one of the metal stakes, stretching the tape across the stream, and then attaching the other end to a tape

Table 1. Recommended Field Equipment List

Equipment	Description
100' Steel Survey tape	Stretched between cross section stakes. (Obtain standard weight of a 1.0 foot section of tape from manufacturer)
Spring Tension Scale	Used to measure pounds of tension on steel tape when stretched between stakes.
Tape Clamp Handle	Holds tape in tension.
Cross Section Stakes	Two 24"-36" metal stakes used to maintain tape tension and to level steel tape. Must be strong enough to be driven into rocky stream bank.
Discharge Wading Rod (or Stadia Rod)	Used to measure vertical depths from suspended tape to stream channel.
Level, Tripod, and Stadia Rod	Used to level ends of suspended tape and to measure slope.
Current Meter	Pygmy, Price AA, Marsh-McBirney or similar devise used to measure stream velocity.
Hand Sledge Hammer	Used to drive cross section stakes into streambank.
Staging Pin	Used to detect changes in discharge during the streamflow measurement.
100' Fiberglass Tape	Used to measure horizontal distance from suspended tape to water-slope stadia rod readings.
Field Forms and Clipboard	Standardized form to ensure complete set of field data.
Miscellaneous Items	Digital camera, GPS Unit, maps, waders, stopwatch and calculator.

clamp and spring scale fastened to the metal stake on the opposite streambank. A minimum of 15 pounds of tension is applied to the tape, as the tape is drawn up and clamped. A survey level and stadia rod are used to adjust the ends of the tape up or down until they are level, thereby producing a consistent datum from which vertical distance measurements can be read.

The R2CROSS program uses the standard weight of a one-foot section of the steel tape, tape tension, and the length of tape in suspension to correct horizontal distance and vertical depth measurements made from the sagging tape. The program adjusts the coordinates at each cross section vertical so that the corrected measurements correspond to a level datum from stake to stake and not the curved datum created by the sagging tape (Figure A).

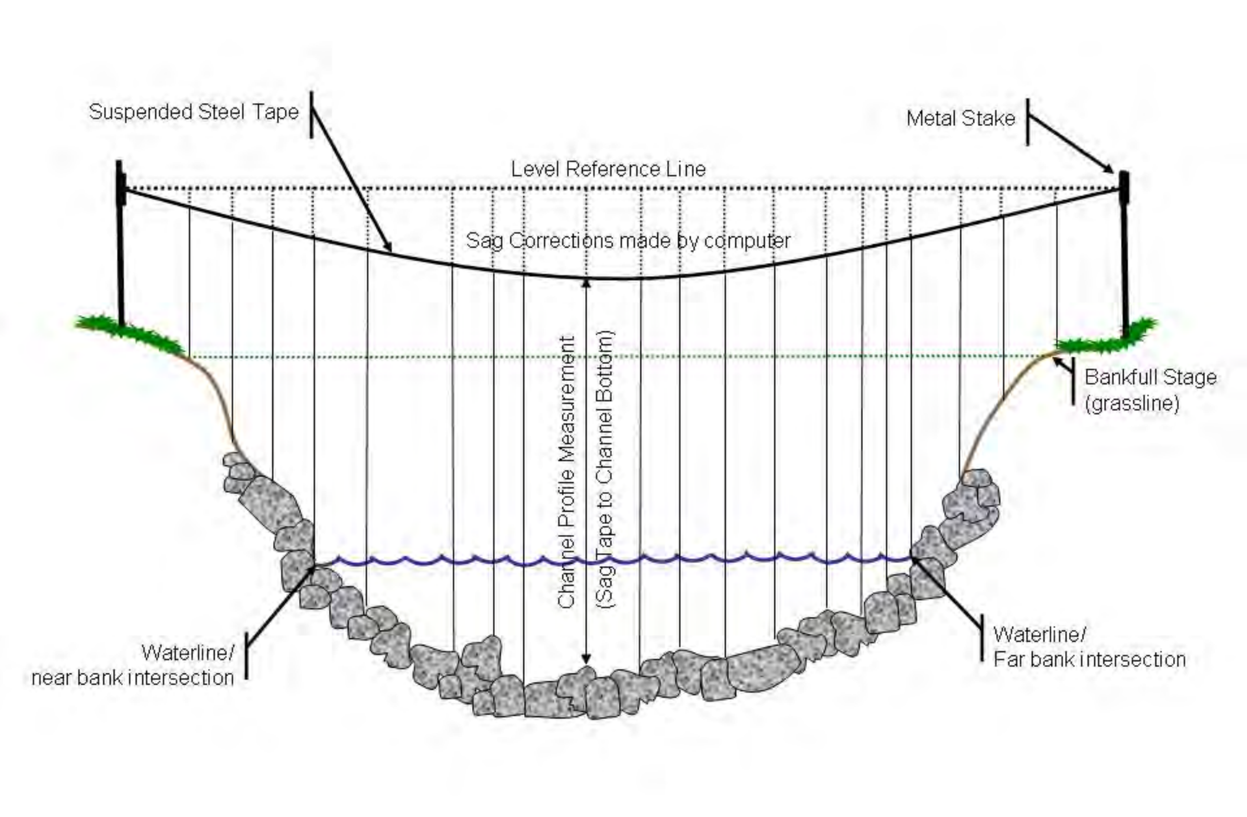


Figure A. Typical stream cross section

Vertical measurements between the suspended tape and the stream channel may be replaced with readings using a survey level and stadia rod. The suspended tape is then used to measure only the horizontal location of each cell vertical. There is no need to precisely level the ends of the suspended tape or to record the tape tension as no sag corrections are required.

Biologic Data Collection

Biologic sampling is conducted to document the existence of a natural environment. Coldwater fish species, particularly salmonids, have been used to indicate the existence of such a natural environment in the majority of the CWCB's instream flow appropriations to date. Warmwater fish species and other aquatic life forms may be used to document the existence of a natural environment in more downstream, low-elevation stream segments. In addition to salmonids, the CWCB has used amphibians, such as frogs and salamanders, and warmwater fish species, including the endangered fishes of the Colorado River basin, as the biologic basis for instream flow appropriations.

Biologic data typically consists of a fish sample, collected by electrofishing, and an aquatic invertebrate sample. Captured fish are identified and measured and a length-frequency distribution is constructed for each species. The fish sample is not tied directly to the R2CROSS hydraulic modeling but it may be used to refine the biologic instream flow recommendation to meet the specific habitat requirements of unique populations.

Digital Camera and GPS Unit

Digital cameras should be used to record the field data collection effort. A photographic record of the hydraulic data collection process may include pictures of the transect location (upstream, downstream and across stream views) and the stream flow measurement process. These photos can serve as valuable visual evidence that cross sections were properly located in riffles and that standard data collection protocols were met. In addition, photographs may help relocate a transect in the future should additional data be required.

Photos of the biologic data collection effort may also assist the CWCB in making its natural environment findings. Photographs of the biologic sampling process and captured organisms (fish, aquatic insects, etc.) may be used in combination with a statistical summary of the results of biologic sampling to document the existence of a natural environment.

Handheld GPS Units should be used to record field data collection site locations. Geographic coordinate information helps relocate transect locations in the future should additional data be required.

Digital cameras and handheld GPS Units are small in size and light in weight. Digital photos can easily be transferred into written reports and they provide valuable visual evidence. A digital camera and a handheld GPS Unit should be considered standard equipment on any field data collection effort.

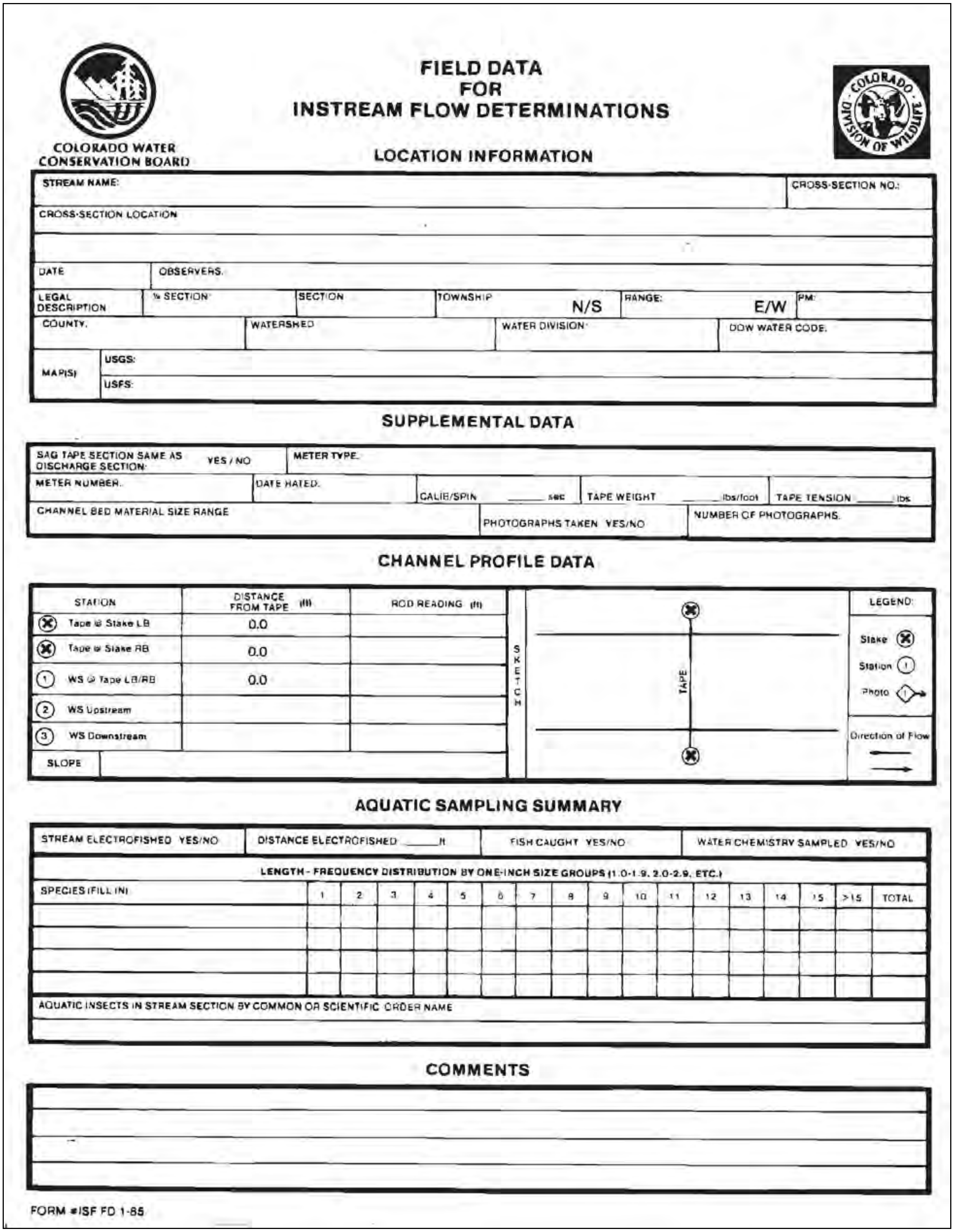
The Field Form

The CWCB and DOW use a standardized field form to record all field data. The use of this form helps to ensure that all instream flow recommendations are based upon a uniform set of field data. The front page of the form provides space for cross section "Location Information", "Supplemental Data", "Channel Profile Data", an "Aquatic Sampling Summary", and "Comments" (Figure B). The back page is dedicated to "Discharge/Cross Section Notes" (Figure C).

The "Location Information" section of the field form is used to describe the location of the cross section as well as the date and names of the members of the field crew. Geographic information can be obtained from USGS maps, United States Forest Service (USFS) maps, or handheld GPS Units. Water divisions and DOW water codes can be obtained from the State Engineers' Office, the CWCB, or the DOW.

The "Supplemental Data" section is used to provide supporting documentation of the field data collection effort. Most importantly, this section is used to record the tape manufacturer's standard weight (lbs/ft) and tape tension (lbs). The R2CROSS program uses this information, together with the length of tape in suspension, to adjust vertical distances measured from the sagging tape to a level reference datum.

The "Channel Profile Data" section of the form is used to establish the relationship between the sag-tape cross section and the stream. Stadia rod readings are taken at each end of the suspended tape and at the water surface on the right and left streambanks. These readings are recorded within the "Rod Reading (ft)" column. They are used to assure that the ends of the tape are level and to quantify the vertical distance between the suspended tape and the water surface. Water surface readings and horizontal distances are also recorded upstream and downstream of the suspended tape. These observations are used to establish the water surface slope for input into Manning's equation.



COLORADO WATER
CONSERVATION BOARD

FIELD DATA
FOR
INSTREAM FLOW DETERMINATIONS

LOCATION INFORMATION

STREAM NAME:

CROSS-SECTION NO.:

CROSS-SECTION LOCATION

DATE

OBSERVERS.

LEGAL DESCRIPTION

¼ SECTION:

SECTION

TOWNSHIP N/S

RANGE: E/W

PM:

COUNTY.

WATERSHED

WATER DIVISION:

DOW WATER CODE.

MAP(S) USGS:

USFS:

SUPPLEMENTAL DATA

SAG TAPE SECTION SAME AS DISCHARGE SECTION: YES / NO

METER TYPE.

METER NUMBER.

DATE RATED.

CALIB/SPIN ______ sec

TAPE WEIGHT ______ lbs/foot

TAPE TENSION ______ lbs

CHANNEL BED MATERIAL SIZE RANGE

PHOTOGRAPHS TAKEN YES/NO

NUMBER OF PHOTOGRAPHS.

CHANNEL PROFILE DATA

STATION	DISTANCE FROM TAPE (ft)	ROD READING (ft)
⊗ Tape @ Stake LB	0.0	
⊗ Tape @ Stake RB	0.0	
① WS @ Tape LB/RB	0.0	
② WS Upstream		
③ WS Downstream		
SLOPE		

SKETCH

TAPE

LEGEND:

Stake ⊗

Station ①

Photo ◇→

Direction of Flow

AQUATIC SAMPLING SUMMARY

STREAM ELECTROFISHED YES/NO

DISTANCE ELECTROFISHED ______ ft

FISH CAUGHT YES/NO

WATER CHEMISTRY SAMPLED YES/NO

LENGTH - FREQUENCY DISTRIBUTION BY ONE-INCH SIZE GROUPS (1.0-1.9, 2.0-2.9, ETC.)

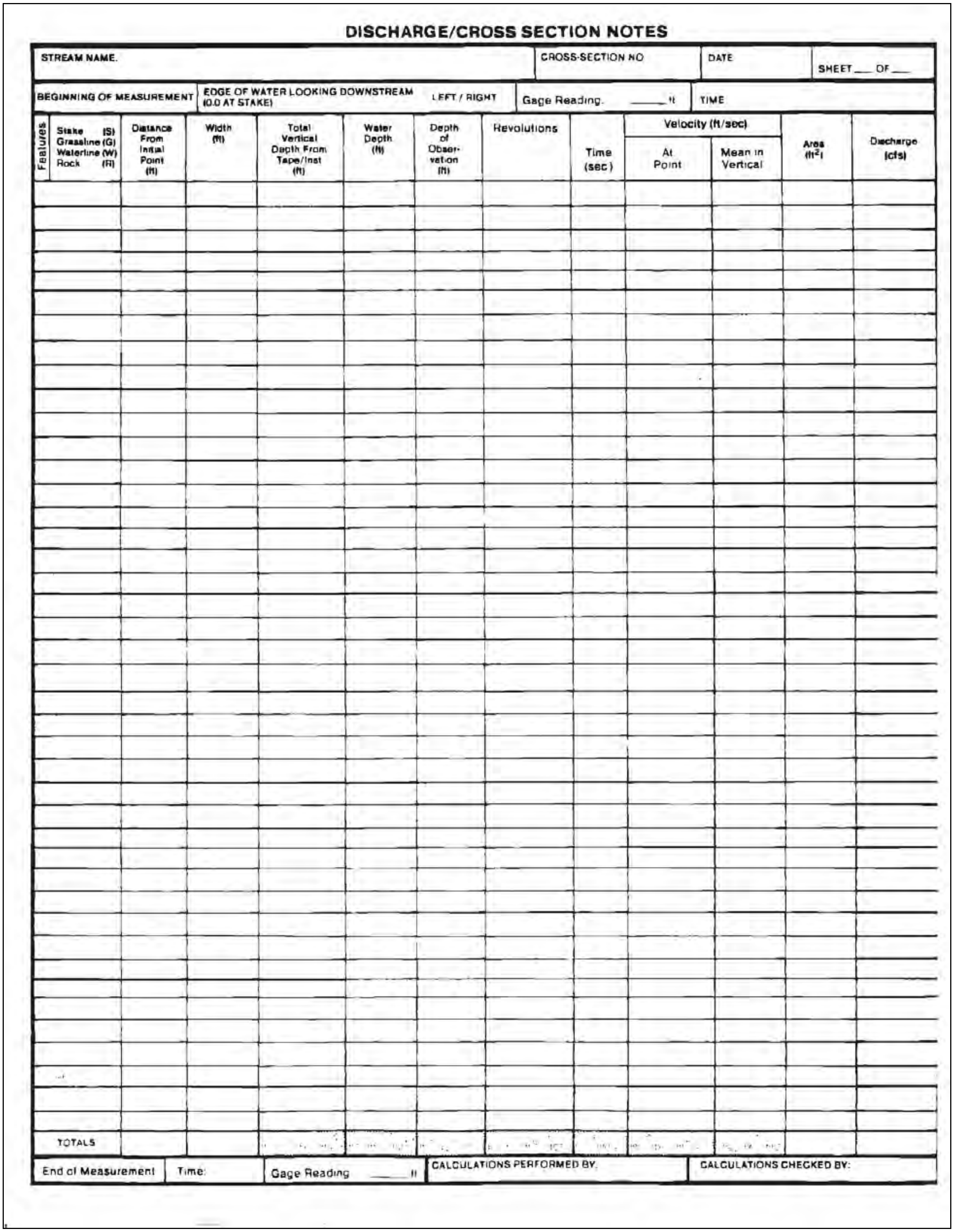
SPECIES (FILL IN)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>15	TOTAL

AQUATIC INSECTS IN STREAM SECTION BY COMMON OR SCIENTIFIC ORDER NAME

COMMENTS

FORM #ISF FD 1-85

Figure B. Field data input sheet (Front Page)



DISCHARGE/CROSS SECTION NOTES

STREAM NAME: | CROSS-SECTION NO | DATE | SHEET ___ OF ___

BEGINNING OF MEASUREMENT | EDGE OF WATER LOOKING DOWNSTREAM (0.0 AT STAKE) LEFT / RIGHT | Gage Reading ______ ft | TIME

Features	Stake (S) Grassline (G) Waterline (W) Rock (R)	Distance From Initial Point (ft)	Width (ft)	Total Vertical Depth From Tape/Inst (ft)	Water Depth (ft)	Depth of Observation (ft)	Revolutions	Time (sec)	Velocity (ft/sec) At Point	Velocity (ft/sec) Mean in Vertical	Area (ft^2)	Discharge (cfs)
TOTALS												

End of Measurement | Time: | Gage Reading ______ ft | CALCULATIONS PERFORMED BY: | CALCULATIONS CHECKED BY:

Figure C. Field data input sheet (Back Page)

The right side of the "Channel Profile Data" section is used to graphically depict the relative locations of the suspended tape and survey level, the direction of streamflow, and any photographic documentation of the field data collection effort. Photographs of the suspended tape are taken looking up, down, and across the stream.

Biologic sampling is summarized in the "Aquatic Sampling Summary" portion of the field form. Biologic data typically consists of a fish sample, collected by electrofishing, and an aquatic invertebrate sample. Captured fish are identified by species and measured to the nearest inch. A species-specific length-frequency distribution is created by placing a hashmark in the appropriate cell of the table as each fish is measured. Aquatic invertebrate sampling is summarized within the space provided at the bottom of this section.

All other pertinent field data is recorded in the "Comments" section of the field form. This section is often used to record weather conditions, water turbidity, or species-specific biomass estimates. This additional information helps characterize the field data when it is being analyzed in the office.

The "Discharge/Cross Section Notes" portion of the field form is used to record all of the hydraulic measurements associated with the discharge measurement (Figure C). A heading is provided to record the stream name, cross section number, date, edge of water looking downstream, the staging pin reading, and time at the beginning of the stream discharge measurement. The table below the heading is used to record "Features", "Distance From Initial Point", "Width", "Total Vertical Depth From Tape/Inst(rument)", and "Water Depth" channel geometry parameters at each cell vertical. Stream velocity measurements are recorded under the columns labeled "Depth of Observation", "Revolutions", "Time", and "Velocity" for each wet cell. All discharge measurement procedures are as outlined by Buchanan and Somers (1969).

The first and last channel geometry measurements are always taken at the cross section stakes. Channel geometry measurements should also be taken at the grassline-streambank and streambank-waterline intersections and at all distinguishable slope breaks between these two intersection points. The horizontal locations of the grassline-streambank and streambank-waterline intersections are also documented by placing a "G" and a "W" in the appropriate row of the "Features" column of the field form. Grassline is identified at the normal high water line, not flood stage, and is generally located below sedges and other plants that may survive submerged under high flows. The "Features" column is also used to document the horizontal locations of the two cross section stakes ("S") and any rocks ("R") or other features that may have an impact on the discharge measurement.

On streams with uniform bottom profiles (i.e., sand, cobble, etc.), channel geometry and discharge measurements are taken at fixed intervals within the wetted portion of the channel. The interval is varied in streams with boulder substrates to more accurately reflect changes in the velocity distribution with changes in channel bottom profile. The stream discharge measurement is divided into a minimum of 20 to 30 discharge cells, depending upon wetted stream width, with a minimum cell width of 0.3 feet. Sufficient measurements are taken to ensure that no more than 10% of the total streamflow occurs within a single discharge cell. Horizontal and vertical distances are taken from the suspended tape and recorded to the nearest tenth of a foot. Stream velocity (ft/sec) within each cell is averaged and recorded.

The bottom of the "Discharge/Cross Section Notes" section is used to summarize the discharge measurement. Space is also provided to record the names of the persons responsible for the field data calculations, the staging pin reading, and time at the end of the stream discharge measurement.

Office Procedures

The CWCB uses a Microsoft Excel for Windows macro, called R2CROSS, to process the field data and model instream hydraulic parameters at streamflows above and below the field-measured discharge. The CWCB relies upon the biologic expertise of the cooperating agencies to interpret the output from R2CROSS and develop an initial, biologic instream flow recommendation. This initial recommendation is designed to address the unique biologic requirements of each stream without regard to water availability. After receiving the cooperating agencies' biologic recommendation, the CWCB staff evaluates stream hydrology to determine whether water is physically available for an instream flow appropriation.

Background on the R2CROSS Methodology

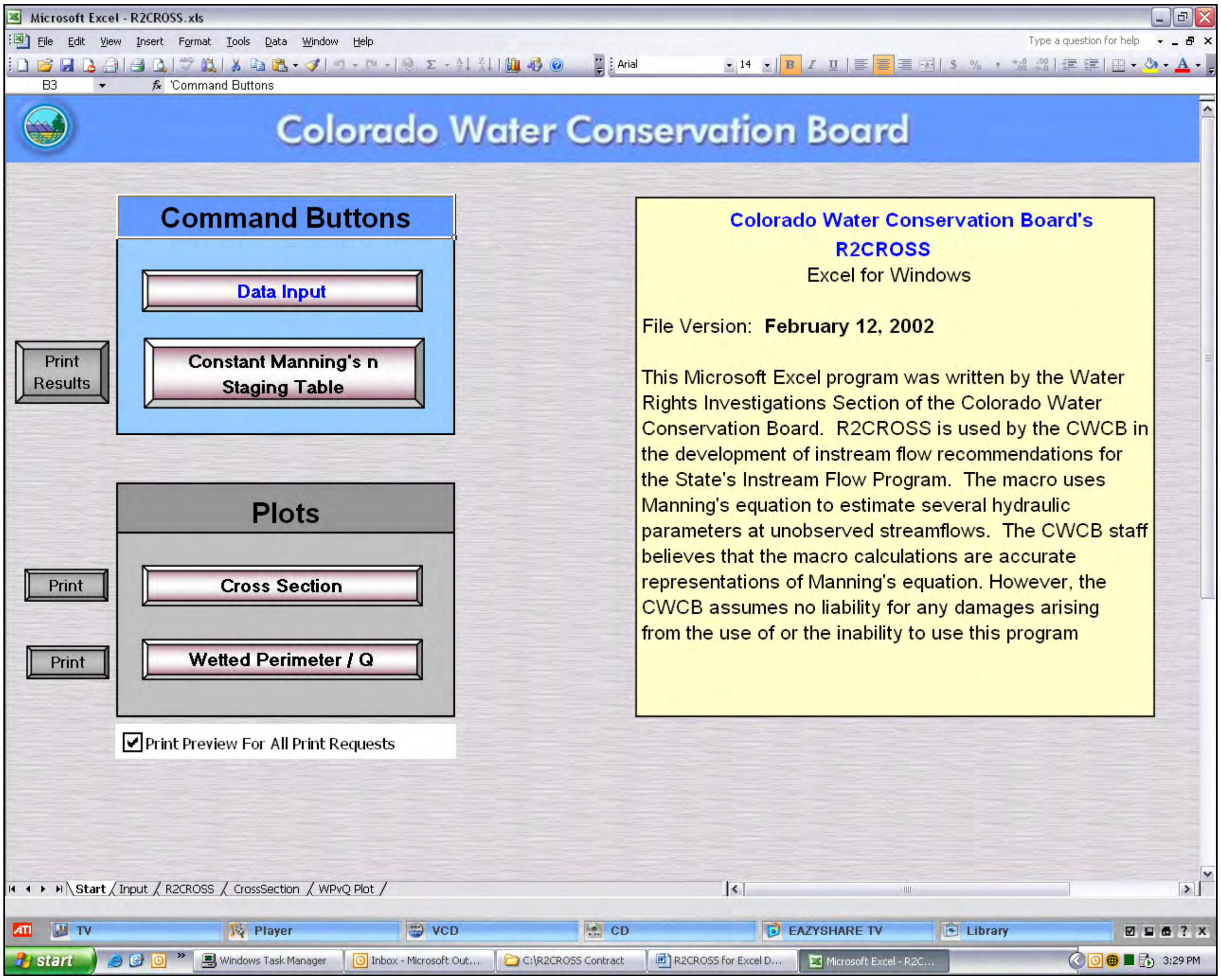
Three instream hydraulic parameters, average depth ($\bar{x}_d$), average velocity ($\bar{x}_v$), and percent wetted perimeter (*%WP*), are used to develop biologic instream flow recommendations in Colorado. The DOW has determined that by maintaining these three hydraulic parameters at adequate levels across riffle habitat-types, aquatic habitat in pools and runs will also be maintained for most life stages of fish and aquatic invertebrates (Nehring 1979).

The R2CROSS methodology uses Manning's equation to predict $\bar{x}_d$, $\bar{x}_v$, *%WP*, and other instream hydraulic parameters, at discharges both above and below the field-measured stream discharge. The methodology is both time and labor efficient, requires data from only a single stream transect, and has been found to produce similar results to more data intensive techniques (Nehring 1979) such as the Instream Flow Incremental Methodology (IFIM) developed by the U.S. Fish and Wildlife Service (Bovee 1982).

In 1973, the CWCB staff performed all Manning's equation calculations with a hand-held calculator. In 1981, the USFS released "*Program Documentation for R2-CROSS-81*" (Weatherred et al. 1981). This Fortran-based, mainframe computer program automated the repetitive task of manipulating and recalculating Manning's equation by hand. The CWCB used the USFS version of R2CROSS on the Colorado State University mainframe computer until 1985.

In 1986, the CWCB staff began development of a personal computer version of R2CROSS using the macro capabilities of Lotus 1-2-3. The CWCB found the R2CROSS macro to be advantageous because it ran on a personal computer and it could be customized to the specific needs of the CWCB. In February 2002, the CWCB staff upgraded the R2CROSS macro to Microsoft Excel for Windows. This latest version of R2CROSS is menu-driven (Figure D) and requires very little experience with

Microsoft Excel. The macro automatically formats the R2CROSS worksheet, initiates data entry, and performs all calculation and printing tasks.



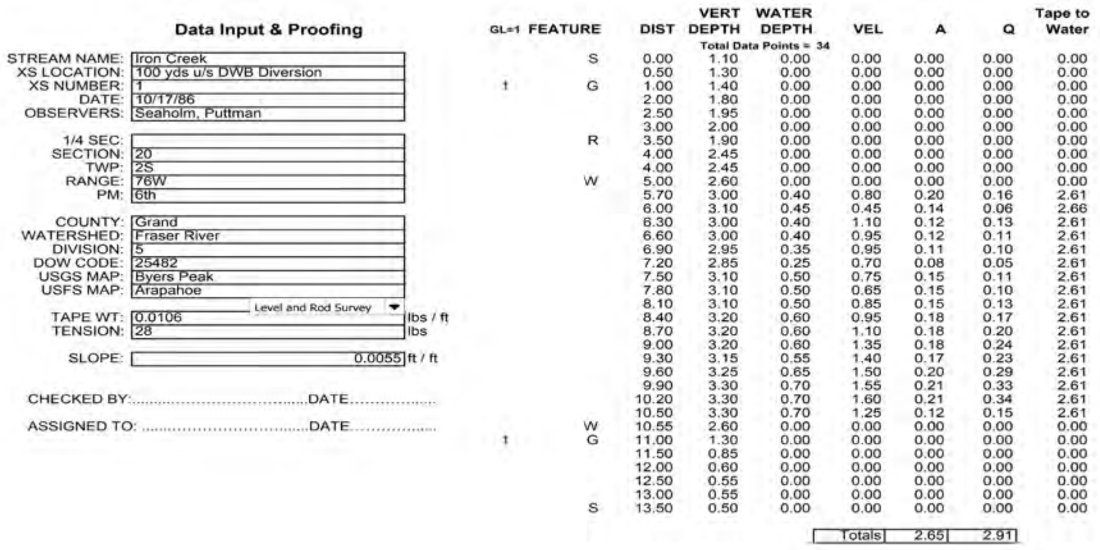
Colorado Water Conservation Board's
R2CROSS
Excel for Windows

File Version: **February 12, 2002**

This Microsoft Excel program was written by the Water Rights Investigations Section of the Colorado Water Conservation Board. R2CROSS is used by the CWCB in the development of instream flow recommendations for the State's Instream Flow Program. The macro uses Manning's equation to estimate several hydraulic parameters at unobserved streamflows. The CWCB staff believes that the macro calculations are accurate representations of Manning's equation. However, the CWCB assumes no liability for any damages arising from the use of or the inability to use this program

Figure D. R2CROSS menu in Microsoft Excel for Windows

Figures E through K provide an example of R2CROSS output from a typical Colorado stream named Iron Creek. Figure E is a "Proof Sheet" that is printed and inspected for data entry errors prior to performing final R2CROSS calculations. Final output consists of a five page printout (Figures F through J). Page one summarizes most of the stream location information, supplemental data, and channel profile data from the field form (Figure F). Page two summarizes the channel geometry/discharge field data set and values computed from the raw field data, including an estimate of Manning's "n" (Figure G). Page three consists of a water line comparison table which the program uses to interpolate the single water surface elevation that results in a calculated cross-sectional area equal to the field-measured cross-sectional area (Figure H). Page four is the staging table that is used by the cooperating agency to develop an initial, biologic instream flow recommendation (Figure I). The staging table provides estimates of modeled instream hydraulic parameters at stages above and below the measured discharge. Page five summarizes measured and calculated flows, waterlines, and depths (Figure J). It also presents estimates of mean velocity, Manning's "n", water slope, and upper and lower streamflow limits within which the instream flow recommendation should fall. In general, hydraulic models based upon Manning's equation are most accurate when predicted flows fall within a range of 0.4 to 2.5 times measured flow (Bovee and Milhous 1978; Bovee 1982). Space is also provided for a narrative describing the basis for the initial instream flow recommendation and for the signatures of the personnel involved in making the recommendation. The macro can also be used to generate a plots of the stream cross section (Figure K) and Wetted Perimeter vs. Discharge (Figure L).



Data Input & Proofing

STREAM NAME: Iron Creek
XS LOCATION: 100 yds u/s DWB Diversion
XS NUMBER: 1
DATE: 10/17/86
OBSERVERS: Seaholm, Puttman

1/4 SEC:
SECTION: 20
TWP: 2S
RANGE: 76W
PM: 6th

COUNTY: Grand
WATERSHED: Fraser River
DIVISION: 5
DOW CODE: 25482
USGS MAP: Byers Peak
USFS MAP: Arapahoe
Level and Rod Survey ▼
TAPE WT: 0.0106 lbs / ft
TENSION: 28 lbs

SLOPE: 0.0055 ft / ft

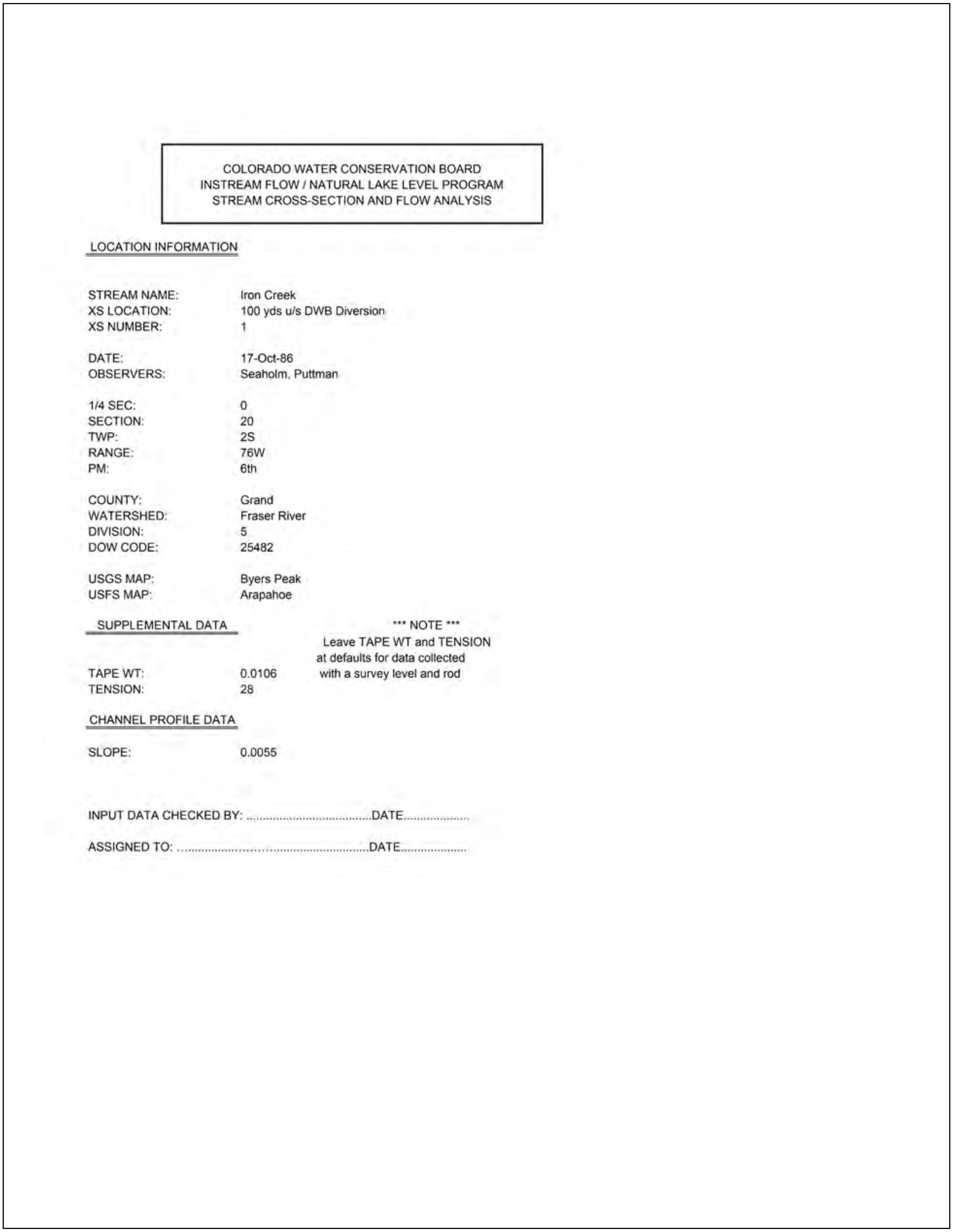
CHECKED BY:................................DATE..................

ASSIGNED TO: ....DATE..................

Total Data Points = 34

GL=1	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	A	Q	Tape to Water
	S	0.00	1.10	0.00	0.00	0.00	0.00	0.00
		0.50	1.30	0.00	0.00	0.00	0.00	0.00
t	G	1.00	1.40	0.00	0.00	0.00	0.00	0.00
		2.00	1.80	0.00	0.00	0.00	0.00	0.00
		2.50	1.95	0.00	0.00	0.00	0.00	0.00
		3.00	2.00	0.00	0.00	0.00	0.00	0.00
	R	3.50	1.90	0.00	0.00	0.00	0.00	0.00
		4.00	2.45	0.00	0.00	0.00	0.00	0.00
		4.00	2.45	0.00	0.00	0.00	0.00	0.00
	W	5.00	2.60	0.00	0.00	0.00	0.00	0.00
		5.70	3.00	0.40	0.80	0.20	0.16	2.61
		6.00	3.10	0.45	0.45	0.14	0.06	2.66
		6.30	3.00	0.40	1.10	0.12	0.13	2.61
		6.60	3.00	0.40	0.95	0.12	0.11	2.61
		6.90	2.95	0.35	0.95	0.11	0.10	2.61
		7.20	2.85	0.25	0.70	0.08	0.05	2.61
		7.50	3.10	0.50	0.75	0.15	0.11	2.61
		7.80	3.10	0.50	0.65	0.15	0.10	2.61
		8.10	3.10	0.50	0.85	0.15	0.13	2.61
		8.40	3.20	0.60	0.95	0.18	0.17	2.61
		8.70	3.20	0.60	1.10	0.18	0.20	2.61
		9.00	3.20	0.60	1.35	0.18	0.24	2.61
		9.30	3.15	0.55	1.40	0.17	0.23	2.61
		9.60	3.25	0.65	1.50	0.20	0.29	2.61
		9.90	3.30	0.70	1.55	0.21	0.33	2.61
		10.20	3.30	0.70	1.60	0.21	0.34	2.61
		10.50	3.30	0.70	1.25	0.12	0.15	2.61
	W	10.55	2.60	0.00	0.00	0.00	0.00	0.00
t	G	11.00	1.30	0.00	0.00	0.00	0.00	0.00
		11.50	0.85	0.00	0.00	0.00	0.00	0.00
		12.00	0.60	0.00	0.00	0.00	0.00	0.00
		12.50	0.55	0.00	0.00	0.00	0.00	0.00
		13.00	0.55	0.00	0.00	0.00	0.00	0.00
	S	13.50	0.50	0.00	0.00	0.00	0.00	0.00
					Totals	2.65	2.91	

Figure E. R2CROSS Proof Sheet – Iron Creek Example



COLORADO WATER CONSERVATION BOARD
INSTREAM FLOW / NATURAL LAKE LEVEL PROGRAM
STREAM CROSS-SECTION AND FLOW ANALYSIS

LOCATION INFORMATION

STREAM NAME: Iron Creek
XS LOCATION: 100 yds u/s DWB Diversion
XS NUMBER: 1

DATE: 17-Oct-86
OBSERVERS: Seaholm, Puttman

1/4 SEC: 0
SECTION: 20
TWP: 2S
RANGE: 76W
PM: 6th

COUNTY: Grand
WATERSHED: Fraser River
DIVISION: 5
DOW CODE: 25482

USGS MAP: Byers Peak
USFS MAP: Arapahoe

SUPPLEMENTAL DATA

*** NOTE ***
Leave TAPE WT and TENSION
at defaults for data collected
with a survey level and rod

TAPE WT: 0.0106
TENSION: 28

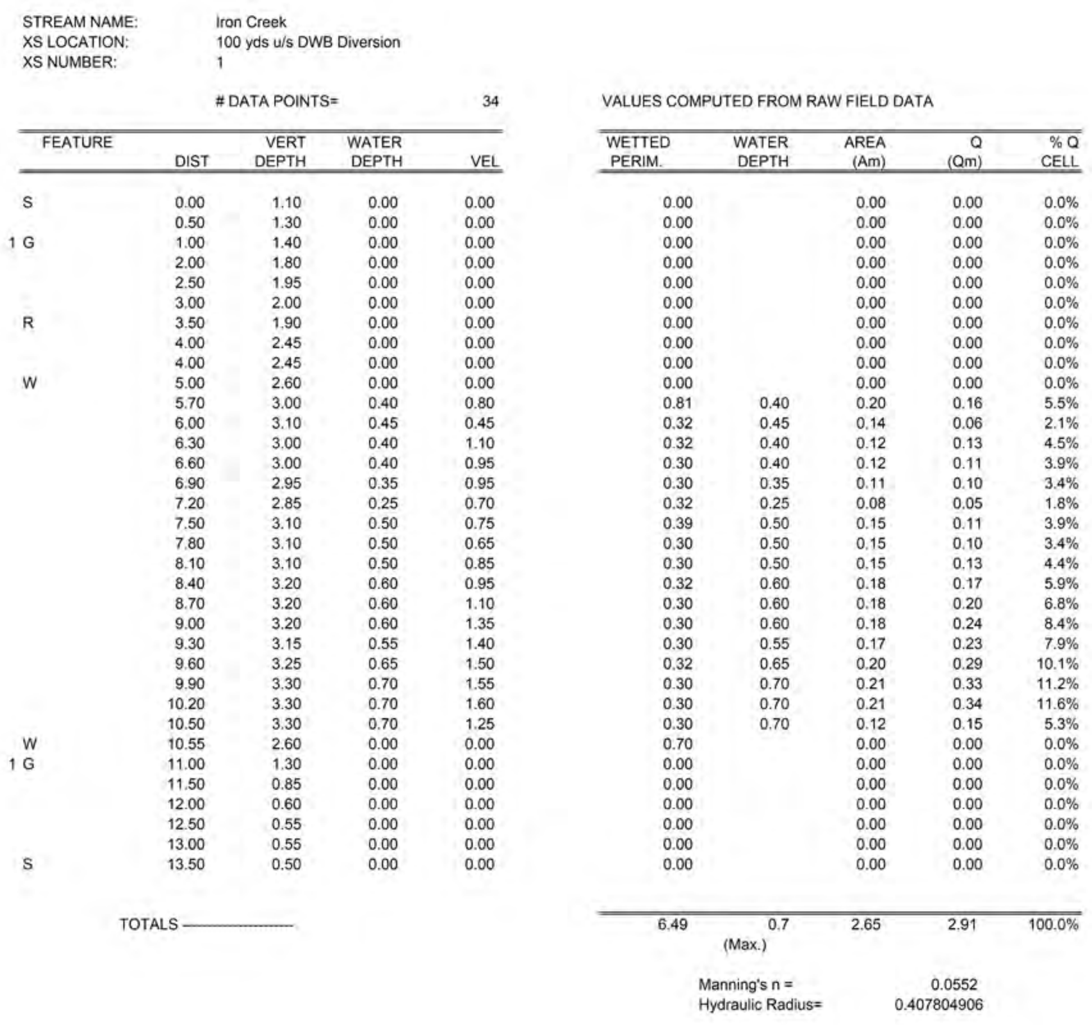
CHANNEL PROFILE DATA

SLOPE: 0.0055

INPUT DATA CHECKED BY: ....DATE....................

ASSIGNED TO: ....DATE....................

Figure F. Final R2CROSS Output (Page 1) – Iron Creek Example



STREAM NAME: Iron Creek
XS LOCATION: 100 yds u/s DWB Diversion
XS NUMBER: 1

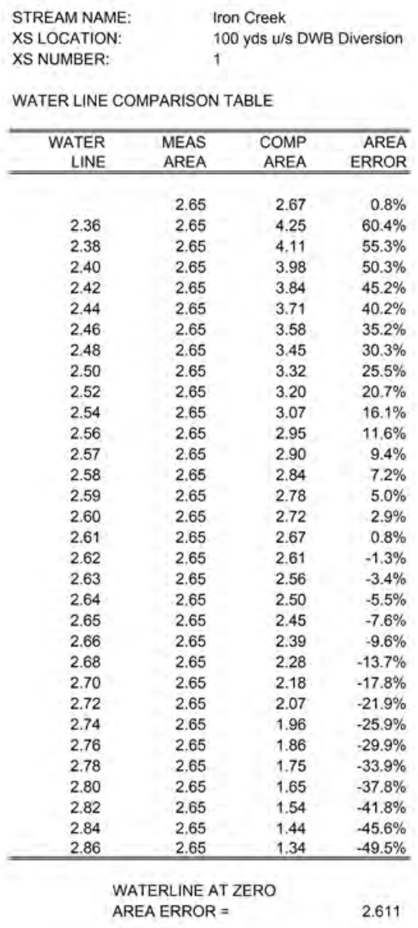
DATA POINTS= 34

VALUES COMPUTED FROM RAW FIELD DATA

FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL	WETTED PERIM.	WATER DEPTH	AREA (Am)	Q (Qm)	% Q CELL
S	0.00	1.10	0.00	0.00	0.00		0.00	0.00	0.0%
	0.50	1.30	0.00	0.00	0.00		0.00	0.00	0.0%
1 G	1.00	1.40	0.00	0.00	0.00		0.00	0.00	0.0%
	2.00	1.80	0.00	0.00	0.00		0.00	0.00	0.0%
	2.50	1.95	0.00	0.00	0.00		0.00	0.00	0.0%
	3.00	2.00	0.00	0.00	0.00		0.00	0.00	0.0%
R	3.50	1.90	0.00	0.00	0.00		0.00	0.00	0.0%
	4.00	2.45	0.00	0.00	0.00		0.00	0.00	0.0%
	4.00	2.45	0.00	0.00	0.00		0.00	0.00	0.0%
W	5.00	2.60	0.00	0.00	0.00		0.00	0.00	0.0%
	5.70	3.00	0.40	0.80	0.81	0.40	0.20	0.16	5.5%
	6.00	3.10	0.45	0.45	0.32	0.45	0.14	0.06	2.1%
	6.30	3.00	0.40	1.10	0.32	0.40	0.12	0.13	4.5%
	6.60	3.00	0.40	0.95	0.30	0.40	0.12	0.11	3.9%
	6.90	2.95	0.35	0.95	0.30	0.35	0.11	0.10	3.4%
	7.20	2.85	0.25	0.70	0.32	0.25	0.08	0.05	1.8%
	7.50	3.10	0.50	0.75	0.39	0.50	0.15	0.11	3.9%
	7.80	3.10	0.50	0.65	0.30	0.50	0.15	0.10	3.4%
	8.10	3.10	0.50	0.85	0.30	0.50	0.15	0.13	4.4%
	8.40	3.20	0.60	0.95	0.32	0.60	0.18	0.17	5.9%
	8.70	3.20	0.60	1.10	0.30	0.60	0.18	0.20	6.8%
	9.00	3.20	0.60	1.35	0.30	0.60	0.18	0.24	8.4%
	9.30	3.15	0.55	1.40	0.30	0.55	0.17	0.23	7.9%
	9.60	3.25	0.65	1.50	0.32	0.65	0.20	0.29	10.1%
	9.90	3.30	0.70	1.55	0.30	0.70	0.21	0.33	11.2%
	10.20	3.30	0.70	1.60	0.30	0.70	0.21	0.34	11.6%
	10.50	3.30	0.70	1.25	0.30	0.70	0.12	0.15	5.3%
W	10.55	2.60	0.00	0.00	0.70		0.00	0.00	0.0%
1 G	11.00	1.30	0.00	0.00	0.00		0.00	0.00	0.0%
	11.50	0.85	0.00	0.00	0.00		0.00	0.00	0.0%
	12.00	0.60	0.00	0.00	0.00		0.00	0.00	0.0%
	12.50	0.55	0.00	0.00	0.00		0.00	0.00	0.0%
	13.00	0.55	0.00	0.00	0.00		0.00	0.00	0.0%
S	13.50	0.50	0.00	0.00	0.00		0.00	0.00	0.0%
TOTALS ------------------					6.49	0.7 (Max.)	2.65	2.91	100.0%

Manning's n = 0.0552
Hydraulic Radius= 0.407804906

Figure G. Final R2CROSS Output (Page 2) – Iron Creek Example



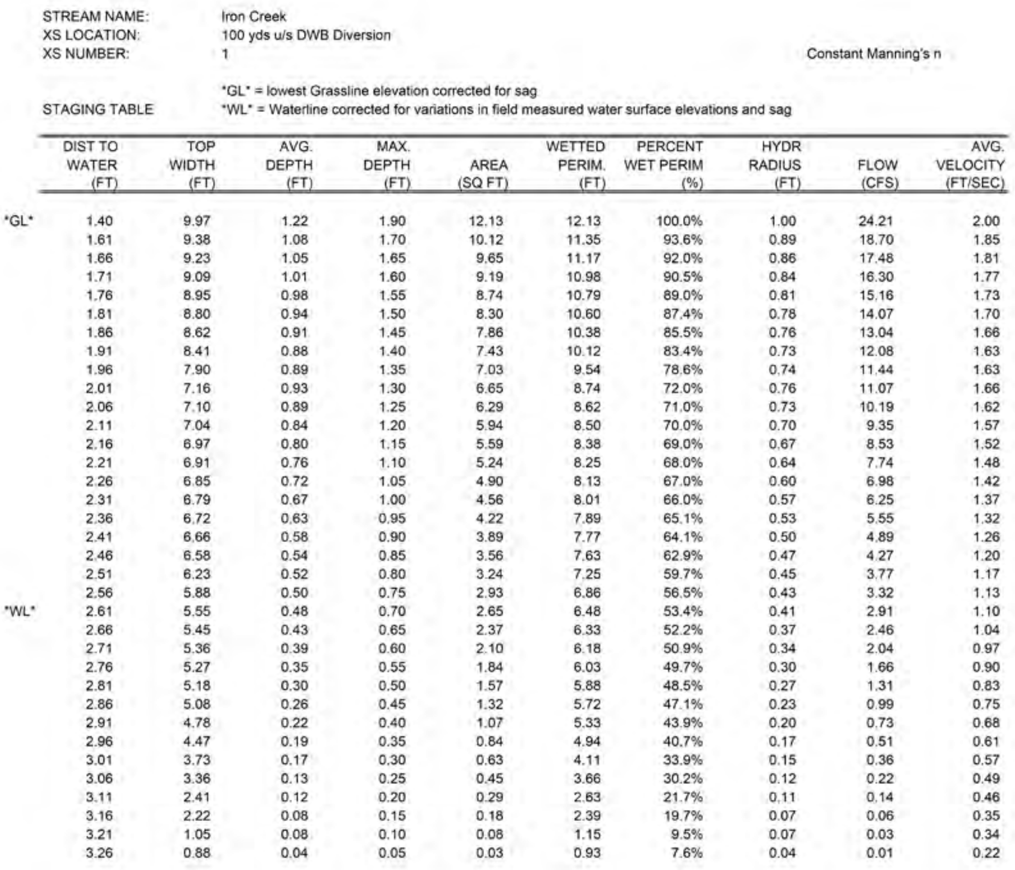
STREAM NAME: Iron Creek
XS LOCATION: 100 yds u/s DWB Diversion
XS NUMBER: 1

WATER LINE COMPARISON TABLE

WATER LINE	MEAS AREA	COMP AREA	AREA ERROR
	2.65	2.67	0.8%
2.36	2.65	4.25	60.4%
2.38	2.65	4.11	55.3%
2.40	2.65	3.98	50.3%
2.42	2.65	3.84	45.2%
2.44	2.65	3.71	40.2%
2.46	2.65	3.58	35.2%
2.48	2.65	3.45	30.3%
2.50	2.65	3.32	25.5%
2.52	2.65	3.20	20.7%
2.54	2.65	3.07	16.1%
2.56	2.65	2.95	11.6%
2.57	2.65	2.90	9.4%
2.58	2.65	2.84	7.2%
2.59	2.65	2.78	5.0%
2.60	2.65	2.72	2.9%
2.61	2.65	2.67	0.8%
2.62	2.65	2.61	-1.3%
2.63	2.65	2.56	-3.4%
2.64	2.65	2.50	-5.5%
2.65	2.65	2.45	-7.6%
2.66	2.65	2.39	-9.6%
2.68	2.65	2.28	-13.7%
2.70	2.65	2.18	-17.8%
2.72	2.65	2.07	-21.9%
2.74	2.65	1.96	-25.9%
2.76	2.65	1.86	-29.9%
2.78	2.65	1.75	-33.9%
2.80	2.65	1.65	-37.8%
2.82	2.65	1.54	-41.8%
2.84	2.65	1.44	-45.6%
2.86	2.65	1.34	-49.5%

WATERLINE AT ZERO
AREA ERROR = 2.611

Figure H. Final R2CROSS Output (Page 3) – Iron Creek Example



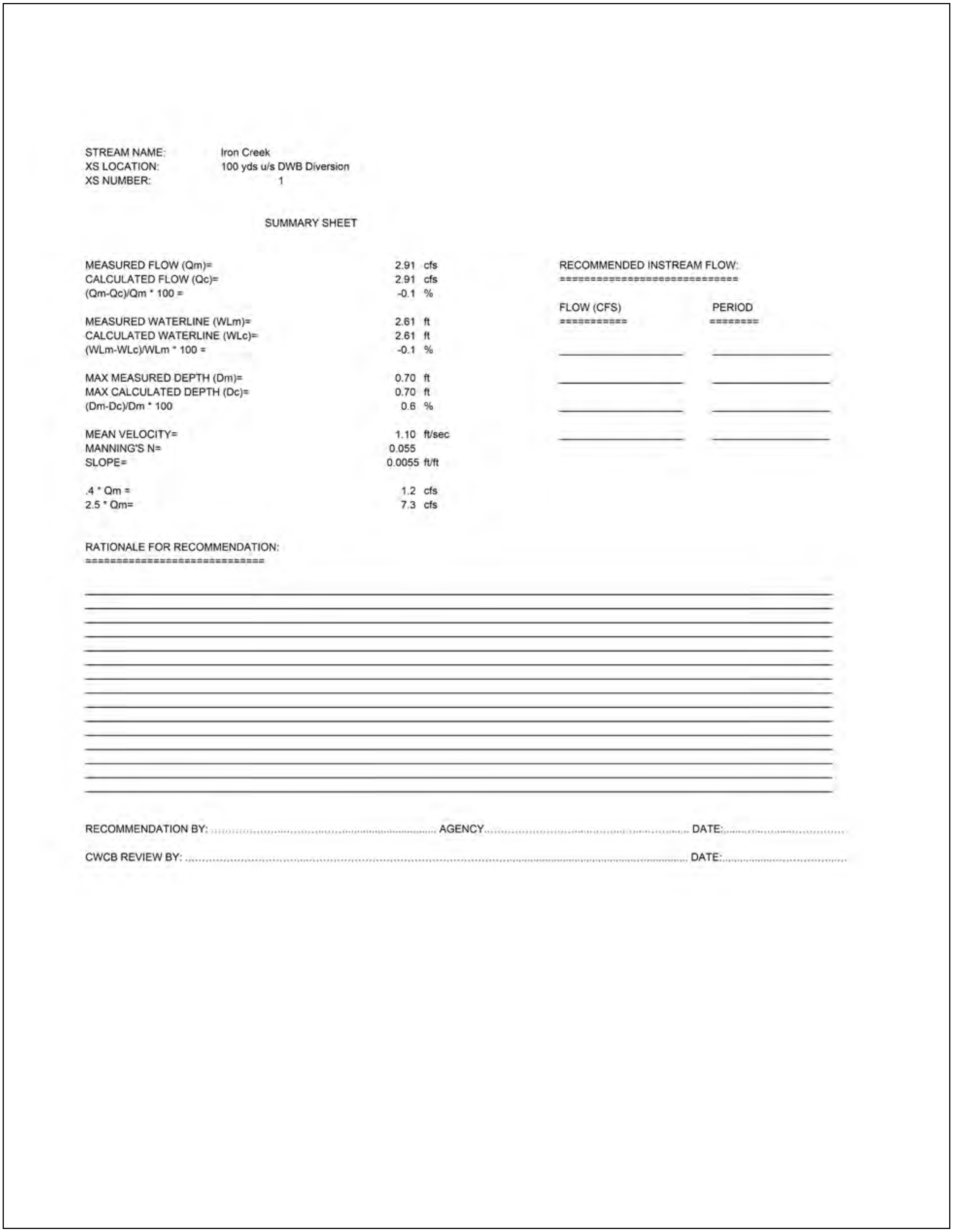
STREAM NAME: Iron Creek
XS LOCATION: 100 yds u/s DWB Diversion
XS NUMBER: 1

Constant Manning's n

"GL" = lowest Grassline elevation corrected for sag
STAGING TABLE "WL" = Waterline corrected for variations in field measured water surface elevations and sag

	DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX. DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
GL	1.40	9.97	1.22	1.90	12.13	12.13	100.0%	1.00	24.21	2.00
	1.61	9.38	1.08	1.70	10.12	11.35	93.6%	0.89	18.70	1.85
	1.66	9.23	1.05	1.65	9.65	11.17	92.0%	0.86	17.48	1.81
	1.71	9.09	1.01	1.60	9.19	10.98	90.5%	0.84	16.30	1.77
	1.76	8.95	0.98	1.55	8.74	10.79	89.0%	0.81	15.16	1.73
	1.81	8.80	0.94	1.50	8.30	10.60	87.4%	0.78	14.07	1.70
	1.86	8.62	0.91	1.45	7.86	10.38	85.5%	0.76	13.04	1.66
	1.91	8.41	0.88	1.40	7.43	10.12	83.4%	0.73	12.08	1.63
	1.96	7.90	0.89	1.35	7.03	9.54	78.6%	0.74	11.44	1.63
	2.01	7.16	0.93	1.30	6.65	8.74	72.0%	0.76	11.07	1.66
	2.06	7.10	0.89	1.25	6.29	8.62	71.0%	0.73	10.19	1.62
	2.11	7.04	0.84	1.20	5.94	8.50	70.0%	0.70	9.35	1.57
	2.16	6.97	0.80	1.15	5.59	8.38	69.0%	0.67	8.53	1.52
	2.21	6.91	0.76	1.10	5.24	8.25	68.0%	0.64	7.74	1.48
	2.26	6.85	0.72	1.05	4.90	8.13	67.0%	0.60	6.98	1.42
	2.31	6.79	0.67	1.00	4.56	8.01	66.0%	0.57	6.25	1.37
	2.36	6.72	0.63	0.95	4.22	7.89	65.1%	0.53	5.55	1.32
	2.41	6.66	0.58	0.90	3.89	7.77	64.1%	0.50	4.89	1.26
	2.46	6.58	0.54	0.85	3.56	7.63	62.9%	0.47	4.27	1.20
	2.51	6.23	0.52	0.80	3.24	7.25	59.7%	0.45	3.77	1.17
	2.56	5.88	0.50	0.75	2.93	6.86	56.5%	0.43	3.32	1.13
WL	2.61	5.55	0.48	0.70	2.65	6.48	53.4%	0.41	2.91	1.10
	2.66	5.45	0.43	0.65	2.37	6.33	52.2%	0.37	2.46	1.04
	2.71	5.36	0.39	0.60	2.10	6.18	50.9%	0.34	2.04	0.97
	2.76	5.27	0.35	0.55	1.84	6.03	49.7%	0.30	1.66	0.90
	2.81	5.18	0.30	0.50	1.57	5.88	48.5%	0.27	1.31	0.83
	2.86	5.08	0.26	0.45	1.32	5.72	47.1%	0.23	0.99	0.75
	2.91	4.78	0.22	0.40	1.07	5.33	43.9%	0.20	0.73	0.68
	2.96	4.47	0.19	0.35	0.84	4.94	40.7%	0.17	0.51	0.61
	3.01	3.73	0.17	0.30	0.63	4.11	33.9%	0.15	0.36	0.57
	3.06	3.36	0.13	0.25	0.45	3.66	30.2%	0.12	0.22	0.49
	3.11	2.41	0.12	0.20	0.29	2.63	21.7%	0.11	0.14	0.46
	3.16	2.22	0.08	0.15	0.18	2.39	19.7%	0.07	0.06	0.35
	3.21	1.05	0.08	0.10	0.08	1.15	9.5%	0.07	0.03	0.34
	3.26	0.88	0.04	0.05	0.03	0.93	7.6%	0.04	0.01	0.22

Figure I. Final R2CROSS Output (Page 4) – Iron Creek Example



STREAM NAME: Iron Creek
XS LOCATION: 100 yds u/s DWB Diversion
XS NUMBER: 1

SUMMARY SHEET

MEASURED FLOW (Qm)=	2.91	cfs
CALCULATED FLOW (Qc)=	2.91	cfs
(Qm-Qc)/Qm * 100 =	-0.1	%
MEASURED WATERLINE (WLm)=	2.61	ft
CALCULATED WATERLINE (WLc)=	2.61	ft
(WLm-WLc)/WLm * 100 =	-0.1	%
MAX MEASURED DEPTH (Dm)=	0.70	ft
MAX CALCULATED DEPTH (Dc)=	0.70	ft
(Dm-Dc)/Dm * 100	0.6	%
MEAN VELOCITY=	1.10	ft/sec
MANNING'S N=	0.055	
SLOPE=	0.0055	ft/ft
.4 * Qm =	1.2	cfs
2.5 * Qm=	7.3	cfs

RECOMMENDED INSTREAM FLOW:
=============================

FLOW (CFS)	PERIOD
===========	========

RATIONALE FOR RECOMMENDATION:
=============================

RECOMMENDATION BY: .... AGENCY.. DATE:...............................

CWCB REVIEW BY: .... DATE:...............................

Figure J. Final R2CROSS Output (Page 5) – Iron Creek Example

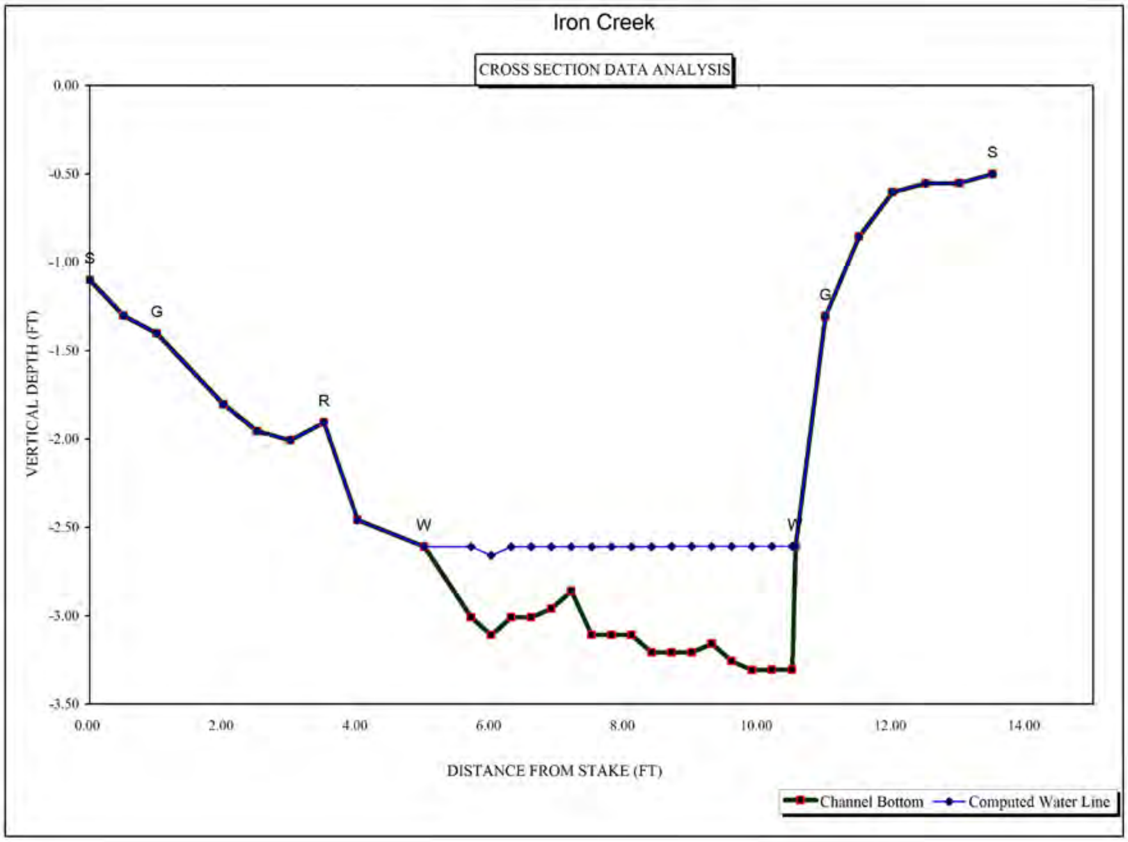


Figure K. Cross Section Plot from R2CROSS – Iron Creek Example

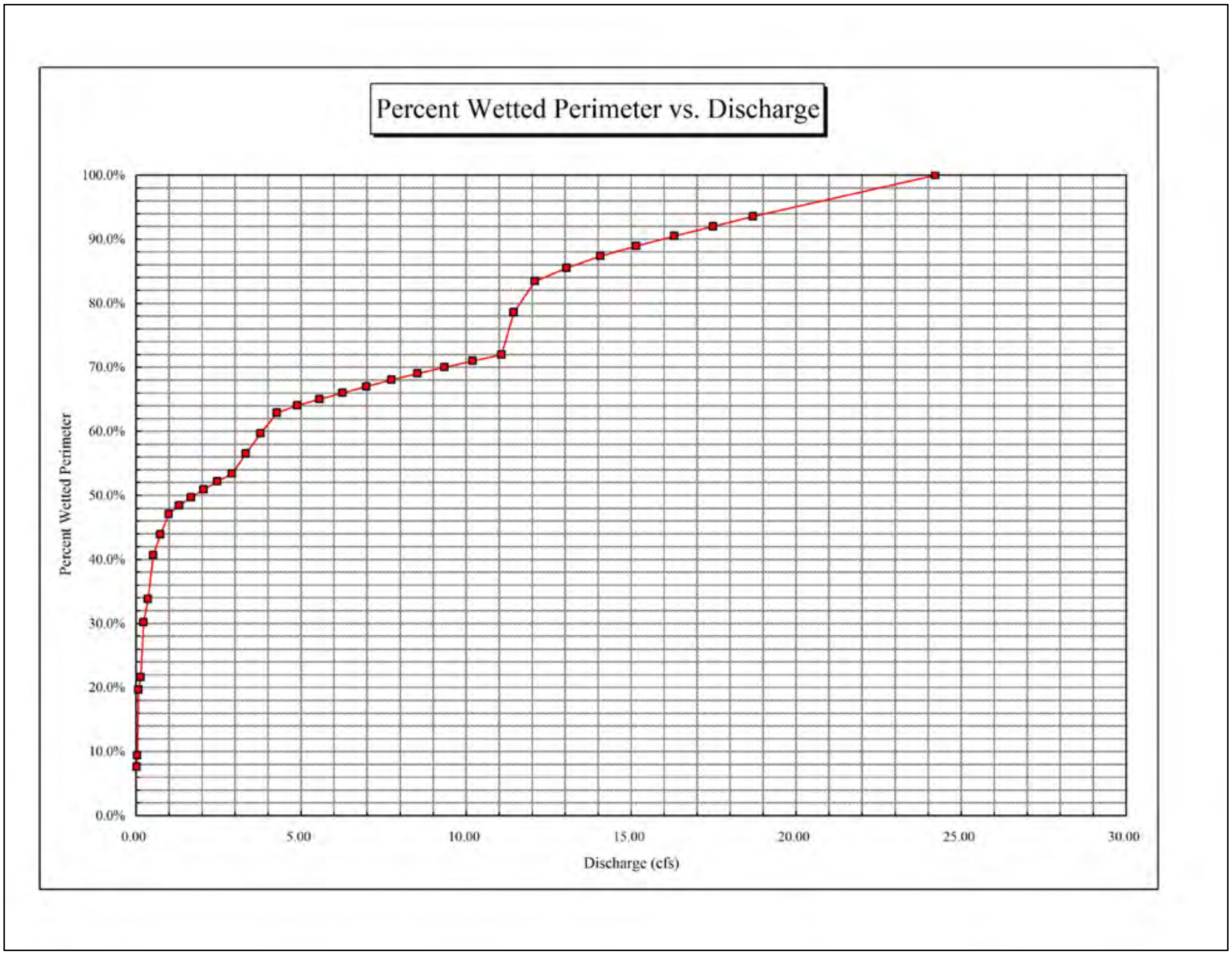


Figure L. Wetted Perimeter Plot from R2CROSS – Iron Creek Example

Biologic Instream Flow Recommendations

When using R2CROSS, biologic instream flow recommendations are based on maintaining three principal hydraulic criteria, $\bar{x}_d$, $\bar{x}_v$, and %WP, at adequate levels across the stream transect (Table 2). The $\bar{x}_d$ and %WP criteria are functions of stream top width and grassline-to-grassline wetted perimeter, respectively. A constant $\bar{x}_v$ of 1 ft/sec is recommended for all streams. The DOW has determined that these three parameters are good indices of flow-related stream habitat quality and that maintenance of these parameters at adequate levels across riffle habitat-types will also result in maintenance of adequate aquatic habitat in pools and runs for most life stages of fish and aquatic invertebrates (Nehring 1979).

The three critical hydraulic parameters are estimated within the R2CROSS staging table at various levels of discharge (Figure I). Biologic instream flow recommendations are developed by locating the modeled streamflow(s) in the R2CROSS staging table that satisfy the three hydraulic criteria summarized in Table 2. As stated above, Colorado's Instream Flow Program was created in 1973, since that time, the Program along with the science of determining instream flows has continued to evolve. For the Instream Flow Program to be successful, instream flow water rights must be able to balance the ever-changing needs and values of the public while honoring existing uses. The greatest asset of the Program, to date, has been its ability to evolve and meet those challenges.

Table 2. Criteria used to determine minimum flow requirements (Nehring 1979)

Stream Top Width (ft)[1]	Average Depth (ft)	Percent Wetted Perimeter (%)[1]	Average Velocity (ft/sec)
1-20	0.2	50	1.0
21-40	0.2-0.4	50	1.0
41-60	0.4-0.6	50-60	1.0
61-100	0.6-1.0	$\geq$ 70	1.0

[1] At bankfull discharge

In the early years of the Program, the DOW's instream flow recommendations consisted of only single year-round flow amounts. These single year-round flow amounts were based on meeting only two of the three critical hydraulic criteria identified by Nehring. For the first third of the Program, these initial flow recommendations were not adjusted due to water availability concerns. It was not until the passage of Senate Bill 414 (SB 414) in 1981, that future instream flow appropriations would require an evaluation of the existing physical water supply. In the mid 1980's, to incorporate these new changes into the Program and address other concerns being raised regarding the R2CROSS model (mainly the tendency of the R2CROSS model to overestimate the $\bar{x}_v$ criteria), DOW biologists modified the original instream flow methodology of recommending single year-round flows and began developing “seasonal flow recommendations” which would incorporate all 3 of the identified critical criteria into the flow recommendations.

These seasonal flow recommendations are an attempt to mimic the natural flow regime, albeit, on a simplistic and much smaller scale. The DOW currently believes spring/summer flows require flow recommendations which meet all three of the critical hydraulic criteria and fall/winter flows require flow recommendations which meet two of the three critical hydraulic criteria, whenever possible. CDOW believes the development of these seasonal flow recommendations helps address the full range of hydrologic and hydraulic conditions required to maintain important stream characteristics and its associated aquatic community. Research has shown that single year-round minimum flows, when maintained as a long-term condition, cannot be expected to sustain the same fish populations or aquatic life as a natural flow regime, where low flow conditions occur infrequently and for shorter periods (Stalnaker and Wick 2000). Higher spring and summer flows provide the water and resultant habitat required to maintain the adjacent riparian zone, the geomorphology of the stream channel and additional habitat and protection for different life stages of the aquatic community. In addition, protection from increasing recreational uses such as rafting, kayaking, boating, tubing, swimming and fishing is gained during these flow periods. Higher spring and summer flows also provide water quality protection from other outside factors such as effluent discharges, high metal concentrations, excess sedimentation and water temperature increases. Aquatic biologists may modify summer and winter flow recommendations based upon biologic considerations such as stream conditions, species composition, and aquatic habitat quality.

These hydraulic criteria can be applied to the R2CROSS staging table from the Iron Creek example (Figure I) to develop an initial biologic instream flow recommendation. In this example, the grassline top width of Iron Creek is 9.97 ft. Therefore, the DOW criteria for an $\bar{x}_d$ of 0.2 feet would be satisfied at a flow of approximately 0.6 cfs. The *%WP* criterion of 50% would be met at a flow of around 1.75 cfs and an $\bar{x}_v$ of 1 ft/sec at a flow of 2.25 cfs. Based upon this analysis, a winter flow recommendation of 1.75 cfs would meet the $\bar{x}_d$ and *%WP* criteria and a summer flow recommendation of 2.25 cfs would satisfy all three criteria. These initial recommendations may be adjusted up or down based upon biologic judgment and expertise.

Water Availability Requirements

Once an initial biologic instream flow recommendation has been developed, the CWCB staff must determine whether water is physically available to satisfy the biologic recommendation. The staff uses stream gaging records to analyze physical water availability whenever possible. In the absence of a gage record, the staff may use standardized hydrologic techniques, such as basin area apportionment or synthetic streamflow modeling (Kircher et al. 1985), to estimate physical water availability. The staff may also conduct a review of the State Engineer's water rights tabulation and consult with Division Engineers and District Water Commissioners to determine the effect of senior diversions on a stream reach.

The water availability analyses may lead the CWCB staff to conclude that sufficient water is not available to meet the biologic recommendation. If the statutory water availability requirement cannot be satisfied, the CWCB must reject the instream flow recommendation.

Appropriating and Protecting an Instream Flow Water Right

The CWCB has adopted the "Rules Concerning the Colorado Instream Flow and Natural Lake Level Program." These Rules codified existing CWCB procedures for implementing the Instream Flow Program and established procedures for handling acquisition of water, water rights, and interests in water including conditional rights, modification of instream flows, and inundation of instream flow water rights. The CWCB's procedural requirements for appropriating and protecting instream flow water rights are also described in great detail within these Rules and Regulations. The procedural aspects of appropriating and protecting an instream flow water right are beyond the intended scope of this manuscript. Individuals who are interested in learning more about these procedures are encouraged to obtain a copy of the above-referenced Rules from the CWCB website at: http://cwcb.state.co.us/Streamandlake/Documents/ADOPTEDRULES11-15-2005.pdf .

Summary

The Colorado State Legislature enacted SB 97 in 1973. By "recognizing the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (§ 37-92-102(3), C.R.S. (2002)), the Legislature sought to balance traditional water development with some reasonable protection of Colorado's natural environment. This is not a simple task in the semi-arid Western United States where water is a scarce and extremely valuable resource. The ongoing success of Colorado's Instream Flow Program assures that coordination between water development and protection of the natural environment will continue -- both now and into the future. . Since that time, the CWCB has completed instream flow appropriations on approximately 8,500 miles of Colorado streams.

The CWCB has adopted standardized field and office procedures for developing instream flow recommendations. This standardization helps to ensure that each instream flow recommendation is "necessary" and "reasonable", as required by state statute.R2CROSS is one of several instream flow assessment techniques employed by state and federal agencies to model instream hydraulic parameters. R2CROSS was chosen by the State of Colorado because it is time and labor efficient and produces comparable results to more costly instream flow assessment techniques. . The R2CROSS macro is also easy to use and requires very little in the way of computer hardware or software.

Biologic instream flow recommendations based upon output from R2CROSS are designed to maintain $\bar{x}_v$, $\bar{x}_d$, and *%WP* at critical levels across riffle habitat-types. It is assumed that by maintaining these critical hydraulic parameters across riffles, aquatic habitat in pools and runs is also preserved. In addition to biologic considerations, water must be physically available for the CWCB to file for an instream flow water right.

An instream flow water right requires a coordinated effort between various state and federal agencies, the public, and the CWCB. The culmination of these efforts is a decreed instream flow water right that is held by the CWCB on behalf of the people of Colorado to "preserve the natural environment to a reasonable degree."

R2CROSS Program Documentation

Program documentation for the R2CROSS macro is divided into two sections. The "Setup and Installation" section provides a brief description of the hardware and software requirements of the R2CROSS macro and copying the R2CROSS program to folders on a hard drive. "The R2CROSS Menu" provides more detailed program documentation for each of the menu choices within R2CROSS (Figure M). Users who are familiar with Microsoft Excel for Windows should have very little difficulty learning how to operate the R2CROSS macro.

Appendix A provides a brief description of the "Program Calculations" that are performed within the R2CROSS macro. Rather than emphasizing the technical aspects of these calculations, this appendix is intended to provide a fundamental understanding of the operations being performed within the macro.

Output from the R2CROSS macro was verified against several simple hand-calculated examples. More complex cross sections were verified by comparison with output from the MANSQ option of IFIM (Bovee 1982). Based on this verification process, it is our belief that the instream hydraulic parameters summarized in the R2CROSS staging table are accurate estimations based upon Manning's equation.

The CWCB hopes that the release of the R2CROSS macro will foster a greater understanding of this technical aspect of Colorado's Instream Flow Program. It is intended to be user-friendly. If you have any problems running the macro or questions regarding its operation, please feel free to contact the CWCB staff.

Setup and Installation

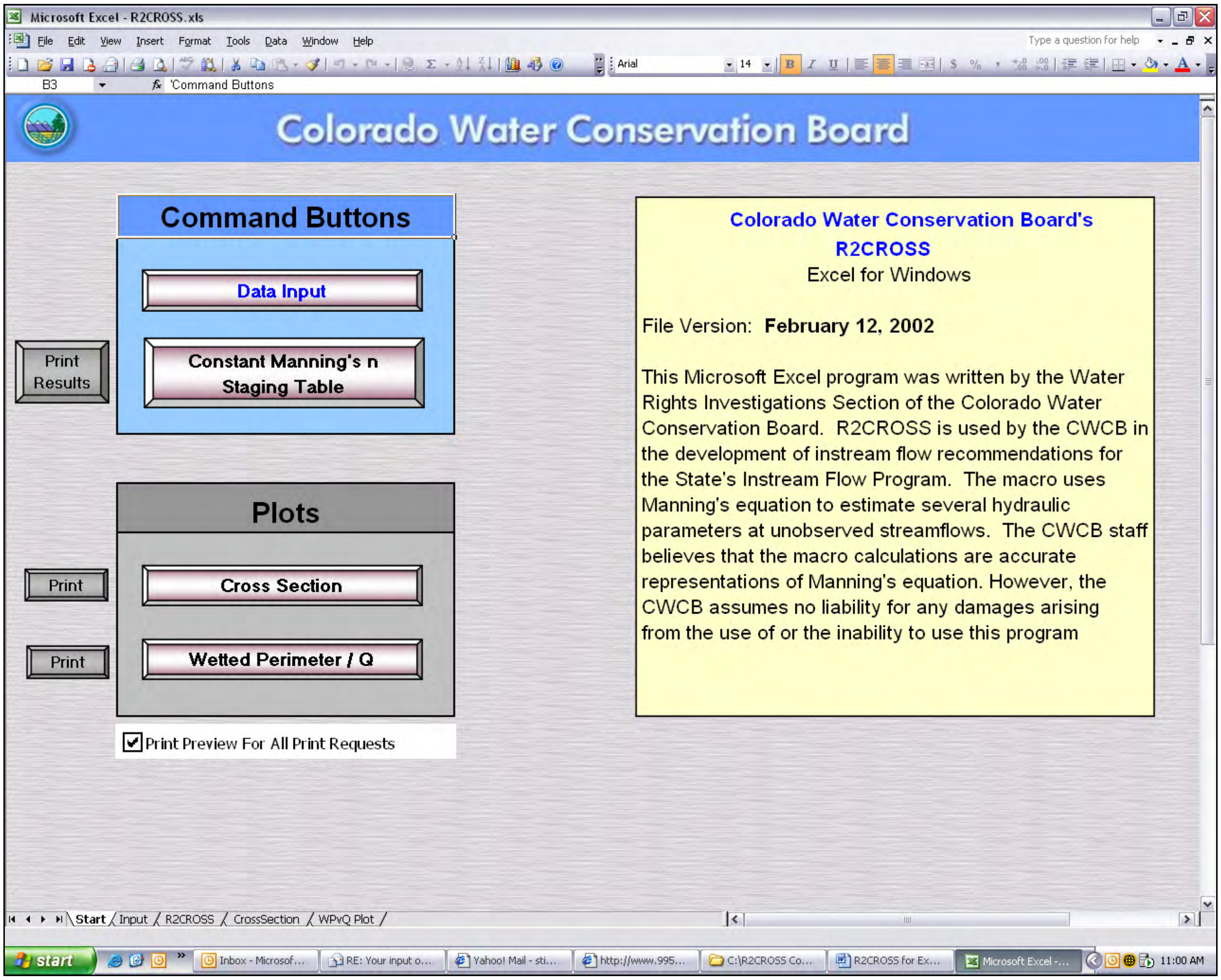
We have found that the R2CROSS macro runs efficiently on most IBM-compatible personal computers equipped with Microsoft Excel for Windows software. We recommend that an original copy of the R2CROSS.xls spreadsheet be stored in a location where it won’t be overwritten. Additional copies can then be placed in other folders where individual stream flow datasets are being evaluated.

To initiate the R2CROSS macro, either double click on the R2CROSS.xls file or start Microsoft Excel for Windows , select “File”” and then “Open” from the Excel menu bar, and then navigate to the location where you saved the working copy of R2CROSS.xls.

Some users may find that the macro runs extremely slow when first installed. This is generally due to the security level setting on an individual’s copy of Microsoft Excel. To increase the speed of the R2CROSS macro, it may be necessary to lower the security level of Excel. This can be accomplished by clicking the “Tools” menu choice in Excel and then selecting “Options” from the drop down menu. Click the “Security” tab and then the “Macro Security” button in the lower right hand corner of the graphic user interface. Select “Low” from the list of available macro security choices. You may want to repeat this procedure and increase the macro security level of your computer back to its original level when you finish an R2CROSS session.

The R2CROSS Menu

Figure M shows the opening screen of R2CROSS. The functionality of the R2CROSS macro is intended to be fairly intuitive. Use the “Data Input” button to initiate and proof data entry. After data entry is complete, use the “Constant Manning’s n Staging Table” button to generate and print R2CROSS output. The “Cross Section” and “Wetted Perimeter/Q” buttons can then be used to generate cross section and wetted perimeter vs. discharge plots.



☑ Print Preview For All Print Requests

Colorado Water Conservation Board's
R2CROSS
Excel for Windows

File Version: **February 12, 2002**

This Microsoft Excel program was written by the Water Rights Investigations Section of the Colorado Water Conservation Board. R2CROSS is used by the CWCB in the development of instream flow recommendations for the State's Instream Flow Program. The macro uses Manning's equation to estimate several hydraulic parameters at unobserved streamflows. The CWCB staff believes that the macro calculations are accurate representations of Manning's equation. However, the CWCB assumes no liability for any damages arising from the use of or the inability to use this program

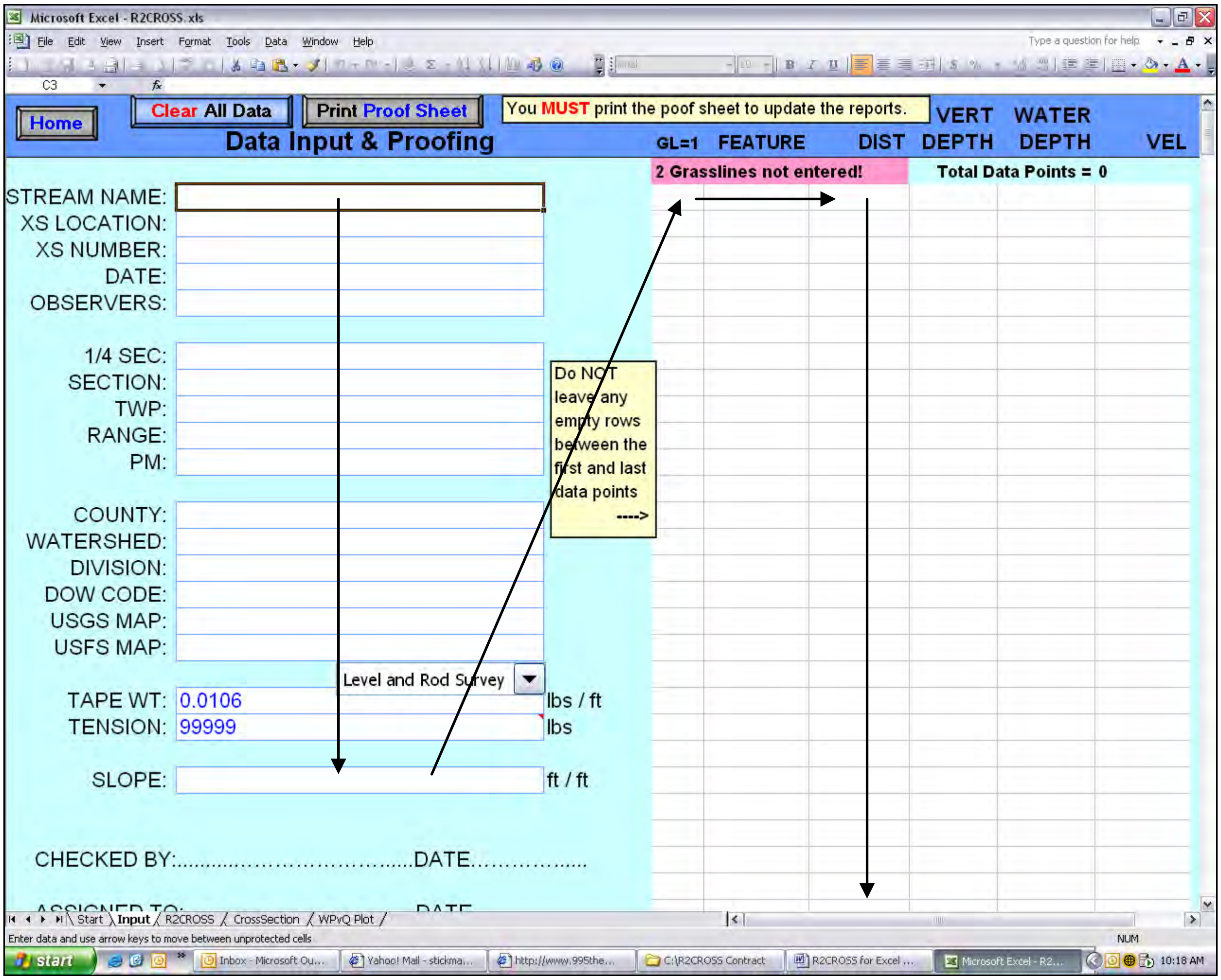
Figure M. R2CROSS Menu

Check the “Print Preview for All Print Requests” option if you want to preview all print requests before sending them to the printer. Uncheck the checkbox if you’d prefer to have all print requests sent directly to the printer without the opportunity to preview.

The “Print Results” and “Print” buttons can be used to send results of plots directly to the printer.

Data Input

Press the “Data Input” button to begin entering cross section data. Figure N shows the R2CROSS data input and proofing screen. Begin by entering the Stream Name, XS Location, etc in the appropriate cells of the spreadsheet. Use the “Enter” key on your keyboard to move the cursor down the column. After entering a Slope, use the Enter key to automatically move the cursor to the top of the “GL=1” column.



You MUST print the poof sheet to update the reports.

2 Grasslines not entered!

Total Data Points = 0

STREAM NAME:
XS LOCATION:
XS NUMBER:
DATE:
OBSERVERS:

1/4 SEC:
SECTION:
TWP:
RANGE:
PM:

COUNTY:
WATERSHED:
DIVISION:
DOW CODE:
USGS MAP:
USFS MAP:

Level and Rod Survey

TAPE WT: 0.0106 lbs / ft
TENSION: 99999 lbs

SLOPE: ft / ft

CHECKED BY:.......................................DATE.................

ASSIGNED TO: DATE

Do NOT leave any empty rows between the first and last data points ---->

Enter data and use arrow keys to move between unprotected cells

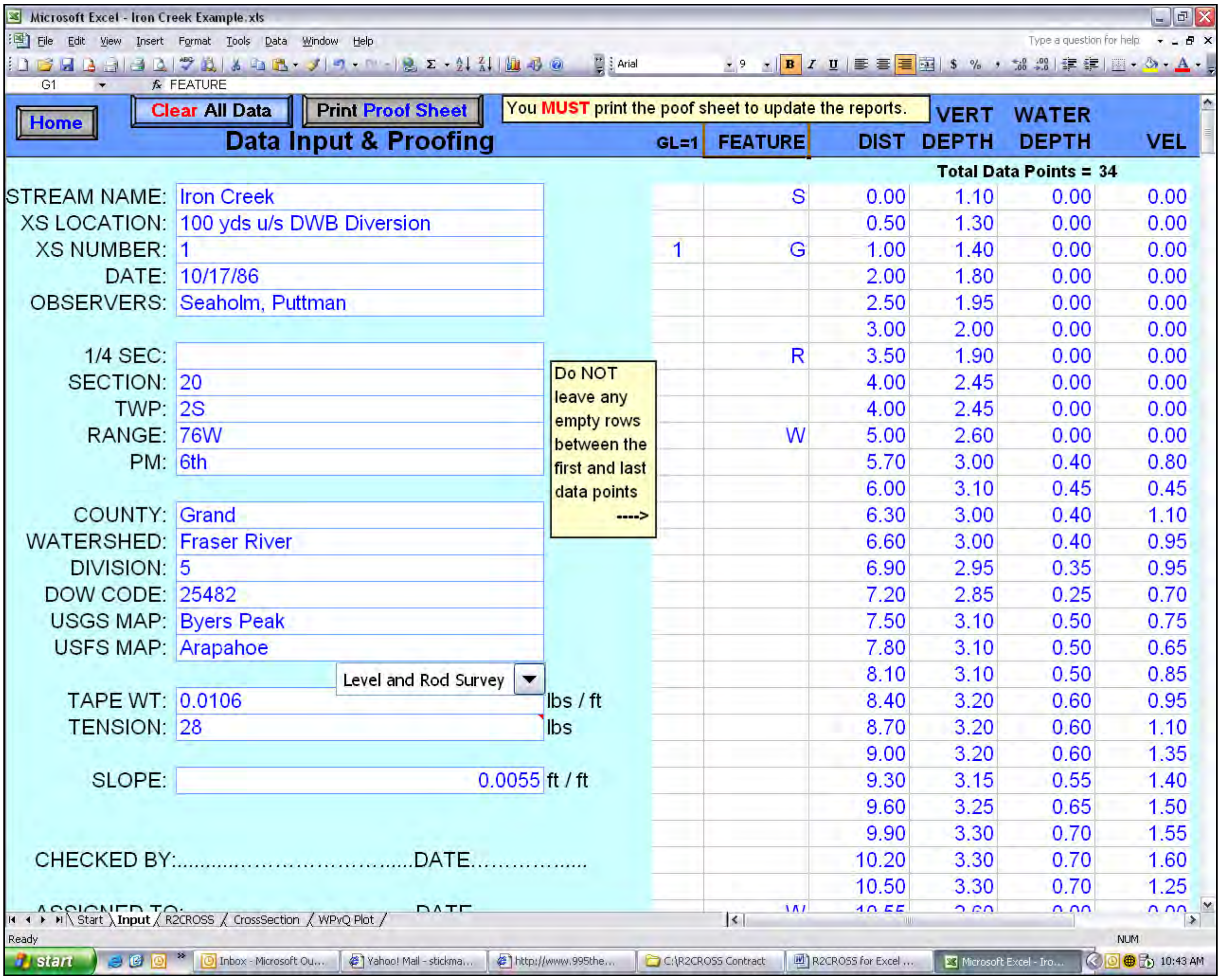
Figure N. R2CROSS Data Input and Proofing Screen

Use the arrow keys on your keyboard to move right into the “Dist” column. Enter all distances from the near bank cross section stake. This is most easily accomplished using the key pad on the right hand side of most computers. Ten-key typing skills will facilitate data entry. After entering the last “Dist” at the far bank cross section stake, scroll or use the arrow keys to move back to the top of the data entry form and verify that the “Total Data Points = *x*” displayed at the top of the data entry form are identical to the number of data points collected in the field. Correct any data entry errors in the “Dist” column.

Use the cursor, arrow keys, or Enter key to navigate through the remainder of the data entry form. R2CROSS requires that you enter a "1" in the "GL=1" for the grasslines on each side of the cross section. The "2 Grasslines not entered" warning will disappear when this requirement has been met.

Note that the standard Microsoft Excel functions like "Cut", "Copy", and "Paste" can be accessed by right-clicking on cells in the worksheet and selecting the desired choice from the Excel menu. In addition, standard Excel "drag and drop" functionality can by used to move single cells or blocks of cells within the data entry worksheet. Experience Excel users may find that using these functions greatly facilitates data entry and editing.

The final data entry screen for Iron Creek is provided as an example in Figure O. Note that the "2 Grasslines not entered" warning is gone and there are 34 Total Data Points on the Iron Creek transect.



You **MUST** print the poof sheet to update the reports.

Data Input & Proofing

STREAM NAME: Iron Creek
XS LOCATION: 100 yds u/s DWB Diversion
XS NUMBER: 1
DATE: 10/17/86
OBSERVERS: Seaholm, Puttman

1/4 SEC:
SECTION: 20
TWP: 2S
RANGE: 76W
PM: 6th

COUNTY: Grand
WATERSHED: Fraser River
DIVISION: 5
DOW CODE: 25482
USGS MAP: Byers Peak
USFS MAP: Arapahoe

Level and Rod Survey

TAPE WT: 0.0106 lbs / ft
TENSION: 28 lbs

SLOPE: 0.0055 ft / ft

CHECKED BY:......................................DATE...................

Do NOT leave any empty rows between the first and last data points ---->

Total Data Points = 34

GL=1	FEATURE	DIST	VERT DEPTH	WATER DEPTH	VEL
	S	0.00	1.10	0.00	0.00
		0.50	1.30	0.00	0.00
1	G	1.00	1.40	0.00	0.00
		2.00	1.80	0.00	0.00
		2.50	1.95	0.00	0.00
		3.00	2.00	0.00	0.00
	R	3.50	1.90	0.00	0.00
		4.00	2.45	0.00	0.00
		4.00	2.45	0.00	0.00
	W	5.00	2.60	0.00	0.00
		5.70	3.00	0.40	0.80
		6.00	3.10	0.45	0.45
		6.30	3.00	0.40	1.10
		6.60	3.00	0.40	0.95
		6.90	2.95	0.35	0.95
		7.20	2.85	0.25	0.70
		7.50	3.10	0.50	0.75
		7.80	3.10	0.50	0.65
		8.10	3.10	0.50	0.85
		8.40	3.20	0.60	0.95
		8.70	3.20	0.60	1.10
		9.00	3.20	0.60	1.35
		9.30	3.15	0.55	1.40
		9.60	3.25	0.65	1.50
		9.90	3.30	0.70	1.55
		10.20	3.30	0.70	1.60
		10.50	3.30	0.70	1.25

Figure O. Iron Creek Data Entry and Proofing Screen

When you are satisfied that all field data has been entered properly, press the "Print Proof Sheet" button. Pressing this button recalculates all computations in the spreadsheet and cycles to the Print

Proof Sheet option Use the standard Microsoft Windows options to Setup and Print Proof Sheet or Close" the print preview window. R2CROSS returns to the opening screen.

The "Home" button can also be used at anytime to return to the R2CROSS opening screen. However, the user should be aware that any changes made to the data entry form will only be revised in the calculations after pressing the "Print Proof Sheet" button.

Constant Manning's n Staging Table

Press the "Constant Manning's n Staging Table" button to preview the R2CROSS staging table. Press the "Home" key to return to the R2CROSS opening screen.

If the staging table appears to be correct, press the "Print Results" button to the left of the "Constant Manning's n Staging Table" button to print all 5 pages of R2CROSS output. You will be provided with an opportunity to preview the output pages if the "Print Preview For All Print Requests" box is checked. If it is not checked, the print request will go directly to the printer.

If the staging table does not appear to be correct, press the "Home" button and then the "Data Input" button to return to data entry/edit mode. Revise the cross section data as necessary and press the "Print Proof Sheet" button to recalculate the worksheet and inspect the proof sheet. Print the proof sheet if necessary.

The R2CROSS output from the Iron Creek example was presented previously in Figures F through J.

Cross Section and Wetted Perimeter/Q Plots

From the R2CROSS opening screen, press the "Cross Section" or "Wetted Perimeter/Q" buttons to preview these plots. Press "Home" to return to the opening screen or "Print" to send the plots to the printer.

Alternatively, press the "Print" button to the left of the "Cross Section" or "Wetted Perimeter/Q" buttons on the R2CROSS opening screen to send these plots to the printer. As with all print requests, you will have an opportunity to preview the plots if the "Print Preview For All Print Requests" is checked.

Cross Section and Wetted Perimeter plots from the Iron Creek example were presented previously in Figures K and L; respectively.

Starting a new R2CROSS analysis and exiting when finished

There are several ways to start a new R2CROSS analysis. One way is to open the R2CROSS.xls spreadsheet as described earlier and using the Excel "File" and "Save As" commands to rename the file and specify the folder location. Another way would be to press the "Data Input" button and then "Clear All Data" button.

Prior to exiting an R2CROSS analysis, use the Excel "File" and "Save As" commands to rename the file and specify a folder location. Data from an existing file can be retrieved by double clicking the saved “.xls” file name or by using the Excel “File” and “Open” menu choices to navigate to the location of the a previously-saved R2CROSS data file.

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Appendix A - Program Calculations

Some R2CROSS users may be interested in the calculations performed by the Microsoft Excel for Windows macro. The four major computations performed within the R2CROSS macro are sag-tape corrections, estimation of Manning's "n", calculation of a water line comparison table, and calculation of a staging table.

Sag-Tape Calculations.

Channel geometry measurements that are taken using the sag-tape methodology must be corrected to a level reference. R2CROSS uses catenary curve formulas to compute these corrections from a sagging tape that has been leveled at each end. The use of the catenary curve solution is based on the assumption that the suspended steel tape is analogous to a suspended cable placed under a unidirectionally distributed load (Laursen 1978).

The derivation of the catenary curve solution is beyond the scope of this manuscript. Basically, R2CROSS uses the length of tape in suspension, the tension applied to the tape, and the standard weight of one foot of tape to apply the necessary vertical distance corrections to each cell vertical within the cross section.

When using a level and stadia rod to survey channel geometry, the tape weight and tension defaults, supplied in the original R2CROSS.WK4 worksheet, will simulate an extremely light tape stretched at very high tension. This results in a sag correction of approximately zero at each cell vertical.

Use of Manning's Equation.

Manning's equation is defined as:

$$Q = \frac{1.486*A*R^{2/3}*S^{1/2}}{n}$$

where;

Q = discharge (cfs);

A = cross-sectional area (ft^2);

R = hydraulic radius (ft);

S = slope (ft/ft); and

n = Manning's "n", a dimensionless coefficient of roughness.

Manning's equation is used in two separate R2CROSS calculations. It is first used to provide an initial estimate of Manning's "n" using the rearranged equation:

$$n = \frac{1.486*A*R^{2/3}*S^{1/2}}{Q}$$

The parameters Q, A, R, and S are calculated from the raw field data and used to solve directly for "n”. Once estimated, Manning's "n" remains constant throughout the remainder of the stream flow modeling.

The empirically-derived estimate of Manning’s n and estimates of A, R, and S, are then used repeatedly in Manning's equation to solve for Q at each simulated water surface elevation within the staging table (Table 3).

Calculation of the Water Line Comparison Table.

R2CROSS uses two techniques for estimating cross-sectional area. One estimate is obtained by summing the product of "measured" water depth and cell width for all cells in the cross section (A_m). This technique allows independent water surface elevations within each cell and provides the most accurate estimate of cross-sectional area at the time the field measurement was made. However, this technique cannot be used to simulate a single, flat water surface elevation at computer-modeled stream discharges.

The second technique used to estimate cross-sectional area involves projecting a single water surface elevation across the stream channel. Channel bottom elevations are subtracted from this projected water surface elevation to obtain a "computed" water depth at each cell vertical. Cross-sectional area is obtained by summing the product of the "computed" water depth and cell width at each cell vertical (A_c). This technique constrains the water surface to a flat plane and is useful for simulating discharges above and below the field-measured discharge.

The water line comparison table (Figure H) iteratively calculates 31 separate estimates of A_c, using projected waterlines ranging from 0.25 feet above to 0.25 feet below the mean waterline measured in the field. The single water surface elevation that results in A_c equal to A_m is interpolated from the water line comparison table and is used in the staging table as the best estimate of the waterline at the field-measured discharge.

Calculation of the Staging Table.

The final product of the R2CROSS macro is the staging table (Figure I). In addition to the three critical biologic criteria ($\bar{x}_d$, $\%WP$, and $\bar{x}_v$), R2CROSS also calculates incremental estimates of top width (TW), maximum depth (D_{max}), cross-sectional area (A), wetted perimeter (WP), hydraulic radius (R), and flow (Q) at a number of waterline elevations. The upper limit of the model occurs at bankfull discharge which is defined as the lower of the two grassline elevations measured in the field. The lower limit is either 1.75 feet below the waterline calculated in the waterline comparison table or stage of zero flow (the lowest field-measured channel profile), whichever is higher in elevation. The formulae for each of the parameters estimated in the staging table are summarized in Table 3.

Table 3. Hydraulic Formulae used in R2CROSS Staging Table

Parameter	Formula
Top Width (TW)	$\sum_{i=1}^{n} TW_i$
Average Depth ($\bar{x}_d$)	$\frac{A}{TW}$
Maximum Depth (D_{max})	$\overset{n}{\underset{i=1}{MAX}}(D_i)$
Area (A)	$\sum_{i=1}^{n} A_i$
Wetted Perimeter (WP)	$\sum_{i=1}^{n} WP_i$
Percent Wetted Perimeter (%WP)	$\frac{WP}{Bankfull\ WP} * 100$
Hydraulic Radius (R)	$\frac{A}{WP}$
Flow (Q)	$\frac{1.486 * A * R^{\frac{2}{3}} * S^{\frac{1}{2}}}{n}$
Average Velocity ($\bar{x}_v$)	$\frac{Q}{A}$