COLORADO WATER CONSERVATION BOARD

WATER SUPPLY RESERVE ACCOUNT APPLICATION FORM

Upper Colorado River Irrigation and Restoration Assessment Phase 1.

Name of Water Activity/Project

Irrigators of Lands in the Vicinity of Kremmling (ILVK): Burchez & Sons, LLC; Raymond & Carol Petersen, Charles Eugene Petersen Trust, & Penny Lynn Petersen Trust; Shepardsbend Colorado, LLC; Martha Shepard Revocable Trust; Riverside Ranch Company, LLLP; McElroy Ranch, LLC

Name of Applicant

Colorado River Basin Roundtable

Amount from Statewide Account:

Amount from Basin Account(s): $50,000

Total WSRA Funds Requested: $50,000

Approving Basin Roundtable(s)
(If multiple basins specify amounts in parentheses.)

Application Content

Required Exhibits

A. Statement of Work, Budget, and Schedule
B. Project Map
C. As Needed (i.e. letters of support, photos, maps, etc.)

Appendices – Reference Material

1. Program Information
2. Insurance Requirements
3. WSRA Standard Contract Information (Required for Projects Over $100,000)
4. W-9 Form (Required for All Projects Prior to Contracting)

Instructions

To receive funding from the Water Supply Reserve Account (WSRA), a proposed water activity must be approved by the local Basin Roundtable **AND** the Colorado Water Conservation Board (CWCB). The process for Basin Roundtable consideration and approval is outlined in materials in Appendix 1.

Once approved by the local Basin Roundtable, the applicant should submit this application **with a detailed statement of work including budget and schedule as Exhibit A** to CWCB staff by the application deadline.

WSRA applications are due with the roundtable letter of support 60 calendar days prior to the bi-monthly Board meeting at which it will be considered. Board meetings are held in January, March, May, July, September, and November. Meeting details, including scheduled dates, agendas, etc. are posted on the CWCB website at: http://cwcb.state.co.us Applications to the WSRA Basin Account are considered at every board meeting, while applications to the WSRA Statewide Account are only considered at the March and September board meetings.

When completing this application, the applicant should refer to the WSRA Criteria and Guidelines available at: http://cwcb.state.co.us/LoansGrants/water-supply-reserve-account-grants/Documents/WSRACriteriaGuidelines.pdf

The application, statement of work, budget, and schedule **must be submitted in electronic format** (Microsoft Word or text-enabled PDF are preferred) and can be emailed or mailed on a disk to:

Greg Johnson – WSRA Application
Colorado Water Conservation Board
1580 Logan Street, Suite 200
Denver, CO 80203
gregory.johnson@state.co.us

If you have questions or need additional assistance, please contact Greg Johnson at: 303-866-3441 x3249 or gregory.johnson@state.co.us.

Water Supply Reserve Account – Application Form
Revised December 2011

Part I. - Description of the Applicant (Project Sponsor or Owner);

1. Applicant Name(s): Irrigators of Lands in the Vicinity of Kremmling (ILVK): Grand Colorado Ranch, LLC; Raymond & Carol Petersen, Charles Eugene Petersen Trust, & Penny Lynn Petersen Trust; Shepardsbend Colorado, LLC; Martha Shepard Revocable Trust; Riverside Ranch Company, LLLP; McElroy Ranch, LLC

Mailing address: C/O
Reeder Creek Ranch
PO Box 1359, 137 County Road 39
Kremmling, CO 81601

Taxpayer ID#:

Primary Contact: Paul Bruchez Position/Title: Ranch Owner: Grand Colorado Ranch, LLC

Email: reedercreekranch@gmail.com

Phone Numbers: Cell: 970-531-2008 Office: 970-725-3568

Alternate Contact: Bill Thompson Position/Title: Ranch Owner: Riverside Ranch Company, LLLP

Email: wendy.thmpsn@gmail.com

Phone Numbers: Cell: 970-485-0479 Office: 970-724-3853

2. Eligible entities for WSRA funds include the following. What type of entity is the Applicant?

[ ] Public (Government) – municipalities, enterprises, counties, and State of Colorado agencies. Federal agencies are encouraged to work with local entities and the local entity should be the grant recipient. Federal agencies are eligible, but only if they can make a compelling case for why a local partner cannot be the grant recipient.

[ ] Public (Districts) – authorities, Title 32/special districts, (conservancy, conservation, and irrigation districts), and water activity enterprises.

[ ] Private Incorporated – mutual ditch companies, homeowners associations, corporations.

[X] Private individuals, partnerships, and sole proprietors are eligible for funding from the Basin Accounts but not for funding from the Statewide Account.

[ ] Non-governmental organizations – broadly defined as any organization that is not part of the government.

3. Provide a brief description of your organization

Response: The ILVK Organization consists of a group of individual ranch owners all of whom are Senate Document 80 and Meadows Act recipients as a result of the construction of the Windy Gap and Moffat Tunnel Firming.

4. If the Contracting Entity is different then the Applicant (Project Sponsor or Owner) please describe the Contracting Entity here.

Response: The contracting entity is Bruchez & Sons LLC. This is the owner of Grand Colorado Ranch, LLC and will serve as the contracting entity for the ILVK Group.

5. Successful applicants will have to execute a contract with the CWCB prior to beginning work on the portion of the project funded by the WSRA grant. In order to expedite the contracting process the CWCB has established a standard contract with provisions the applicant must adhere to. A link to this standard contract is included in Appendix 3. Please review this contract and check the appropriate box.

[X] The Applicant will be able to contract with the CWCB using the Standard Contract

[ ] The Applicant has reviewed the standard contract and has some questions/issues/concerns. Please be aware that any deviation from the standard contract could result in a significant delay between grant approval and the funds being available.

6. The Tax Payer Bill of Rights (TABOR) may limit the amount of grant money an entity can receive. Please describe any relevant TABOR issues that may affect the applicant.

The Applicant is not subject to TABOR limitations.

Part II. - Description of the Water Activity/Project

1. What is the primary purpose of this grant application? (Please check only one)

	Nonconsumptive (Environmental or Recreational)
X	Agricultural
	Municipal/Industrial
	Needs Assessment
	Education
	Other Explain:

2. If you feel this project addresses multiple purposes please explain.

The ranchers have been experiencing issues with the elevation of the intakes and pump operations. Throughout this reach of the Colorado River there is evidence of channel headcutting, bank erosion, and channel aggradation. Historically this reach of river has experienced significant hydromodifications in the way of trans-basin diversions, in-channel and off-channel dams, channelization, and the loss of riparian vegetation. The issues with the elevations of the pump intakes are directly related to the historic hydromodification of the Colorado River and its associated geomorphic response. The solution(s) to the irrigation problems need(s) to work within the overall river system to be sustainable, cost effective and reduce long-term operations and maintainance. A systems-based approach to resolving the irrigation issues will directly impact other functions of the river such as flood conveyance, riparian and aquatic habitat, and sediment transport. The goal of this project is to identify location specific and reach wide projects that solve the irrigation diversion issues and improve multiple river functions including aquatic habitat and river recreation. In summary:

- This project addresses the future water supply for existing, senior irrigation water rights. This project will have multiple benefits to multiple stakeholders: wildlife, fisheries, and non-point source pollution.
- This project will result in construction projects that will resolve issues with the irrigation systems so that the water rights can meet existing and future irrigation water needs.
- The reduction of non-point source sediment pollution from Bank Erosion will improve water quality.
- This project is actively seeking the participation of all potential stake holders so that we may expand the study area. In particular the ILVK is in active discussions with Grand County. This application is for Phase 1 of the project. If Grand County, or other entities, becomes a participant for a larger study area that portion of the project would be called Phase 2.
- The recommendations from this project will directly impact water based recreation opportunities not only by improving fisheries habitat, but also by identifying recreation specific improvements.
- The recommended projects will include projects specifically intended to improve in-stream and riparian habitat.
- This project helps to maintain commercial, irrigated agriculture.
- Hunting and fishing account for over $112,046,700 in direct economic impact on Headwaters Counties (Eagle, Grand, Gunnison, Pitkin, Routt and Summit; Source: Water and Its Relationship to the

Economies of the Headwaters Counties, NWCCGF, 2011). The recommendations from this project will have a direct positive impact on aquatic and riparian habitat which will improve fishing and hunting throughout this reach. This will have a positive impact on the local hunting and fishing industries.

3. Is this project primarily a study or implementation of a water activity/project? (Please check only one)

X	Study		Implementation

4. To catalog measurable results achieved with WSRA funds can you provide any of the following numbers?

	New Storage Created (acre-feet)
	New Annual Water Supplies Developed, Consumptive or Nonconsumptive (acre-feet)
	Existing Storage Preserved or Enhanced (acre-feet)
52,000	***Potential*** Length of Stream Restored or Protected (linear feet)
	Length of Pipe/Canal Built or Improved (linear feet)
	Efficiency Savings (acre-feet/year OR dollars/year – **circle one**)
	Area of Restored or Preserved Habitat (acres)
12	Other -- Explain: Improve diversion operations for 12 water rights owned by applicants which are diverted at 14. Potentially improve diversion operations for two additional water rights not owned by applicants. The total flow rate of these water rights is ~ 160.68 cfs.

4. To help us map WSRA projects please include a map (Exhibit B) and provide the general coordinates below:

Latitude: 40° 2'55.19"N Longitude: 106°19'40.30"W

5. Please provide an overview/summary of the proposed water activity (no more than one page). Include a description of the overall water activity and specifically what the WSRA funding will be used for. A full **Statement of Work** with a detailed budget and schedule is required as **Exhibit A** of this application.

Transbasin diversions have impacted this reach of the Colorado River for over 100 years. Senate Document 80, which authorized the Colorado-Big Thompson project in 1937, included a requirement that an "adequate system as determined by the Secretary of the Interior * * * shall be provided for the irrigation of the lands in the vicinity of Kremmling, now irrigated by either natural or artificial means, and the installation made therefor shall be a part of this project. The rights to the use of water for the irrigation of these lands shall be considered to have a date of priority earlier than that of the rights to the use of water to be diverted through the works of this project to the Eastern Slope." This was in response to concerns voiced by Grand County irrigators that low water flows, which are caused by trans-mountain water diversions, create a lack of positive pressure in ditch heads and natural flood irrigation making the irrigation systems harder and more labor intensive. Senate Document 80 resulted in the installation of a number of irrigation pumps. Over the decades these pumps have become crucial to the success of ranching along this reach of the Colorado River despite continued operational issues. After years of negotiation with Northern Colorado Water Conservancy District, the Ranchers have reached a settlement regarding the continued operation and maintenance of the Senate Document 80 irrigation pumps in which the Ranchers have agreed to own and maintain the pumps. The Settlement will partially fund the river improvements necessary to improve irrigation efficiency.

In the spring of 2013 URS conducted a site visit to evaluate performance issues related to the operation of these diversions. During that site visit it was apparent that there were other issues impacting irrigation operations besides reduced flows: excessive erosion at some locations and sedimentation at others were clearly impacting irrigation diversions. In 2004 Northern installed four boulder drop structures in an attempt to improve performance of the diversions. While these structures have increased the water surface elevation they were constructed improperly and have exacerbated bank erosion both up and downstream.

A preliminary geomorphic assessment of the Colorado River was performed in an effort to better characterize the river mechanics issues and potential driving forces behind the river changes impacting irrigation operations. This assessment identified a number of potential causes for the ongoing instabilities. We propose this current scope of work to prove or disprove the theories identified in the preliminary geomorphic assessment report. Alluvial rivers are dynamic systems that have many interdependent functions (e.g. flood conveyance, sediment transport, aquatic habitat, etc.). A thorough understanding of these complex dynamics, and their response to historic and future perturbations, is necessary to develop a successful river stabilization/restoration plan. Alluvial river systems are extremely complex and the immediate causes of instabilities may not be readily apparent. Rivers are dynamic systems that are capable of major adjustments in response to disturbances, both natural and manmade, and trying to impose an engineered solution onto a river system without fully understanding the geomorphology can result in accelerated instabilities such as the drop structure built by Northern in 2004.

Once these cause/affect relationships are understood sustainable solutions will be developed that not only improve the operation of the irrigation diversions but also improve the overall function of the river. The final product of this effort will be a Reach Master Plan report and associated GIS database that may include: Background/History; Geomorphic Description of sub-reaches; Hydraulic and Sediment Transport Modeling Results; Identified areas of instability; Potential flow modification recommendations; Biological/habitat considerations; and Recommend Land Use Practices (e.g. grazing exclusion). The report will present specific prioritized projects and provide preliminary conceptual cost estimates for engineering and construction.

Part III. – Threshold and Evaluation Criteria

1. Describe how the water activity meets these **Threshold Criteria.** (Detailed in Part 3 of the Water Supply Reserve Account Criteria and Guidelines.)

   a) The water activity is consistent with Section 37-75-102 Colorado Revised Statutes.[1]

   Response: The proposed water activity is an analysis of structural, nonstructural, consumptive, and nonconsumptive water needs, projects, or activities. The water activity does not involve any changes to adjudicated water rights. This project does not restrict the ability of any water rights holder to use or dispose of said water rights in any manner permitted under Colorado Law. This water activity will not diminish, impair, or cause injury to any property or contractual right created by intergovernmental agreements, contracts, stipulations among parties to water cases, terms and conditions in water decrees, or any other similar document related to the allocation or use of water. This water activity will improve the ability for 12 senior water rights to be diverted for beneficial use. Without this project there is a risk that that the irrigators will not be able to divert these water rights, negatively impacting ranching operations and potentially leading the way for the abandonment of these water rights.

   b) The water activity underwent an evaluation and approval process and was approved by the Basin Roundtable (BRT) and the application includes a description of the results of the BRTs evaluation and approval of the activity. At a minimum, the description must include the level of agreement reached by the roundtable, including any minority opinion(s) if there was not general agreement for the activity. The description must also include reasons why general agreement was not reached (if it was not), including who opposed the activity and why they opposed it. Note- If this information is included in the letter from the roundtable chair simply reference that letter.

Roundtable letters of support need to be referenced here and attached.

[1] 37-75-102. Water rights - protections. (1) It is the policy of the General Assembly that the current system of allocating water within Colorado shall not be superseded, abrogated, or otherwise impaired by this article. Nothing in this article shall be interpreted to repeal or in any manner amend the existing water rights adjudication system. The General Assembly affirms the state constitution's recognition of water rights as a private usufructuary property right, and this article is not intended to restrict the ability of the holder of a water right to use or to dispose of that water right in any manner permitted under Colorado law. (2) The General Assembly affirms the protections for contractual and property rights recognized by the contract and takings protections under the state constitution and related statutes. This article shall not be implemented in any way that would diminish, impair, or cause injury to any property or contractual right created by intergovernmental agreements, contracts, stipulations among parties to water cases, terms and conditions in water decrees, or any other similar document related to the allocation or use of water. This article shall not be construed to supersede, abrogate, or cause injury to vested water rights or decreed conditional water rights. The General Assembly affirms that this article does not impair, limit, or otherwise affect the rights of persons or entities to enter into agreements, contracts, or memoranda of understanding with other persons or entities relating to the appropriation, movement, or use of water under other provisions of law.

c) The water activity meets the provisions of Section 37-75-104(2), Colorado Revised Statutes.[2] The Basin Roundtable Chairs shall include in their approval letters for particular WSRA grant applications a description of how the water activity will assist in meeting the water supply needs identified in the basin roundtable's consumptive and/or non-consumptive needs assessments.

Applicant Response: The water activity meets the provisions of Section 37-75-104(2). This project will make recommendations for resolving the irrigation operational issues. Specifically, the recommendations resulting from this project will help ensure that future agricultural water needs within this reach will be met. This project specifically addresses the impacts of transbasin firming projects. Additionally, the recommendations resulting from this project will consider environmental and recreational non-consumptive needs. The Colorado Basin SWSI Identified this reach as having fishing and aesthetic resource values at risk. Additionally, the Grand County Stream Management Plan specifically recommended additional research to address the grade control structures within this reach.

d) Matching Requirement: For requests from the **Statewide Fund**, the applicants is required to demonstrate a **20 percent** (or greater) match of the request from the Statewide Account. Statewide requests must also include a minimum match of **5 percent** of the total grant amount from Basin Funds. Sources of matching funds include but are not limited to Basin Funds, in-kind services, funding from other sources, and/or direct cash match. Past expenditures directly related to the project may be considered as matching funds if the expenditures occurred within 9 months of the date the application was submitted to the CWCB. Please describe the source(s) of matching funds. (NOTE: These matching funds should also be reflected in your Detailed Budget in **Exhibit A** of this application)

Response: The applicants will fund $54,000, or 52% of the total project cost of $104,000. This will be in the form of a direct cash match.

[2] 37-75-104 (2)(c). Using data and information from the Statewide Water Supply Initiative and other appropriate sources and in cooperation with the on-going Statewide Water Supply Initiative, develop a basin-wide consumptive and nonconsumptive water supply needs assessment, conduct an analysis of available unappropriated waters within the basin, and propose projects or methods, both structural and nonstructural, for meeting those needs and utilizing those unappropriated waters where appropriate. Basin Roundtables shall actively seek the input and advice of affected local governments, water providers, and other interested stakeholders and persons in establishing its needs assessment, and shall propose projects or methods for meeting those needs. Recommendations from this assessment shall be forwarded to the Interbasin Compact Committee and other basin roundtables for analysis and consideration after the General Assembly has approved the Interbasin Compact Charter.

2. For Applications that include a request for funds from the **Statewide Account**, describe how the water activity/project meets all applicable **Evaluation Criteria.** (Detailed in Part 3 of the Water Supply Reserve Account Criteria and Guidelines and repeated below.) Projects will be assessed on how well they meet the Evaluation Criteria. **Please attach additional pages as necessary.**

Evaluation Criteria – the following criteria will be utilized to further evaluate the merits of the water activity proposed for funding from the Statewide Account. In evaluation of proposed water activities, preference will be given to projects that meet one or more criteria from each of the three "tiers" or categories. Each "tier" is grouped in level of importance. For instance, projects that meet Tier 1 criteria will outweigh projects that only meet Tier 3 criteria. WSRA grant requests for projects that may qualify for loans through the CWCB loan program will receive preference in the Statewide Evaluation Criteria if the grant request is part of a CWCB loan/WSRA grant package. For these CWCB loan/WSRA grant packages, the applicant must have a CWCB loan/WSRA grant ratio of 1:1 or higher. Preference will be given to those with a higher loan/grant ratio.

Tier 1: Promoting Collaboration/Cooperation and Meeting Water Management Goals and Identified Water Needs

a. The water activity addresses multiple needs or issues, including consumptive and/or non-consumptive needs, or the needs and issues of multiple interests or multiple basins. This can be demonstrated by obtaining letters of support from other basin roundtables (in addition to an approval letter from the sponsoring basin). ***See Exhibit E for letter of recomendation***
b. The number and types of entities represented in the application and the degree to which the activity will promote cooperation and collaboration among traditional consumptive water interests and/or non-consumptive interests, and if applicable, the degree to which the water activity is effective in addressing intrabasin or interbasin needs or issues.
c. The water activity helps implement projects and processes identified as helping meet Colorado's future water needs, and/or addresses the gap areas between available water supply and future need as identified in SWSI or a roundtable's basin-wide water needs assessment.

Tier 2: Facilitating Water Activity Implementation

d. Funding from this Account will reduce the uncertainty that the water activity will be implemented. For this criterion the applicant should discuss how receiving funding from the Account will make a significant difference in the implementation of the water activity (i.e., how will receiving funding enable the water activity to move forward or the inability obtaining funding elsewhere).
e. The amount of matching funds provided by the applicant via direct contributions, demonstrable in-kind contributions, and/or other sources demonstrates a significant & appropriate commitment to the project.

Tier 3: The Water Activity Addresses Other Issues of Statewide Value and Maximizes Benefits

f. The water activity helps sustain agriculture & open space, or meets environmental or recreational needs.
g. The water activity assists in the administration of compact-entitled waters or addresses problems related to compact entitled waters and compact compliance and the degree to which the activity promotes maximum utilization of state waters.
h. The water activity assists in the recovery of threatened and endangered wildlife species or Colorado State species of concern.
i. The water activity provides a high level of benefit to Colorado in relationship to the amount of funds requested.
j. The water activity is complimentary to or assists in the implementation of other CWCB programs.

Continued: Explanation of how the water activity/project meets all applicable **Evaluation Criteria**.
Please attach additional pages as necessary.

Part IV. – Required Supporting Material

1. **Water Rights, Availability, and Sustainability** – This information is needed to assess the viability of the water project or activity. Please provide a description of the water supply source to be utilized, or the water body to be affected by, the water activity. This should include a description of applicable water rights, and water rights issues, and the name/location of water bodies affected by the water activity.

Response: This project directly addresses the impacts Trans-basin diversions have had on the Colorado River water rights through this reach. The water rights along this reach of the river have a complex history, with many transfers and alternate points of diversion therefore it is difficult to precisely quantify the diversion rates without detailed analysis. The following table presents the water rights owned (or partially owned) by the applicants. A preliminary review of the CDSS database indicates that the total diversion rate for these water rights is approximately **140.84 cfs**.

Water Rights Owned by Applicants

Water Right Name	*DIV*	*WD*	*ID*	*Admin No*	*Priority*
McElroy No 1 Ditch	5	50	612	32335.11971	167
Mcelroy No 2 Ditch	5	50	613	32335.11677	165
					166
TA Engle Ditch No 1	5	51	925	34241.18263	449A
TA Engle Ditch No 2	5	51	926	34241.18263	449B
TA Engle Ditch No 3	5	51	927	34241.18263	449C
Thompson Pump No 1	5	51	1148	34241.18263	449D
McElroy State Pump No. 1	5	50	755	39095.18414	
Ennis Pump Ditch System	5	50	566	34762.18414	
Holdcroft Pump No. 1 (A.K.A. Orr No. 1)	5	51	1274	33063.12023	430
	5	51	1274	34241.18263	449E
	5	51	1274	46020.40907	
Holdcroft Pump No. 2 (A.K.A. Orr No. 2)	5	51	1275	33063.12023	430
	5	51	1275	34241.18263	449E
	5	51	1275	46020.40907	
Kinney Barriger Ditch (Partially owned by applicants)	5	51	763	20676.13818	171
	5	51	763	33063.12023	430
	5	51	763	33433.33151	438
	5	51	763	34241.18263	449D
	5	51	763	34241.18263	449E

The following table lists the water rights in the reach that are not owned by the applicants but may benefit from this

project. The total flow rate of these water rights is approximately **19.84 cfs**.

Other Water Rights potentially benefiting from Project					
Water Right Name	***DIV***	***WD***	***ID***	***Admin No***	***Priority***
Thompson Pump No 2	5	51	1149	34241.18263	449D
River Ranch Village PMP1	5	53	1112	38753.17319	409
TA Engle Ditch	5	50	651	34762.18414	

This project has the potential to improve irrigation operations for a total of approximately **160.68 cfs**.

Please provide a brief narrative of any related studies or permitting issues.

Response:

- URS completed a preliminary geomorphology assessment for this reach of the Colorado River. This report identifies potential cause of the instabilities. A copy of the preliminary geomorphic assessment is attached in Exhibit D in support of the scope of work. The IVLK Ranchers paid approximately $6,000 for this report.
- Colorado River Aquatic Resources Investigations Federal Aid Project F-237R-18, Nehring, R. Berry, Heinold, B., and Pomeranz, J., Colorado Division of Wildlife, Aquatic Wildlife Research Section, June 2011. This detailed report presents the results of an investigation into the relative abundance and distribution of aquatic invertebrate fauna, and the mottled sculpin of the upper Colorado River between the confluence with the Blue River and Windy Gap Dam west of Granby, Colorado. The study shows that the health of the river has been severely degraded. The study identified six critical issues that need to be address to reverse the trend of degradation: 1) restoration of channel connectivity, 2) channel reconfiguration, stream power and flushing flows, 3) sediment deposition and transport, 4) water temperature, 5) encroachment of rooted aquatic vegetation, and 6) whirling disease. The six issues are listed in order of descending priority (from highest to lowest). The problems of channel armoring and chronic sedimentation and clogging of the interstitial spaces in the cobble-rubble dominated riffles areas has been ongoing in the upper Colorado River basin for more than half a century. The proposed firming projects at Windy Gap and the Moffat Tunnel will exacerbate the situation. The report identifies two things must be done if there is to truly be any hope of enhancement of aquatic ecosystem in the upper Colorado River in the future: A bypass channel around Windy Gap Dam and a major investment in stream channel reconfiguration for the Colorado River below WGD are both equally important and the only way true enhancement has any possibility of success. Either one without the other will have virtually no chance of succeeding. The report's specific recommendations include restoration of channel connectivity, channel reconfiguration downstream of WGR to increase stream power in the face of continued Transbasin diversions, and increased flushing flows to mobilize accumulated fine sediment.
- Grand County Stream Management Plan: http://co.grand.co.us/WRM/Draft_Report/Executive%20Summary/Executive_Summary_August_2010.pdf
- COLORADO'S SECTION 303(D) LIST OF IMPAIRED WATERS AND MONITORING AND EVALUATION LIST: This section of the Colorado River (COUCUC03, from 578 Bridge to just above the confluence with the Blue River) has been identified as being impaired due to high temperatures and high manganese levels (water supply issue).

2. Statement of Work, Detailed Budget, and Project Schedule

The statement of work will form the basis for the contract between the Applicant and the State of Colorado. In short, the Applicant is agreeing to undertake the work for the compensation outlined in the statement of work and budget, and in return, the State of Colorado is receiving the deliverables/products specified. **Please note that costs incurred prior to execution of a contract or purchase order are not subject to reimbursement**. All WSRA funds are disbursed on a reimbursement basis after review invoices and appropriate backup material.

Please provide a detailed statement of work using the template in Exhibit A. Additional sections or modifications may be included as necessary. Please define all acronyms and include page numbers.

The Statement of Work, Detailed Budget, and Project Schedule are included in Exhibit A. A Map is included in Exhibit B. Exhibit C presents responses to the specific questions outline in the Colorado Basin Roundtable Grant Evaluation and Prioritization Supplement. Exhibit D presents the preliminary

geomorphology report. Exhibit F presents resumes for the main team members.

REPORTING AND FINAL DELIVERABLE

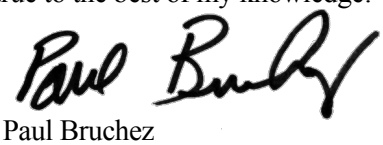
Reporting: The applicant shall provide the CWCB a progress report every 6 months, beginning from the date of the executed contract. The progress report shall describe the completion or partial completion of the tasks identified in the statement of work including a description of any major issues that have occurred and any corrective action taken to address these issues.

Final Deliverable: At completion of the project, the applicant shall provide the CWCB a final report that summarizes the project and documents how the project was completed. This report may contain photographs, summaries of meetings and engineering reports/designs.

PAYMENT

Payment will be made based on actual expenditures and invoicing by the applicant. Invoices from any other entity (i.e. subcontractors) cannot be processed by the State. The request for payment must include a description of the work accomplished by major task, and estimate of the percent completion for individual tasks and the entire water activity in relation to the percentage of budget spent, identification of any major issues and proposed or implemented corrective actions. The last 5 percent of the entire water activity budget will be withheld until final project/water activity documentation is completed. All products, data and information developed as a result of this grant must be provided to the CWCB in hard copy and electronic format as part of the project documentation. This information will in turn be made widely available to Basin Roundtables and the general public and help promote the development of a common technical platform.

The above statements are true to the best of my knowledge:

Signature of Applicant: 

Print Applicant's Name: Paul Bruchez

Project Title: Upper Colorado River Irrigation and Restoration Assessment

Return an electronic version (hardcopy may also be submitted) of this application to:

Greg Johnson – WSRA Application
Colorado Water Conservation Board
1580 Logan Street, Suite 200
Denver, CO 80203
gregory.johnson@state.co.us

WATER ACTIVITY NAME- Upper Colorado River Irrigation and Restoration Assessment- Phase 1.

GRANT RECIPIENT- Irrigators of Lands in the Vicinity of Kremmling (ILVK): Bruchez & Sons, LLC; Raymond & Carol Petersen, Charles Eugene Petersen Trust, & Penny Lynn Petersen Trust; Shepardsbend Colorado, LLC; Martha Shepard Revocable Trust; Riverside Ranch Company, LLLP; McElroy Ranch, LLC

FUNDING SOURCE- Colorado River Basin Roundtable

INTRODUCTION AND BACKGROUND

Transbasin diversions have impacted this reach of the Colorado River for over 100 years. Senate Document 80, which authorized the Colorado-Big Thompson project in 1937, included a requirement that an "adequate system…shall be provided or the irrigation of lands in the vicinity of Kremmling...and the installation…shall be a part of this project." This was in response to concerns voiced by Grand County irrigators that low water flows, which are caused by trans-mountain water diversions, create a lack of positive pressure in ditch heads and natural flood irrigation making the irrigation systems harder and more labor intensive. Senate Document 80 resulted in the installation of a number of irrigation pumps. Over the decades these pumps have become crucial to the success of ranching along this reach of the Colorado River despite continued operational issues. After years of negotiation with Northern Colorado Water Conservancy District, the Ranchers have reached a settlement regarding the continued operation and maintenance of the Senate Document 80 irrigation pumps in which the Ranchers have agreed to own and maintain the pumps. The Settlement will partially fund the river improvements necessary to improve irrigation efficiency.

In the spring of 2013 URS conducted a site visit to evaluate performance issues related to the operation of these diversions. During that site visit it was apparent that there were other issues impacting irrigation operations besides reduced flows: excessive erosion at some locations and sedimentation at others were clearly impacting irrigation diversions. In 2004 Northern installed four boulder drop structures in an attempt to improve performance of the diversions. While these structures have increased the water surface elevation they were constructed improperly and have exacerbated bank erosion both up and downstream.

A preliminary geomorphic assessment of the Colorado River was performed in an effort to better characterize the river mechanics issues and potential driving forces behind the river changes impacting irrigation operations. This assessment identified a number of potential causes for the ongoing instabilities. We purpose this current scope of work to prove or disprove the theories identified in the preliminary geomorphic assessment report. Alluvial rivers are dynamic systems that have many interdependent functions (e.g. flood conveyance, sediment transport, aquatic habitat, etc.). A thorough understanding of these complex dynamics, and their response to historic and future perturbations, is necessary to develop a successful river stabilization/restoration plan. Alluvial river systems are extremely complex and the immediate causes of instabilities may not be readily apparent. Rivers are dynamic systems that are capable of major adjustments in response to disturbances, both natural and manmade, and trying to impose an engineered solution onto a river system without fully understanding the geomorphology can result in accelerated instabilities such as the drop structure built by Northern in 2004.

Once these cause/effect relationships are understood sustainable solutions will be developed that not only improve the operation of the irrigation diversions but also improve the overall function of the river. The final product of this effort will be a Reach Master Plan report and associated GIS database that may include: Background/History; Geomorphic Description of sub-reaches; Hydraulic and Sediment Transport Modeling Results; Identified areas of instability; Potential flow modification recommendations; Biological/habitat considerations; and Recommend Land Use Practices (e.g. grazing exclusion). The report will present specific prioritized projects and provide preliminary conceptual cost estimates for engineering and construction.

THE PROJECT TEAM

URS has assembled a highly qualified and experienced team to perform this work. A brief description of the senior team members is provided below. A complete list of team members is presented at the end of this section. Resumes are included in Exhibit F.

Project Manager-John Sikora: The project will be led by URS Vice President John Sikora, PE, CFM. Mr. Sikora is the URS Glenwood Springs Office Manager and has more than 25 years of experience in water resources design, water rights, and large civil engineering project management. His water resources engineering experience includes the engineering analysis, justification, design, plans and specifications for water related structures. His water rights experience includes administration of water rights, litigation support for the State Engineer's Office, water rights enforcement, augmentation plan accounting. Mr. Sikora will serve as the Principal-in-Charge and project manager.

Senior Geomorphologist-Edmund D. Andrews, PhD: In order to ensure that the proposed projects are compatible with the altered geomorphology of the Colorado River URS will work closely with Edmund D. Andrews, PhD. Dr. Andrews was with the U.S. Geological Survey from 1975-2009. From 1980 on he was Chief of the River Mechanics Project, National Research Program, USGS Water Resources Division. He conducted research on river mechanics, especially river channel change in response to variations in flow and sediment supply due to climate change, land use, and water resources development. Dr. Andrews is author of numerous peer-reviewed publications including numerous papers on streams and rivers within the Upper Colorado River Basin. Dr. Andrews' vast research and academic background is complemented by practical, project based experience including serving as the principle river restoration designer for the Provo River Restoration Project located between Jordanelle Dam and Deer Creek Reservoir in central Utah. Dr. Andrews will serve as the lead project geomorphologist, helping to refine the detailed scope of the assessment, develop restoration design alternatives and providing technical oversight and quality control.

Senior Hydraulic Engineer-Frank Lan, PhD: Dr. Lan will serve as Senior Hydraulic Engineer. Dr. Lan is a principal water resources engineer with more than 20 years of successful experience in the application of surface water and groundwater hydraulic/hydrologic analysis and modeling to the planning and design in various water resources projects for international and domestic clients. His expertise includes multidimensional surface and groundwater flow and solute transport modeling and analysis, hydrologic modeling/analysis, sediment transport and river engineering, hydraulic structure design, dam break analysis, floodplain delineation, mitigation and management, storm water planning and modeling, urban drainage design, alluvial geomorphology, water management modeling, and statistical analysis. Dr. Lan is best known for his extensive experience in applying numerical models to various water resources applications. He is an expert in applying three-dimensional CFD models to solve hydraulic problems in dams and spillways. Dr. Lan will provide technical support and oversight for all hydrologic, hydraulic and sediment transport modeling.

Project Team:

Principle-In-Charge/Project Manager: John Sikora, PE, CFM (URS)

Senior Geomorphologist: Edmond D. Andrews, PhD (Tenaya Water Resources)

Senior Hydraulic Engineer: Frank Lan, PhD, PE, CFM (URS)

Water Resource/River Engineer: Chris Romeyn, PE, CFM (URS)

Geologist: Chris Rey (URS)

Ecologist: Eric Petterson, MS (URS)

OBJECTIVES

TASKS

Task 1- Project Management

Description of Task

This task includes the work associated with managing the project such as invoicing, accounts receivable, scheduling, etc. This task also includes a project kick off meeting with the Ranchers to identify the schedule for the investigations and project deliverables to make sure we all understand the expectations.

Task 2- Background Research and Data Collection

Description of Task

This task includes the work necessary to obtain and review all pertinent reference information including previous studies and reports (e.g. Grand County Stream Management Plan). Flow data will be obtained from the USGS for the Colorado River and several tributaries. Aerial photography will be obtained to assess planform changes over time. Topographic information will be obtained from the USGS. URS will perform research to identify any additional available topographic information (e.g. LIDAR). USGS Geologic mapping information will be obtained and included in the base mapping. County archives will be searched for any additional photographic information regarding historic conditions throughout the reach.

Method/Procedure

URS will review relevant documents including Historic Aerial Photos, Colorado River Aquatic Resources Investigations Federal Aid Project F-237R-18, Grand County Stream Management Plan, Windy Gap and Moffat Tunnel EIS documentation, USGS gage records, etc.

Deliverable

Information incorporated in subsequent tasks and final report and GIS database.

Task 3- Field Work

Description of Task

This task includes all necessary field work. The project river engineer, geomorphologist, geologist and environmental scientist will float the entire project reach to assess the condition of the river.

to identify the following: All areas of instability (including approximate length, height, etc.); locations for detailed survey work for hydraulic modeling (e.g. grade controls); identify habitat improvement opportunities; local geology of significance; and potential recreational opportunities. A hydrographic survey will be conducted to obtain data for hydraulic modeling. The survey will include critical cross-sections, invert elevations at the intakes, water surface elevations for model calibration and other important features. Bed load sampling will be conducted at a minimum of five locations. Sediment samples will also be collected from point bars, banks, riffles, and pools.

Method/Procedure

URS staff will float river and a mapping grade GPS will be used to record locations of critical items of interest (i.e. cross-section location, area of instability, etc.)

Deliverable

Shapefiles of critical items of interest (i.e. cross-section location, area of instability, etc.) to be incorporated into final report and GIS database.

Task 4- Develop Base Map for Project in ArcView GIS

Description of Task

A Base Map will be developed using ArcView GIS. The ground survey data will be merged with other available topographic data (USGS, LIDAR, etc.) to develop a model of the existing topographic conditions. The map will include important geologic features. Data collected in Task 3 will be included in the map and GIS database.

Method/Procedure

GPS data collected in Task 4 will be incorporated into an ArcView GIS map and associated database. Topographic and geologic mapping information will be incorporated along with other background data such as parcel ownership, water resources features, etc.

Deliverable

PDF of Map document. Raw GIS files including .mdx and .shp files used to develop the mapping.

Task 5- Hydrology and Hydraulic Data Analysis

Description of Task

A hydrologic analysis will be performed to identify historic, current and future hydrology for the project reach. Gage records from representative, unregulated streams in the watershed will also be collected and analyzed to estimate historic flow statistics. Flow duration curves will be developed for past present and future conditions. Modeling of future hydrologic conditions will consider the hydrologic modeling data from the Windy Gap Firming Project EIS.

An existing conditions hydraulic model will be developed using HEC-RAS. This model will be used to develop project solutions. The model will also be used to perform preliminary sediment transport modeling. The sediment transport modeling will be calibrated using collected bed load samples.

A geomorphic assessment of the project reach will be completed. This assessment will identify project sub-reaches, describe existing instabilities and identify key variables driving current river morphology.

Method/Procedure
Standard statistical analysis of hydrologic data. Standard HEC-RAS hydraulic modeling procedures (sub-critical analysis for floodplains and mixed flow analysis for design).

Deliverable
Summary of hydrology will be included in final report. Final HEC-RAS files.

Task 6- Develop Alternatives

Description of Task
This task will identify the restoration methods (e.g. flow alterations, grade control, etc.) to mitigate the erosion and sedimentation issues identified in Task 5. A plan view will be developed to identify location specific projects (e.g. bank stabilization, intake modification, etc.). Alternative methods of restoration will be identified and discussed. Conceptual level plan and profiles will be developed for the alternatives. Comparative cost estimates will be developed for the alternatives.

Method/Procedure
HEC-RAS models developed in Task

Deliverable
Information included in final report. Plan view drawings of alternatives.

Task 7- Report, Map and Conceptual Level Plans

Description of Task
URS will present a summary of the work completed, an overview of the analysis and general project recommendations to the Ranchers. This meeting will provide the Ranchers with an opportunity to provide input into the final work product. URS will incorporate the Rancher input into the final draft of the Reach Master Plan and GIS database.

This task includes the development of a Reach Master Plan report that will include: Background/History; Geomorphic Description of Reaches; Hydraulic and Sediment Transport Modeling Results; Identified areas of instability; Potential flow modification recommendations (within limits of future hydrologic conditions and diversion operations); Biological/habitat considerations; and Recommend Land Use Practices (e.g. grazing exclusion). The report will present specific prioritized projects and provide preliminary conceptual cost estimates for engineering and construction.

A GIS Map and Database will be developed. This will identify the project sub-reaches, specific areas of instability, present prioritized projects, and identify opportunities for additional habitat or recreational enhancements.

Method/Procedure
All information obtained/developed in Tasks 1 through 7 will be summarized and presented in a report. ArcVIEW GIS software will be used to develop a project base map and database.

Deliverable
Final Report, drawings, and electronic copy of GIS database.

Project Cost and Financial Information

We have provided the attached Table 2 demonstrating our level of effort by task to show a breakdown of costs for the project. **URS proposes to perform the above described tasks on a time and materials basis for a fee not to exceed $104,000**.

- In addition to the grant funds being applied for the Applicants will support this project through a direct cash contribution of $54,000.00.
- The Applicants do not have the means to repay a loan. Also, this project will have benefits to many stakeholders in addition to the Applicants and the Applicants should not be required to fund all of this work.
- The Applicants are offering to pay $54,000.00 for this project.
- The Applicants are in discussions with the Grand County Commissioners to have Grand County become a participant in an expanded study that looks at a larger reach of river: From Windy Gap to Gore Canyon. If an agreement with Grand County is reached the expanded work will be called Upper Colorado River Irrigation and Restoration Assessment- Phase 2.
- This project will benefit the Colorado River from the project reach downstream to the State Line. The Applicants are passionate enough about solving the problems with the Colorado River that they are willing to fund $54,000 of the project. They request grant money from the CBRT WSRA to fund the balance to the project that has far reaching benefits to the citizens of Grand County and the State of Colorado in General.
- This project is a study and does not involve the construction of any facilities. If Phase 2 of the project moves forward there will be a second study that will be

combined with the results of this study to provide recommendations for the entire phase 1 and phase 2 reach.

PROJECT SCHEDULE

The proposed project will be completed within 300 days from notice to proceed.

Table 1 Project Schedule

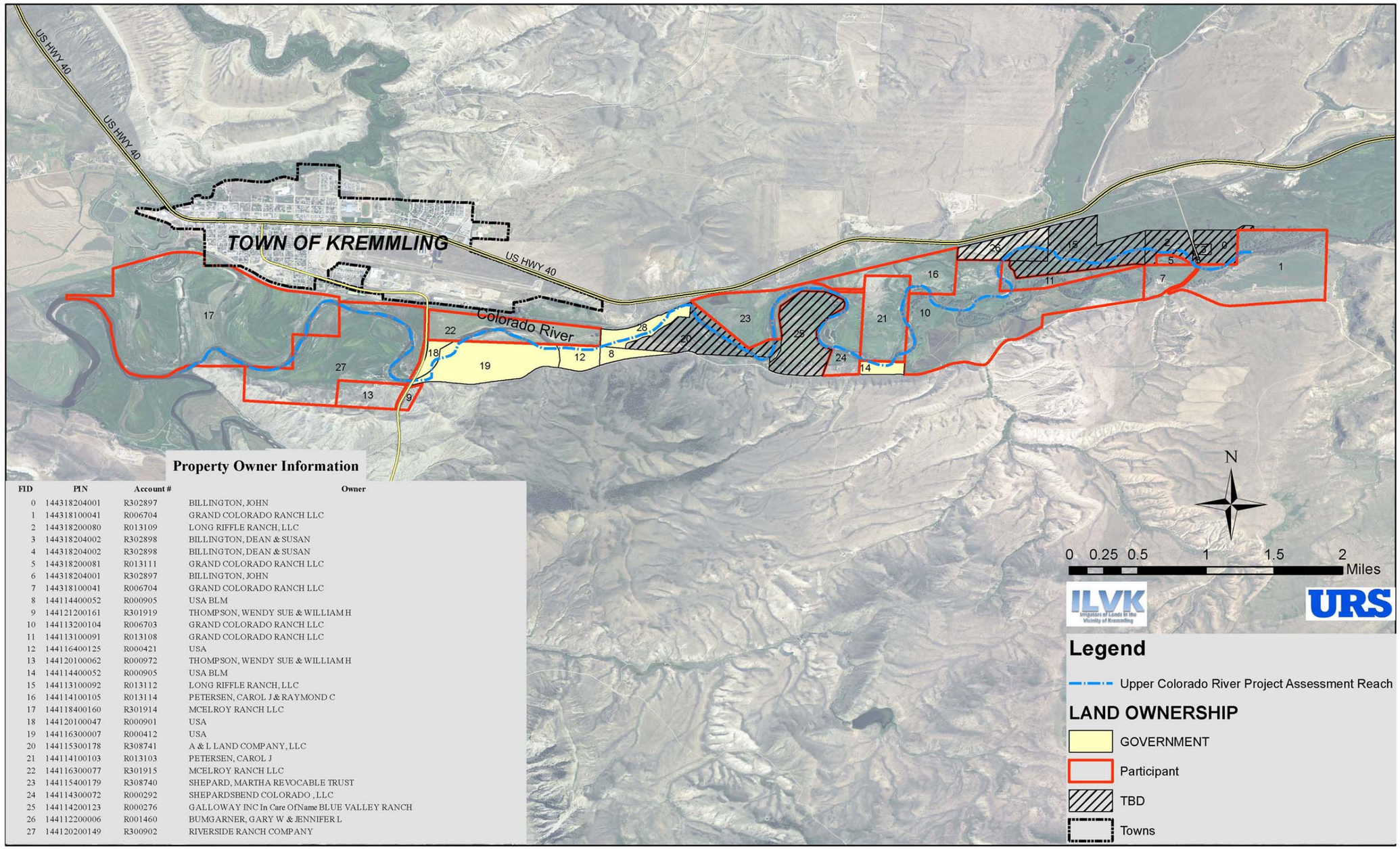
Task	Start Date	Finish Date
1	Upon NTP	NTP + 14 days
2	Upon NTP	NTP + 30 days
3	NTP + 14 days	NTP + 90 days
4	NTP + 14 days	NTP + 90 days
5	NTP + 30 days	NTP + 180 days
6	NTP + 90 days	NTP + 300 days
7	NTP + 90 days	NTP + 300 days

URS

Exhibit A
Cost Estimate

Table 2 Colorado River Assessment Proposed Cost

URS CORP.	Labor Category:	Principal/ Project Manager	Sr Hydraulic Engineer	Sr. Geomorphologist	Geologist	Ecologist	Water Resources/River Engineer	GIS/CAD Support	Project Admin.	Labor Subtotal		Subcontract (+7%)	Other Direct Costs-As noted		Mileage	Total	Matching Funds	Grant Funds Requested
	Employee:	John Sikora	Frank Lan	E.D. Andrews	Chris Rey	Eric	Chris Romeyn		Marcia Ginther									
	Labor Rates:	$ 180.00	$ 155.00	$ 150.00	$ 105.00	$ 155.00	$ 120.00	$ 100.00	$ 88.00	Hours	$				$0.52			
Task	Description																	
1	PROJECT MANAGEMENT														$85.80	$ 85.80		
	1.1 Kick off Meeting	8					8				$ 2,400.00					$ 2,400.00		
	1.2 Administration	16							20		$ 4,640.00					$ 4,640.00		
	Subtotal	**24**	**0**	**0**	**0**	**0**	**8**	**0**	**20**	**52**	**$ 7,040.00**	**$ -**		**$ -**	**$ 85.80**	**$ 7,125.80**		
2	BACKGROUND RESEARCH AND DATA COLLECTION																	
	2.1 Photo Analysis						4				$ 480.00					$ 480.00		
	2.2 Review Reports and References	1					16				$ 2,100.00					$ 2,100.00		
	2.3 Flow records	1					4				$ 660.00					$ 660.00		
	2.4 Existing Topographic Data						4				$ 480.00					$ 480.00		
	2.5 Geologic Base Mapping				2		2				$ 450.00					$ 450.00		
	2.6 Historic Info						8				$ 960.00					$ 960.00		
	Subtotal	**2**	**0**	**0**	**2**	**0**	**38**	**0**	**0**	**42**	**$ 5,130.00**	**$ -**		**$ -**	**$ -**	**$ 5,130.00**		
3	FIELD WORK																	
	3.1 Reconnaissance Float Trip			16	16	16	16				$ 8,480.00				$85.80	$ 8,565.80		
	3.2 Hydrographic Survey	1					32				$ 4,020.00	$ 10,000.00			$85.80	$ 14,105.80		
	3.3 Sediment Sampleing						8				$ 960.00	$ 600.00				$ 1,560.00		
	Subtotal	**1**	**0**	**16**	**16**	**16**	**56**	**0**	**0**	**105**	**$ 13,460.00**	**$ 11,342.00**		**$ -**	**$ 171.60**	**$ 24,973.60**		
4	PROJECT BASE MAPPING																	
	4.1 Topographic Data						4	1			$ 580.00					$ 580.00		
	4.2 GIS from Task 3.1				2	2	16	1			$ 2,540.00					$ 2,540.00		
	4.3 Project Subreaches	2					16	1			$ 2,380.00					$ 2,380.00		
	4.4 Geology				2		2	1			$ 550.00					$ 550.00		
	Subtotal	**2**	**0**	**0**	**4**	**2**	**38**	**4**	**0**	**50**	**$ 6,050.00**	**$ -**		**$ -**	**$ -**	**$ 6,050.00**		
5	DATA ANALYSIS																	
	5.1 Complete Hydrology Analysis	1	4	4			8				$ 2,360.00					$ 2,360.00		
	5.2 Preliminary Hydraulic Modeling	1	4	4			20				$ 3,800.00					$ 3,800.00		
	5.3 Preliminary Sediment Transport Modeling	4	4	4			30				$ 5,540.00					$ 5,540.00		
	5.4 Geomorphic Assessment	4		16			30				$ 6,720.00					$ 6,720.00		
	Subtotal	**10**	**12**	**28**	**0**	**0**	**88**	**0**	**0**	**138**	**$ 18,420.00**	**$ -**		**$ -**	**$ -**	**$ 18,420.00**		
6	DEVELOP PROPOSED ACTIONS																	
	6.1 Reach Scale restoration approaches	4		16			32	2			$ 7,160.00					$ 7,160.00		
	6.2 Location Specific Projects	1					32				$ 4,020.00					$ 4,020.00		
	6.3 Alternative Intake Approaches	4					16				$ 2,640.00					$ 2,640.00		
	6.4 Project Cost Estiamtes	4					60				$ 7,920.00					$ 7,920.00		
	6.5 Prioritize Projects	6					32				$ 4,920.00					$ 4,920.00		
	Subtotal	**19**	**0**	**16**	**0**	**0**	**172**	**2**	**0**	**209**	**$ 26,660.00**	**$ -**		**$ -**	**$ -**	**$ 26,660.00**		
7	DELIVERABLES																	
	7.1 Master Plan Report	4		4	4	4	32	6	4		$ 7,152.00					$ 7,152.00		
	7.2 GIS Database	4			2	2	24	24	3		$ 6,784.00					$ 6,784.00		
	7.3 Presentation of Results	4					8				$ 1,680.00					$ 1,680.00		
	Subtotal	**12**	**0**	**4**	**6**	**6**	**64**	**30**	**7**	**129**	**$ 15,616.00**	**$ -**		**$ -**	**$ -**	**$ 15,616.00**		
	Subtotal:	**70**	**12**	**64**	**28**	**24**	**464**	**36**	**27**	**725**	**$ 92,376.00**	**$ 11,342.00**			**$ 257.40**	**$ 103,975.40**		
	Total	**Rounded up to nearest $1000**														**$ 104,000.00**	**$ 54,000.00**	**$ 50,000.00**



Property Owner Information

FID	PIN	Account #	Owner
0	144318204001	R302897	BILLINGTON, JOHN
1	144318100041	R006704	GRAND COLORADO RANCH LLC
2	144318200080	R013109	LONG RIFFLE RANCH, LLC
3	144318204002	R302898	BILLINGTON, DEAN & SUSAN
4	144318204002	R302898	BILLINGTON, DEAN & SUSAN
5	144318200081	R013111	GRAND COLORADO RANCH LLC
6	144318204001	R302897	BILLINGTON, JOHN
7	144318100041	R006704	GRAND COLORADO RANCH LLC
8	144114400052	R000905	USA BLM
9	144121200161	R301919	THOMPSON, WENDY SUE & WILLIAM H
10	144113200104	R006703	GRAND COLORADO RANCH LLC
11	144113100091	R013108	GRAND COLORADO RANCH LLC
12	144116400125	R000421	USA
13	144120100062	R000972	THOMPSON, WENDY SUE & WILLIAM H
14	144114400052	R000905	USA BLM
15	144113100092	R013112	LONG RIFFLE RANCH, LLC
16	144114100105	R013114	PETERSEN, CAROL J & RAYMOND C
17	144118400160	R301914	MCELROY RANCH LLC
18	144120100047	R000901	USA
19	144116300007	R000412	USA
20	144115300178	R308741	A & L LAND COMPANY, LLC
21	144114100103	R013103	PETERSEN, CAROL J
22	144116300077	R301915	MCELROY RANCH LLC
23	144115400179	R308740	SHEPARD, MARTHA REVOCABLE TRUST
24	144114300072	R000292	SHEPARDSBEND COLORADO , LLC
25	144114200123	R000276	GALLOWAY INC In Care Of Name BLUE VALLEY RANCH
26	144112200006	R001460	BUMGARNER, GARY W & JENNIFER L
27	144120200149	R300902	RIVERSIDE RANCH COMPANY

The following are responses to the 12 questions presented in the document titled "Colorado Basin Roundtable Grant Evaluation and Prioritization Supplement."

1. What benefit does the project provide? Are there multiple purposes? What water body(ies) will directly benefit from this project?
    a. This project will provide an understanding of the various cause and effect relationships that are driving geomorphologic change through the project reach. The goal of the project is to develop solutions to the problems the ranchers are experiencing that are sustainable moving forward with the modified hydrology and sediment loading. The project will identify reach wide and site specific projects that will have multiple benefits for multiple stakeholders. The recommended projects will improve irrigation operations for 12 water rights as well as improve aquatic and riparian habitat, reduce downstream impacts from non-point source sedimentation. This project will directly benefit the Colorado River downstream to the state line and beyond.
2. Outline the Steps needed for completion of the project.
    a. Exhibit A provides a detailed scope including task descriptions and budget.
3. What permit issues must be overcome, if any?
    a. This is an assessment project that will not require any permitting at this stage. The resulting recommended reach-wide and site specific projects may require local, county, state or federal permitting to move forward. Obtaining the required permitting will be a necessary component of future phases of this ongoing project.
4. What alternatives to the proposed project have been considered? Are there water rights conflicts involving the source of water for the project? If so, please explain.
    a. The project includes an assessment of alternative solutions to the issues throughout this reach of the Colorado River. No water will be required for this project and there are no known water rights conflicts.
5. How has public input been solicited and is there local support for the project? Have the beneficiaries obtained funding, letters or other documentation to demonstrate support?
    a. The ILVK group is actively seeking project partners. The ILVK is talking with nearby property owners to solicit their participation and support. The ILVK is also in active discussions with Grand County to include the county on an expanded phase 2 scope. The ILVK has received verbal statements of support from Ground County but has not obtained written documentation. The ILVK will present the project to the Grand County Commissioners on July 2, 2013, the day after the application deadline. If written documentation of support is obtain from Grand County or other stakeholders it will be submitted as an addendum to this application.
6. Is there opposition to the project? Is opposition documented in writing? If there is opposition, how have those concerns been addressed?
    a. There is no known opposition to this project.
7. How does the project affect the protection and conservation of the natural environment, including the protection of open space?

   a. Among the project's goals is developing recommendations for improving riparian and aquatic habitat. The continued sustainable irrigation of the ranch lands (open space) within this reach is a primary goal of this project.

8. What is the impact of the proposed action on other non-decreed values of the stream or river? Non-decreed values may include things such as non-decreed water rights, or uses, recreational uses, environmental services such as pollution filtration and dilution, and soil/land conservation practices.
   a. The proposed project will recommend specific actions/projects that will improve the non-decreed values of the stream. The project will make recommendations for recreational enhancements. The resulting projects will be conceived and designed with the specific purpose of improving environmental services and reducing land loss and related non-point source pollution.
9. How does the project relate to local land use plans or development standards? If conflicts exist, how will these be addressed?
   a. There are no known conflicts with existing land use plans or development standards. All recommended projects will be conceived and designed to meet the requirements of all City, County and/or State development standards.
10. Identify any interbasin conflicts and how they would be addressed. Will there be any injury to water users as a result of this project.
   a. There are no known interbasin conflicts at this time. All recommended projects will be conceived and designed to meet all relevant State of Colorado water rights administration statues, rules, agreements, compacts, treaties, etc. There will be no injury to water users as a result of this project.
11. Identify any interbasin impacts and how any conflicts would be addressed
   a. There are no known interbasin impacts from this project.
12. How does the project support agricultural development or protect the existing agricultural economy?
   a. This projects main goal is to protect the existing working agricultural opertaions.

Preliminary Geomorphology Report

Date: May 10, 2013

To: Mr. Paul Bruchez

From: Chris Romeyn, PE, CFM-Water Resources Engineer

Subject: Geomorphology Assessment of Colorado River near Kremmling, Colorado

Introduction

Last fall, the Ranchers pooled their resources to call attention to the impacts to the Colorado River upstream from the Blue River/Muddy Creek confluence to the KB Ditch in response to a 1041 application by Northern Colorado River Conservancy District (Northern) for the Windy Gap Firming. This reach of stream has experienced significant geomorphological changes due to the construction of large reservoirs and east slope diversions and other disturbances. The upstream and downstream reservoirs and diversions by Northern, Denver Water, Colorado Springs and the River District have caused significant changes to the hydrology and the sediment load of the Colorado River. The changes to the hydrology and sediment load have an impact on channel stability in this reach of Colorado River. Examination of aerial photographs shows that this reach of river has moved across the valley through time. The construction of the reservoirs and diversions has likely increased the stream channel instabilities. While the current focus has been upstream from this reach of stream it may be likely that a source of some of the stream channel instabilities may be coming from downstream.

URS has performed a preliminary geomorphic assessment of the Colorado River in an effort to better characterize the issues and potential driving forces behind the changes identified by the irrigators. Additionally a preliminary assessment of the condition of the irrigation pumps was prepared. The following sections outline the results of these efforts.

Colorado River Geomorphic Assessment

URS engineers and geologists have reviewed aerial photographs, historic photos, and geologic maps to gain a better understanding of the river dynamics behind the apparent instabilities. On May 7, 2013, URS engineers visited the section of the Colorado River between the Martin Pump No. 1 Point of Diversion and the Ennis Pump Point of Diversion. The field visit was led by Bill Thompson, Paul Bruchez and the other ranchers involved in the agreement with Northern.

The aerial photos show that the overall planform of the river has been fairly stable over the last 80 years (see Figure 1). While the sinuosity has remained nearly constant, it appears to be a much more active channel in 1938. There are significantly more mid-channel bar deposits, larger point bars, and noticeably less riparian vegetation. The side channels and remnant channels appear more distinct in the 1938 photo. This may indicate that the side channels have experienced less disturbance (flooding) in the time period between photo dates, which has allowed riparian vegetation to become established. This has likely resulted in a decrease in conveyance capacity in the side channels. Despite this apparent planform stability, the aerial photos do show the historic meander patters of the

Colorado River, indicating that the channel has meandered across the entire valley throughout recent geologic history.

A number of the diversion structure locations were observed during the May 7 site visit. There is extensive evidence of channel instability at many of the locations visited. Detailed observation notes are included at the end of this memorandum for reference. One piece of critical information revealed during the site visit to the McElroy No. 2 pump station and check dam was that in the early 1900s a large meander was cutoff and the river was channelization near McElroy No. 2. URS researched photographs at the Denver Public Library historic collection. Figure 2 shows two photographs taken from approximately the same location at the top of the mesa due north of the Town of Kremmling. The upper photo was taken between 1906 and 1916 and the lower photo was taken in 2010. A large meander in the Colorado River is evident in the top photo. The 2010 photo clearly shows the filled in, over grown scar of the historic meander. The length of channel was reduced from 8,850 ft to 1,600 ft which increased the bed slope from approximately 0.0008 ft/ft to 0.0038 ft/ft. This channelization would have caused a headcut to form and progress upstream as the river tries to reestablish the old channel bed slope. The evolution of a typical headcut is presented in Figure 3.

Based on our brief assessment, the section of river between the confluence of the Colorado and Troublesome and the mouth of Gore Canyon appears to have four distinct reaches as follows:

Reach 1, the most downstream reach, goes from the head of Gore Canyon to the confluence of the Colorado River, Blue River and Muddy Creek. This reach has different hydrology from the up-stream reaches due to the contribution of the Blue and Muddy. The reach is characterized by fine grained sediment, a wider channel and slow velocities. This reach has been significantly impacted by upstream changes in morphology, hydrology, and sediment loading. Research indicates that the USGS Gage 09058000, Colorado River Near Kremmling, CO, has experienced minor aggradation over the operational period up to 2005. Then the trend reversed and channel depredation has occurred since. The historic aggradation may be due to the progression of the headcut (see Reach 2 below) which transports greater amounts of sediment downstream. The recent degradation may be the result of a reduction in sediment supply resulting from the upstream check structures (see Reach 2 below).

Reach 2 goes from the confluence of the Colorado, Muddy and the Blue up to the Thompson fault (see Figure 4) located just downstream of the Elk and Trout Lodge. This reach has been impacted by the channelization and subsequent headcut. There is a significant amount of bank failure as the channel readjusts to its new slope. This indicates that the headcut has progressed upstream and now the channel is widening (see III in Figure 3). The downstream USGS gage cross-section switched from an aggrading channel to a degrading channel at the same time the various check structures were installed at the various up-stream diversions. It's possible that the historic aggradation was caused by sediment input from upstream reaches. The active headcut in the lower sub-reach, and the meandering of the upstream sub-reaches contributed to this aggradation. The installation of the check structures would cause aggradation of the channel immediately upstream. This would temporarily limit the supply of sediment that

reaches the Gage. Once the river has stabilized upstream of the check structures sediment loading may increase at the USGS gage above Gore Canyon. The Thompson Fault may also function as a grade control, limiting the upstream progression of the headcut.

Reach 3 goes from the fault, to somewhere in the vicinity of the Orr Pump No. 1. This portion of the stream appears to not be impacted by the headcut due to geologic control at the fault. This sub-reach is wider than the upstream reach (Reach 4); it has a fine grained sand bed and minimal evidence of bank erosion.

Reach 4, the most upstream reach, goes from a location near the Orr Pump No. 1 upstream to the confluence with Troublesome Creek. This sub-reach is narrower than the downstream sub-reach. It has a gravel bed channel with numerous mid channel bars. This reach may be aggrading slightly due to the sediment load from Troublesome Creek and as well as the reduction in main stem hydrology. This type of aggradation can lead to bank erosion.

The Colorado River and its tributaries have been significantly altered since the arrival of ranching in the mid to late 1800s. Diversions from the river started in the late 1800s. The first trans-basin diversion was the Grand Ditch which began diverting in 1890. The hydrology changed substantially with the completion of the Colorado-Big Thompson Project and filling of Granby Reservoir in 1947. The result of all diversions and impoundments has been to reduce the magnitude and frequency of flood flows (see Figure 5 and Figure 6).

In addition to the reduced flows the reservoirs have stopped sediment from moving downstream. The total basin area above the confluence with the Blue and Muddy is 1380 square miles. The combined basin area above Lake Granby, Williams Fork, and Willow Creek Reservoirs is 675 square miles. Approximately half of the 1380 square mile watershed no longer contributes sediment the project reach. Even if Lake Granby is assumed to have always trapped sediment, the combined effects of Williams Fork and Willow Creek is a 34% reduction in contributing area. Research indicates that the upper reaches of the watershed have typically been sediment limited and all available sediment is moved downstream. Evidence of this impact is the fact that after 25 years Windy Gap Reservoir required dredging in 2010 to remove 5,600 tons of accumulated sediment.

Discussion

This preliminary geomorphic assessment is based on limited information. There are many different factors that have influenced the current condition of the river: water diversions, impoundments, and channel modifications are known to have occurred over the past 100 years. By the time the first aerial photographs were taken in 1938 the river was significantly altered. Changes to the river include: irrigation diversions; channelization, meander cutoff and resulting headcut; reservoir impoundments; reduced sediment loads; modified flows with smaller and less frequent large flows; rapid fluctuations of flows due to reservoir operations; agricultural activities such as grazing and irrigation return flows.

While these changes have been significant the overall planform of the river has remained remarkably stable over the last 80 years. Aerial photos indicate that the channel has migrated all the way across the valley over geologic history. It's possible that the river

was already responding to the above mentioned changes by the time the first photos were taken. The 1938 photo clearly has significantly more gravel and sand bars (see Figure 1).

Reach 1 has been impacted by significant upstream alterations. The headcut in Reach 2 would have increased the sediment load in Reach 1 as the river adjusted. The installation of the check structures would have decreased sediment loading to this reach. Additionally, the cumulative impact of upstream changes, including alterations to the hydrology and sediment loading by multiple reservoirs, has significantly impacted this reach, possibly exacerbating bank erosion. When rivers are deprived of their natural upstream sediment load they may respond by trying to move additional sediment from within the reach by scouring the banks and or bed.

The channelization above the confluence with the Blue has likely caused a headcut to progress up stream in Reach 2, causing a significant drop in invert elevation. While further investigation is necessary, it's possible that the headcut has progressed all the way upstream to the Thompson Fault or it may still be working its way. There is some evidence that there are layers of clay present in the Colorado River alluvium. These clay layers, where present, may have had the effect of slowing the progressing of the headcut.

Reach 3, between the Thomson Fault and the Orr Pump No. 1 is more stable than the upstream or downstream reaches. This reach is likely controlled by the Thompson Fault. Analysis of USGS 10 meter DEM indicates that this portion of the valley is very flat (.0017%). It's possible that the fault functions as a hydraulic control which causes a backwater. As the flow of the river slows it drops out its sediment load. This process has sorted the bed material such that more coarse particles are found upstream and finer particles are found downstream.

Reach 4 is noticeably narrower than the lower reaches. Numerous mid channel bars are evident. There is active bank erosion but little evidence of down cutting. Troublesome Creek is a significant source of sediment loading to the Colorado River. It's possible that the altered hydrology is not capable of moving the sediment downstream. Additionally, the upstream reservoirs have reduced the inflow of sediment from the main stem. This lack of incoming sediment combined with possible aggradation may be causing the river to erode the banks. Additionally, this portion of the valley is much steeper than the valley is in Reach 3 (0.31%).

Recommendations

The findings presented in this memo are based on a single site visit and a few days of research and should be considered as preliminary. Further, detailed work is necessary to adequately identify the driving forces behind the obvious morphological changes in each of the above described reaches. Given the extent and duration of the changes to the Colorado River system it's likely that the river will continue to adjust its planform and width-depth ratio as it tries to establish dynamic equilibrium with the altered hydrology and sediment load. Additional analysis may confirm the possible causes of instability identified above, or alternate causes of instability may be identified. Alluvial river systems are extremely complex and the immediate causes of instabilities may not be apparent at first.

One approach to mitigating the problems would be to develop a plan for each intake separately. While this approach provides individual autonomy there is risk that the actions of one irrigator/land owner will have a negative impact on adjacent properties and diversions. Rivers are dynamic systems, somewhat analogous to a living organism, and there can be many contributing factors causing the apparent instabilities. River systems are capable of major adjustments in response to disturbances, both natural and manmade. Trying to impose an engineered solution onto a river system without fully understanding the geomorphology can result accelerated instabilities.

We recommend evaluating and understanding the source and magnitude of the stream channel instabilities with a focus towards developing the least cost approach to improving diversion performance and limiting loss of land through erosion. This more holistic approach will be a more cost effective way to address the river instabilities and diversion problems. The Ranchers, by jointly participating together, can avoid constructing measures that would negatively impact each other. Another rational for jointly evaluating the global stream instabilities is that it may be possible to identify channel control structures that can be constructed that would improve the diversions for all of the ranchers; for example a small number of strategically placed drop structures as opposed to a structure at each headgate. The ranchers may choose to invest in these structures as a group to reduce the costs of addressing issues at their individual diversions.

Approaching these river issues on a reach wide basis will result in solutions that are more in tune with the natural river system. These types of solutions tend to be more cost effective and have better performance, resulting in a more sustainable system. Additionally, these types of solutions will improve the overall river and riparian ecosystems. This region is world renowned for its natural environment and associated activates (fishing, hunting, boating, climbing, etc.). Bald eagles, Ospreys, deer, elk, pronghorn, coyote, Pelicans, and Western Greebs were all observed during a single site visit. A holistic approach to addressing the problems in each of these river reaches will improve habitat for both aquatic and upland species.

Approaching the river mechanics issues in a holistic way does not address issues with the pumping facilities. We have developed a separate summary memo identifying the pump issues with the individual pumps. If you have any questions regarding this matter please do not hesitate to contact John Sikora, Josh Shackelford or myself.

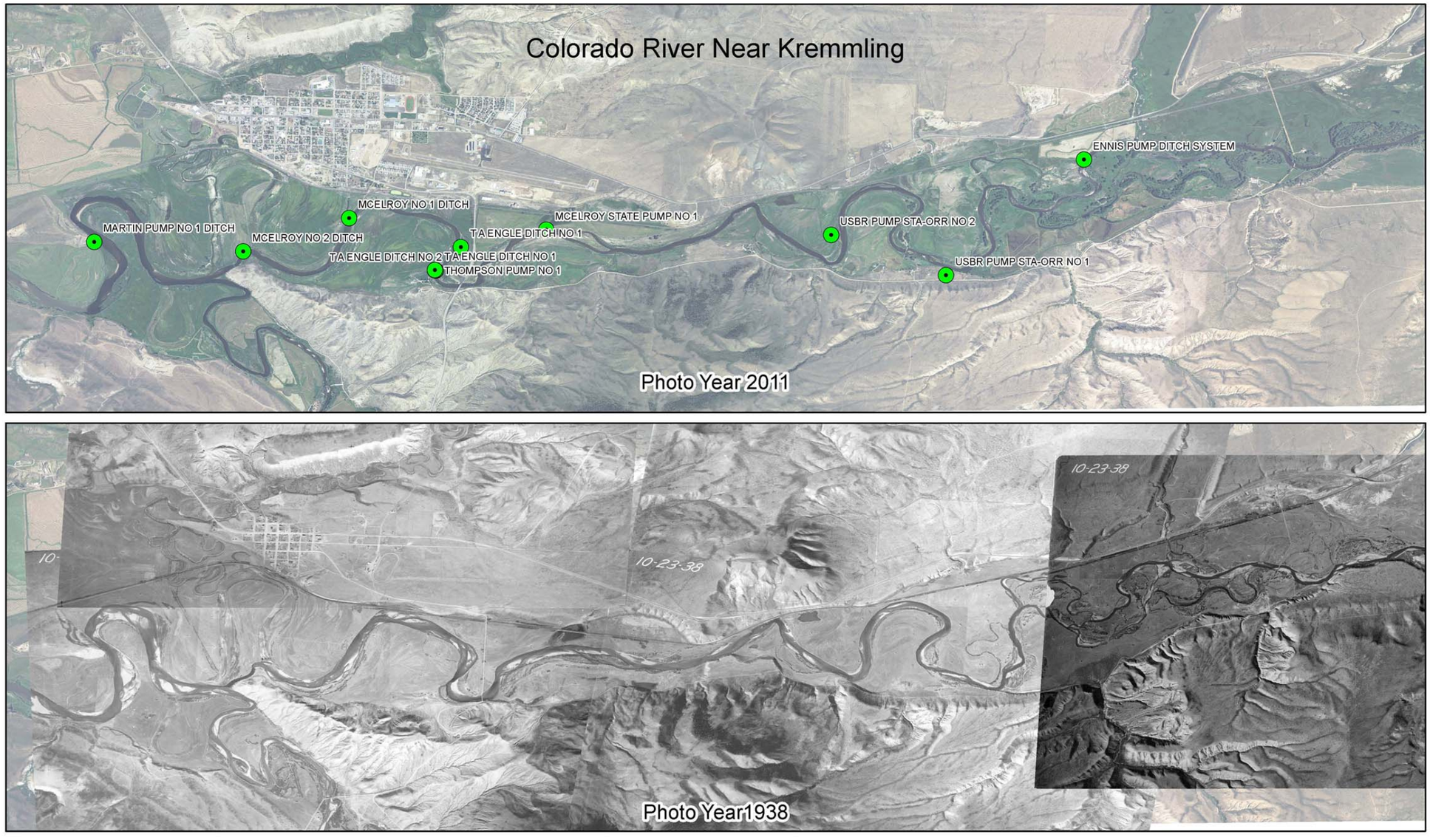


Figure 1 Aerial photos from 2011 and 1938.

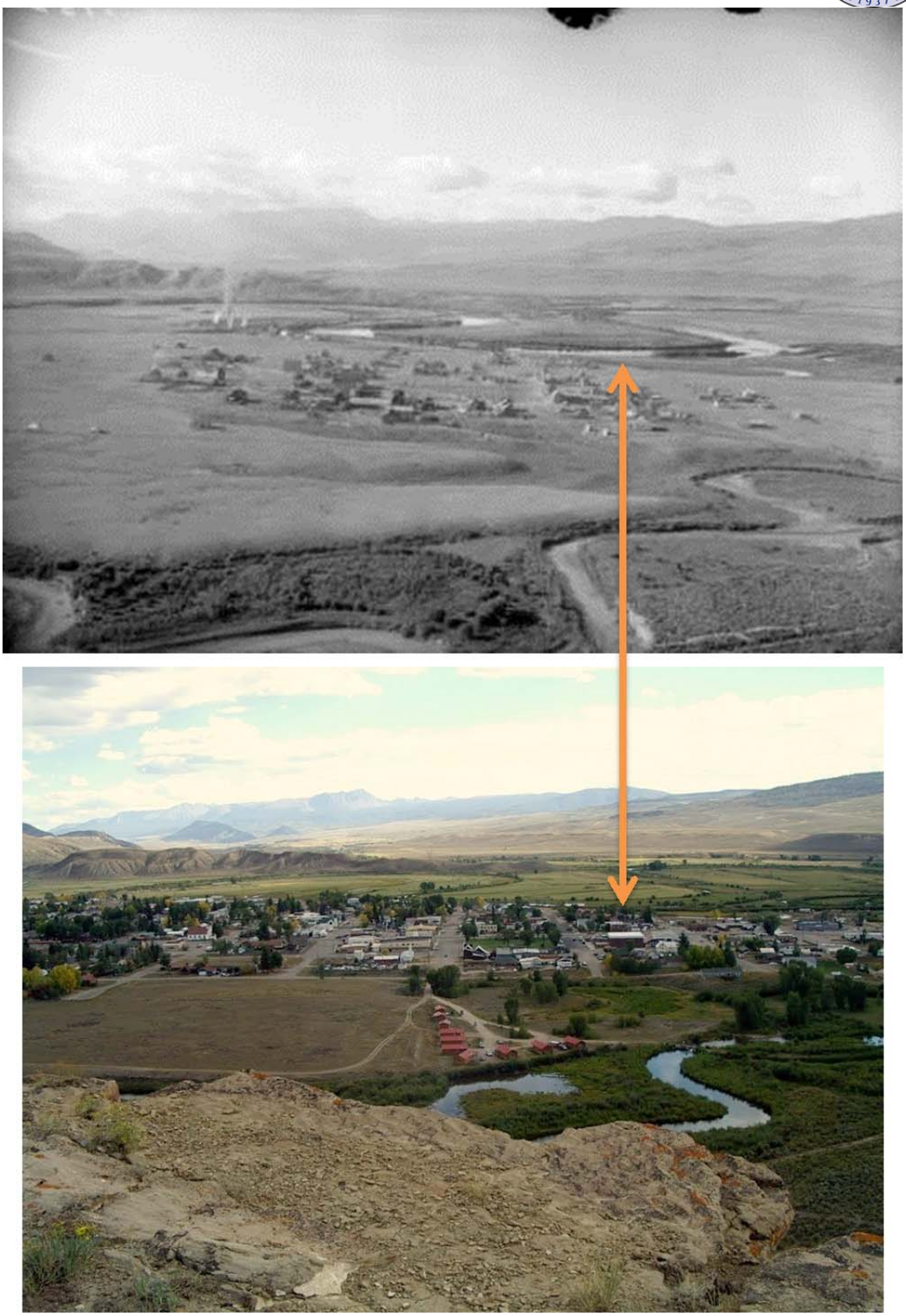


Figure 2 Colorado River at Kremmling. Photos taken from ridge due north of Town looking south towards Eagle's Nest Range. Upper photo taken between 1906 adn 1916 shows large meander close to Town. Lower photo taken in 2010 shows scar of former channel.

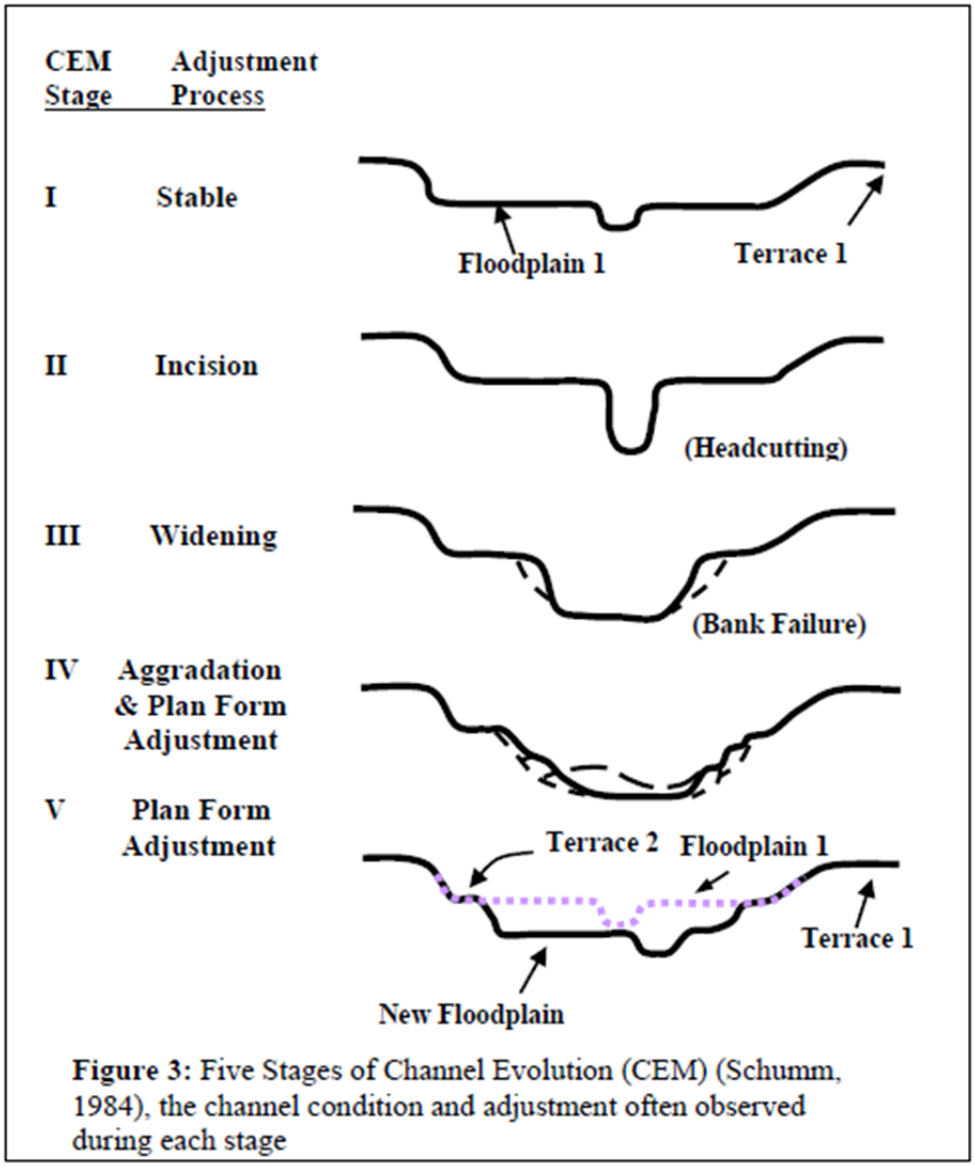


Figure 3: Five Stages of Channel Evolution (CEM) (Schumm, 1984), the channel condition and adjustment often observed during each stage

Figure 3 Schumm Five stages of Channel Evolution. From Vermont River Management Program River Dynamics 101- Fact Sheet

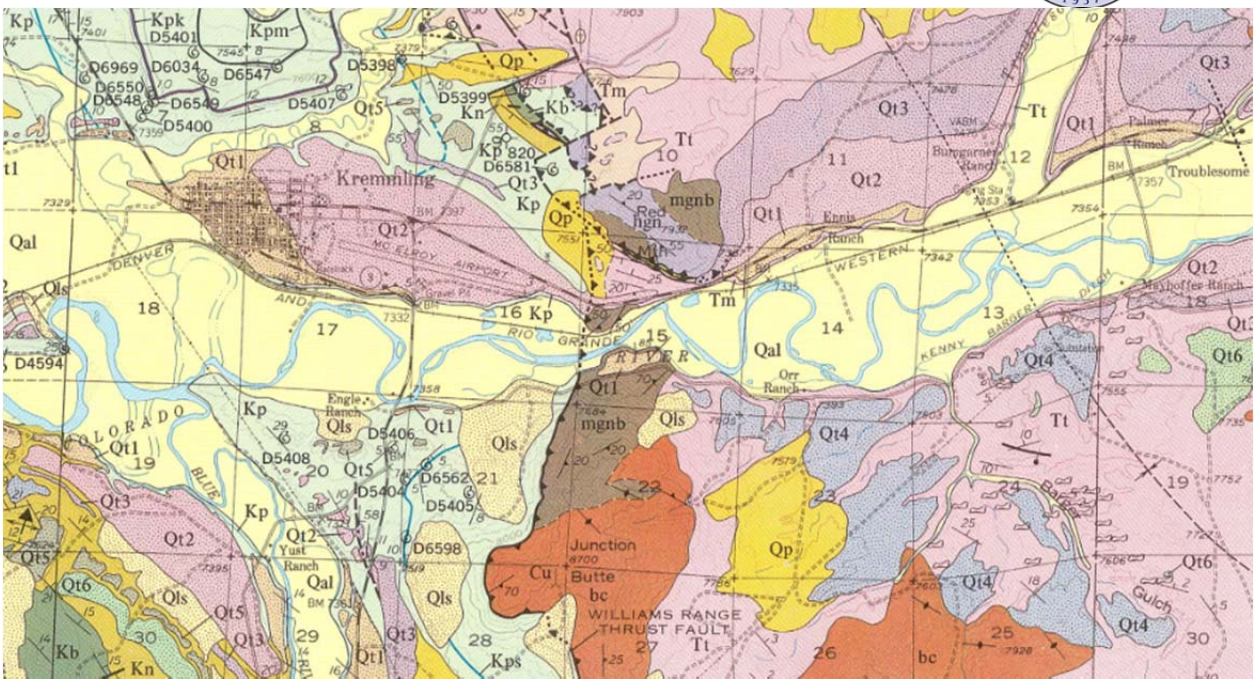


Figure 4 Geologic Map of the Kremmling Quad, Grand County Colorado. The Thompson Fault is evident at the center of the image. The combination of the fault and the basalt formations just upstream may form a hydraulic control in the Colorado River, fixing the bed elevation at this point. This would directly impact upstream and downstream geomorphology.

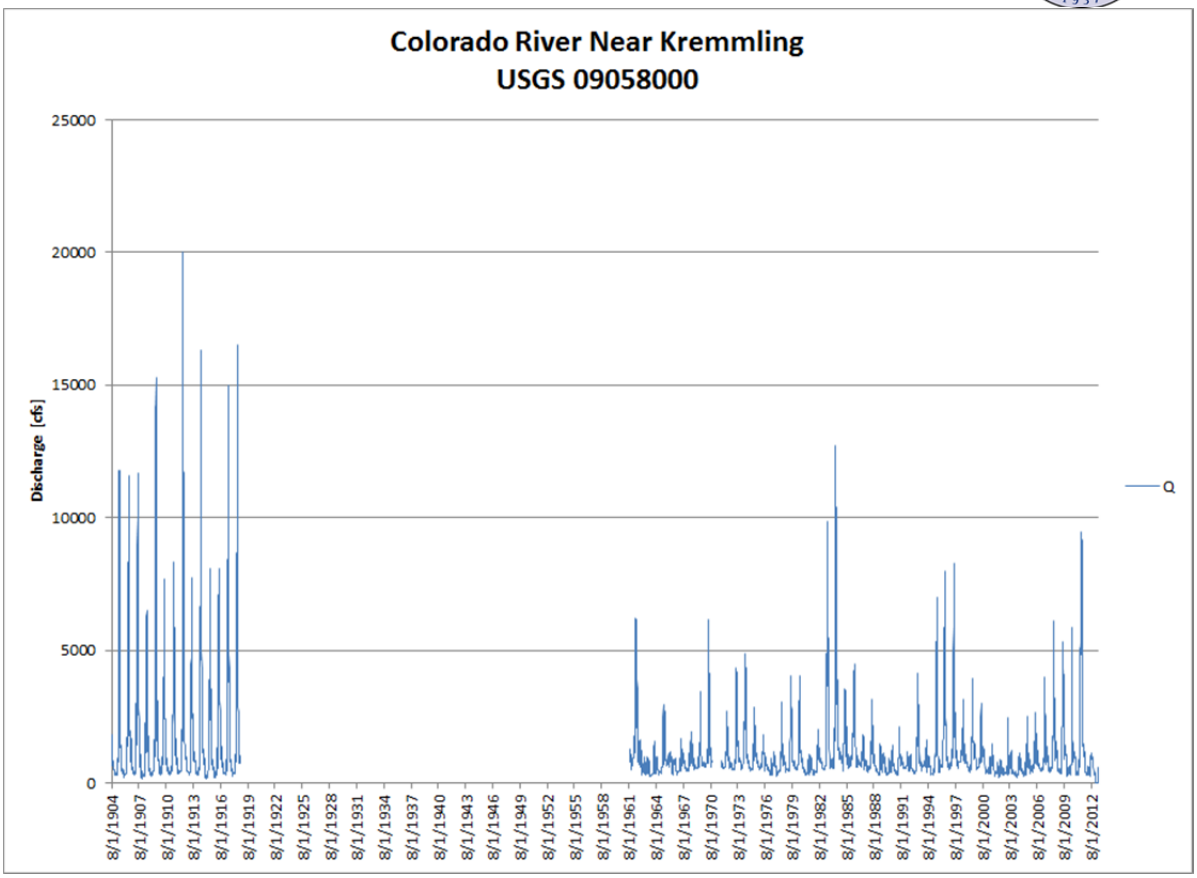


Figure 5 Flow Record for the Colorado River Near Kremmling (USGS 09058000). While there is a significant portion of the record missing between 1918 and 1961, there is a clear trend of decreasing flows magnitude and decreasing flood recurrence.

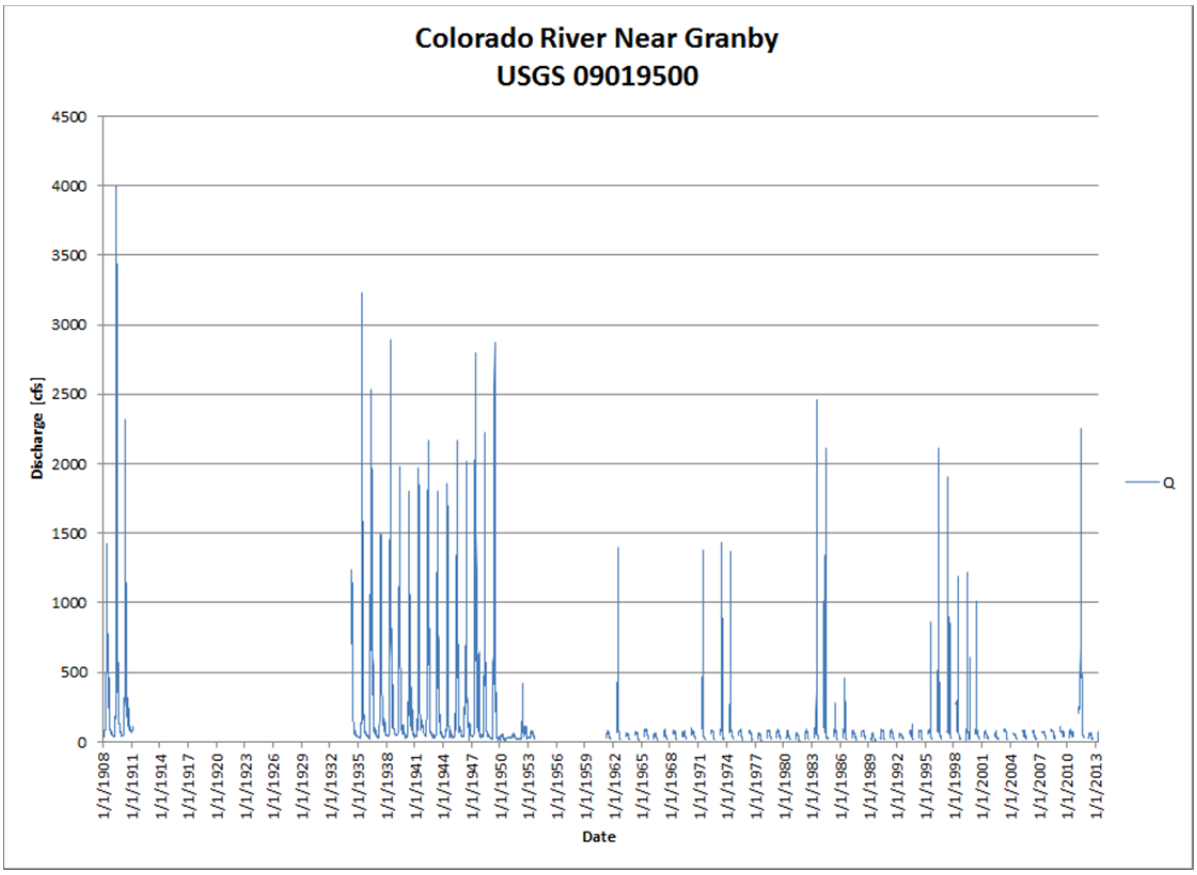


Figure 6 Flow Record for the Colorado River Near Granby (USGS 09019500). While there is a significant portion of the record missing, there is a clear trend of decreasing flows magnitude and decreasing flood recurrence.

Observations from Site Visit

a. At Martin Pump No. 1 Ditch, noticed fine grain nature of sediment. Evidence of active bank erosion. Upstream outside bend over steepened, vertical. Some undercutting of sod evident across river downstream of inside bend and point bar. Erosion severe where no willows established (see Figure 7).
b. At McElroy No 2 Ditch drop structure. Bank erosion due to improperly constructed check structure. Safety Hazard due to keeper hole at high flow and strainers at low flow (see Figure 8). Upstream outside (north) bank has been stabilized with automobiles. Some undercutting of sod evident, but also some siltation evident on banks above drop. Owners indicate that in the early 1900's a large meander bend was cut off to facilitate ranching operations (see Figure 2). This meander bend is also evident in both photos in Figure 1.
c. At a point between McElroy No. 2 Ditch and McElroy No. 2 Ditch. Significant bank erosion on outside of bend. Evidence of some attempts to stabilize bank including tires and concrete. See Figure 9.
d. At McElroy No. 1 Ditch. Evidence of bank erosion. Relatively straight stretch of river. River right bank stabilized by riprap, some cars, etc. Some undercutting of sod evident on river right but overall not too bad.
e. TA Engle Ditch No. 1 Island present at and above intake location. Poorly constructed check structure on right channel failing. Significant deposit of sand on left bank below river may be caused by redirection of flows by check structure. Significant degradation has occurred between installation of Senate Document 80 pump and installation of newer pump. Significant collapse of over stepend banks, undercut sod, etc. (see Figure 10).
f. Thompson Pump No. 1, et/ al. Located on outside bend. Three check structures, upper ones direct flow to intake, lower one creates head. Improperly constructed. Significant bank collapse and erosion. Upstream Outside bend has been partially riprapped with concrete etc. (see Figure 11).
g. Orr Pump No. 1. Significant bank erosion at check structure. Check constructed incorrectly. Directs flow towards right bank. May exacerbate gravel bar formation, further compounding bank problems (see Figure 12). Channel may be aggrading in locations upstream as evidenced by large gravel deposits (see Figure 13). Check structure appears to be located at old bridge site. Maybe placed on bridge piers.

h. Orr Pump No. 2. More stable section of river. Wider, some bank erosion and some car riprap. Bed elevation appears comparatively stable. Finer grain sediments that Orr No. 1 upstream.

i. Reach downstream of Ennis Pump Ditch System. Evidence of recent bank erosion and collapse. This reach has had some "restoration" work done by previous owner. Perhaps J-Hooks were improperly installed and caused bank erosion. There could be some aggradation of the bed due to loading from Troublesome Creek. The reduced hydrology may not be sufficient to move the bed load, so the channel is aggrading resulting in lateral migration of channel (see Figure 14).

j. Ennis Pump. Significant bank erosion. Stabilized with cars. Cars have floated downstream causing a gravel bar to form on inside of bend. Causing erosion on outside of bend. Some of the bank erosion could also be caused by over grazing and trampling. However, livestock have been excluded from the riverbank in numerous areas and bank erosion continues. Reduction in flows may be causing aggradation. Research indicates that sediment transport of gravels is increase by the addition of some amount of sand. Upstream impoundments not only reduce the hydrology and therefore sediment transport capacity, but the prevent sediment from moving downstream. See Figure 15.

Figure 7 Bank instability upstream of Martin Pump No. 1. Erosion more severe where willows are not established.

Figure 8 Check structure below McElroy No. 2 Ditch. Structure creates hydraulic hazard for boaters and swimmers. Also exacerbates erosion on banks because it is curved incorrectly. Center of structure should be upstream of wings to relieve stress on banks, provide boat and fish passage, and eliminate dangerous hydraulics.

Figure 9. Severe bank erosion between McElroy No. 2 Ditch and McElroy No. 1 ditch. It's likely that the channel has experienced a headcut and now the oversteepened banks are eroding.

Figure 10 Bank collapse above TA Engle Ditch No. 1.

Figure 11 Bank erosion at Thompson Pump No. 1. May be caused by both headcutting and improperly constructed drop structure that focuses stresses on the bank.

Figure 12 Bank instability at Orr Pump No. 1. Improperly constructed drop structure directs stresses towards bank. May also cause formation of gravel bar on right of the photo which may place additional stresses on the bank.

Figure 13 Gravel bar deposit upstream of Orr No. 1 check structure. May be caused by reach wide aggradation.

Figure 14. Bank erosion downstream from Ennis Pump Point of Diversion. This reach may be impacted by previous "restoration" activities. Improperly implemented j-hooks may have exacerbated bank erosion. Reach is noticeably narrower then downstream reaches.

Figure 15 Bank erosion downstream of Ennis Pump Point of Diversion. Portions of bank have been protected with cars. Two cars have been moved downstream by the river. They are apparent at the top left of the photo. They have caused the formation of a significant gravel bar deposit. There is no evidence of channel degradation. Bank erosion may be caused by aggradation due to reduced sediment transport capacity resulting from modified hydrology and sediment input.

The ILVK gave a presentation on the proposed project to the Grand County Commissioners on June 24, 2013. The County Commissioners expressed their support for the project during that meeting. Grand County is currently drafting a letter of support for the project to be submitted prior to the July Round Table meeting.

Project Team Resumes

John H. Sikora, PE, CFM

Principal Water Resources Engineer

Overview

John Sikora, P.E., Principal Water Resources Engineer, has over 25 years of experience of managing, planning, designing and constructing large civil engineering projects. He has been involved in environmental permitting and public involvement for these projects.

Areas of Expertise

Water Rights
Dam Design and Construction
Dam Rehabilitation
Hydraulics
Hydrology
Water Supply Planning
Hydraulic Structure Design

Years of Experience

With URS: 16 Years
With Other Firms: 9 Years

Education

BS/Agricultural Engineering/ University of Illinois

Graduate Studies/Agricultural Engineering/1986/University of Illinois

Registration/Certification

Professional Engineer: Illinois (062-046150), Colorado (30358)

AAWRE, D. WRE

Certified Floodplain Manager

Professional Experience

URS Corporation (Current)
Glenwood Springs, Colorado
Principal Water Resources Engineer

- Water supply planning
- Dam design and construction
- Water conveyance planning, design and construction

Colorado Division of Water Resources (2001 – 2006)
Glenwood Springs, Colorado
Assistant Division Engineer – Division 5 Water Resources

- Assists in the administration of water rights in Colorado River Basin and its tributaries, spanning 11 water districts from Grand County to Colorado-Utah State Line, containing approximately 24,000 water rights and 11,000 dams, diversions, and wells.
- Direct supervision of 5 water commissioners and indirect supervision of 4 water commissioners. Manages staff of 25 engineers, administrative support, and engineering techs including 15 field water commissioners.
- Reviews, makes recommendations and provides water resources engineering support to Division Engineer for water court and litigation issues, including trial preparation; conducts extensive reviews of water court filings; reviews field inspection notes, computer databases and ground/surface water computer models, attends litigation meetings, provides water court consultations, and negotiates final decrees for integration into the Division's Water Rights Tabulation.
- Provides technical information to general public, engineering and legal firms, and public and private organizations in relation to state statutes, administrative policies, hydrology, and availability of ground and surface water throughout the state.
- Interprets water court decrees for water rights and augmentation plans for water administration.
- Assists the dam safety engineer with dam safety inspections.

URS Corporation (1991 – 2001)
Denver, Colorado
Surface Water Group Manager

- Managed and provided direct supervision of 10 water resources engineers.
- Planning, design and construction of over 150 dams for water supply, flood control and tailings dams in the United States and abroad.
- Watershed modeling for hydrology, hydraulics and sediment transport.

DuPage County, Illinois (1989 – 1991)
Wheaton, Illinois
Water Resource Engineer

- Planning and design of flood control projects in DuPage County, Illinois

Illinois Department of Transportation (1987 – 1989)
Schaumburg, Illinois
Civil Engineer

- Floodplain permitting, planning and design of flood control projects Northern Illinois

University of Illinois (1986 – 1987)
Champaign, Illinois
Teaching and Research Assistant

- Teaching Assistant for graduate level hydrology, hydraulics and surveying
- Research assistant for technical guidance for Agricultural Drainage Law for Illinois

Project Specific Experience

- Project Manager for the Climax Mayflower Tunnel Project. The project involves constructing a tunnel for flood bypass on a 20-sq. mile drainage area for a 210-foot high tailing dam. The dam is to be raised an additional 210-ft over 15 years.
- Project Manager for Ute Water Raw Water Supply Project. The project involves planning Ute's water system through 2045, water quality evaluation, environmental permitting, reservoir siting and preliminary engineering for the water supply components.
- Project Manager for the Ziegler Reservoir Enlargement Project. The project involved geotechnical investigation, design, environmental permitting and construction observation.
- Project Manager for the Basalt Levee Investigations. The project involved the geotechnical and hydraulic investigation evaluating the

existing levee and recommendations for designing and constructing a FEMA compliant levee.

- Project Manager for Ritschard Dam inspection and outlet void repairs, evaluation of dam crest settlement, geotechnical investigations, instrumentation and monitoring near Kremmling, Colorado.
- Project Manager for a natural gas development project near Battlement Mesa, Colorado. The project involved identifying locations for constructing pads and roads in landslide areas on both private surface and federal lands. The project also involved the design of pipeline and compression facilities.
- Principle in Charge for estimating the water consumption from Energy Development in the Colorado River system located in NW Colorado.
- Project Manager for developing water supply and environmental permitting for energy development in the Haynesville Shale, Eagle Ford Shale and Permian Basins.
- Project Manager for the rehabilitation of McElroy Dam, near Kremmling, Colorado. Including plans and specification, SEO permitting, CWCB loan and construction observation.
- Project Manager for the hydrogeologic and water rights evaluation of the Glenwood Springs Geothermal Aquifer. The project focused on potential impacts to the Leadville Limestone aquifer due to building foundation construction.
- Expert Witness for the Vidler Tunnel litigation involving Green Mountain replacement and Upper Blue water rights.
- Project Engineer for the environmental assessment of the potential impacts to Green Mountain from diversion from Upper Blue Reservoir.
- Project Manager for developing conceptual alternatives for a haul road onto the Roan Plateau over 4 miles and 2,000 vertical feet.
- Technical advisor to the Colorado, Yampa and Gunnison Basin Roundtables. Responsible for the development of a scope of work to evaluate the impacts to energy development on western Colorado.
- Design Engineer for Salinas River Diversion structure. Evaluate the hydraulics of a fish ladder and diversion.
- Project Manager for Palisade Cabin Reservoir Rehabilitation construction project near Palisade, Colorado.
- Project Manager for water supply, produced water non-tributary determination, floodplain management, pad siting, geohazard review for natural gas development near DeBeque, Colorado.

- Expert Witness for LEDE Reservoir condemnation near Gypsum, Colorado.
- Project Manager for the evaluation of groundwater supply for the ConocoPhillips TLQ near Meeker, Colorado.
- Design of the first United States application of fusegates. A PMF, flood frequency analysis, and incremental damage analysis was also performed for McClure Reservoir near Santa Fe, NM.
- Project Manager for the alternatives analysis for improving the downstream flood control benefits, dam break analysis, stability analysis and design, plans, specifications and cost estimate and construction of an RCC overtopping spillway for Fawell Dam, near Naperville, IL. The project also involved a flood wall design, levee design, environmental permitting, public involvement and recreational improvements such as bike paths and bridges.
- Project Engineer for the Phase 1 Dam Structure Assessment for flood control dams in Maricopa County, AZ. The project involved dam inspections and analysis for the repair of existing deficiencies in the structures associated with subsidence and desiccation cracking.
- Project Engineer for the 100-year Flood Recovery Maps for Los Alamos. The project involved estimating the 100-year flow and sediment and debris transport following the fires.
- Evaluated the hydrology, hydraulics, sediment transport and risk during construction for a 108-foot high RCC dam to provide flood control for the Los Alamos National Laboratory and the Town of White Rock in New Mexico.
- Design and sizing of a 50-m high RCC dam, spillway and stepped spillway chute including construction diversion for Toker Dam in Eritrea, Africa.
- Preliminary design and sizing of a 151-m high rockfill dam, spillway, fuseplugs and construction diversion for Tekkeze Dam in Eritrea, Africa.
- Preliminary design and cost estimate for minimizing the sediment deposition and transporting the sediment around the Strontia Springs Dam near Denver, CO.
- Project engineer for the development of a mine closeout plan for the Molycorp Mine Site near Questa, NM. Responsible for erosion stabilization of the mine rock piles and development of hydrology for the site.
- Peer review for the redesign of the Burlington Ditch canal diversion structure on the South Platte River in Denver, CO to minimize sediment deposition.

- Project Manager for the conceptual design of river diversion structure and desanding facilities for the Horseshoe Bend Hydroelectric Facility near Boise, ID.
- Project engineer for the redesign of the Chalk Bluff Diversion Dam near Reno, NV to minimize the reverse roller effect downstream of the dam.
- Project engineer for the conceptual design of a diversion dam on the Elwha River to provide water supply to the town of Port Angeles and provide fish passage as well as sediment management.
- Peer review for the sedimentation and flood analysis for Roxbourgh Dam, Alexandra, New Zealand.
- Project manager for the alternatives analysis for minimizing high groundwater in the Cress Creek Subdivision, Naperville, IL.
- Project manager for the Dry Creek Flood Control Project, Larimer County, CO. The project involves the design of river and canal diversion structures, flood control dams and fuseplugs.
- Project manager for the West Vine Drainageway Master Plan, Ft. Collins, CO. The project involved the conceptual design of five detention structures, three irrigation structure crossings and on open channel all within an urban area.
- Final spillway sizing and estimate of the PMF for the Brush Hollow Dam Rehabilitation near Penrose, CO.
- Alternatives analysis for a high hazard dry basin flood control dam upstream from Madison, SD. The analysis included sizing the dam to store the 100-year event while releasing the maximum bypass flow through the City and designing an RCC overtopping section for the dam for flows greater than the 100-year event.
- Development of a calibrated HEC-1 and HEC 2 model for the Imperial River watershed, near Bonita Spring, FL. The models were used to analyze alternatives to reduce the flood damages associated with frequent flooding and to submit for a FEMA flood map revision.
- Project Manager for the development of a calibrated unsteady flow model of the West Branch of the DuPage River. The watershed is approximately 130 square miles and has a main channel length of 32 miles and is located in the western portion of DuPage County, IL.
- Project Manager for the development of two dambreak models and inundation mapping for San Luis and New Melones Dams in the San Jaoquin Valley, CA for the USBR. New Melones is a 625-foot rockfill and New Melones is a 300-foot high earthfill dam. Developed inundation mapping for approximately 60-miles downstream.
- Drop inlet replacement design, specifications, bidding assistance and construction observation for Vouga Reservoir, near Doyleville CO,

including preliminary design of an RCC spillway for passing the inflow design flood.

- Design of a conveyance system and an HDPE pressure pipe to carry slurry tailings near Tacna, Peru.
- Labyrinth spillway, spillway chute and energy dissipater design for Twin Lakes Dam including estimating the PMF and lower frequency events for the upstream watershed, near Sheridan, WY.
- Alternative dam spillway design to provide downstream flood control benefits while not impacting an upstream national forest preserve near Elk Grove, IL. The analysis included 36 years of continuous hydrology and unsteady flow hydraulic routing of a 117-square-mile watershed and developing an event-by-event economic damage model to estimate the benefits from the project.
- Conducted a preliminary engineering analysis for alternative reservoir configuration for a 1,775-acre-foot pump-evacuated flood control reservoir near Wood Dale, IL. As the project engineer, he coordinated the environmental permitting, funding, and design.
- Project engineer for a 8,700-acre-foot flood control reservoir in an open pit quarry near Elmhurst, IL. The preliminary analysis included evaluation of flood control benefits and underground mine stability, hazardous waste assessment, environmental permitting, and preliminary funding in a 14-week period.
- Watershed planning for the Ginger Creek and Westwood Creek watersheds in DuPage County, IL. The two watersheds were located in urban/urbanizing areas and the analysis included computer model development, flood damage analysis, and flood control optimization.
- Conducted a dam break analysis using HEC-1 for McKinney Lake Dam in North Carolina for the U.S. Fish and Wildlife Service. The analysis included a downstream incremental damage analysis.
- Conducted alternative spillway design evaluations, PMF analysis and a dam break analysis using the DAMBRK model for the Meacham Grove Flood Control Reservoir near Bloomingdale, IL. Final design plans and specifications were developed for a side channel labyrinth spillway and baffle block energy dissipater.
- Construction observation for the Chambers Lake Dam Rehabilitation project near Cameron Pass, CO.
- Floodplain analysis using HEC-1 and HEC-2, and construction plans for the remediation of floodplain soils in Gill Creek in Niagara Falls, NY.
- Dam break and hydrologic/hydraulic analysis for the PMF for the Fish Creek Dam Enlargement near Steamboat Springs, CO.

- HEC-1, HEC-2, HEC-6 sediment sampling, and sediment transport analysis for contaminated soils for a CERCLA site for Fields Brook near Ashtabula, OH.
- Project manager for the development of a SWMM model for the design and flushing of the Dearborn CSO Tunnel located in Dearborn, MI.
- Dam inspection, developed PMF inflow design floods, HEC-1, hydraulic analysis, dambreak analysis, incremental damage analysis and preliminary design for Lake Vesuvius and Kenton Lake Dam Rehabilitation project in Southern Ohio.
- Sediment transport analysis for CERCLA Site at California Gulch near Leadville, CO.
- Hazard mapping of high-risk flood, debris, and mud slide areas resulting from the Southern California fires in 1993.
- Preliminary design of run-on, diversion channels, and toe collection system for a tailing dam expansion near Salt Lake City, UT.
- Stormwater plan and stormwater design, including erosion analysis, conveyance, detention design and analysis, for the Pelham Bay Landfill in the Bronx, NY.
- Diversion channel design for final closure of a tailing dam near Pecos, NM.
- Detention pond design and erosion analysis for a landfill near Glenwillow, OH.
- Preliminary engineering for alternative spillway design for Pardee Dam near Valley Springs, CA.
- PMF analysis for run-on and diversion channel design for a tailings dam near Leadville, CO.
- Workplan development for a CERCLA site involving 2-dimensional hydraulic and sediment transport modeling on a tidally influenced river in New Jersey.

Expert Testimony and/or Depositions

05-03CW323 – Rosemary Circle Water Rights Application
05-08CW77 – Upper Eagle Water and Sanitation District

Professional Societies/Affiliates

ASCE, D.WRE, Colorado River Water Users Association, West Slope Director ACEC

Awards

Manager of the Year, 2005, Colorado Division of Water Resources
Young Engineer of the Year, Woodward-Clyde Consultants, 1995

Publications

Publication List available upon request.

Chronology

2006 – Present: URS Corporation, Principal Water Resources Engineer

2001 – 2006: State of Colorado, Division of Water Resources, Assistant Division Engineer

1991-2001: URS, Senior Project Engineer/Project Manager

1989 – 1991: DuPage County, Department of Environmental Concerns, Project Engineer

1987 – 1989: Illinois Department of Transportation, Division of Water Resources, Civil Engineer

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EDMUND D. ANDREWS

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Boulder, Colorado 80302

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EDUCATION, UNIVERSITY, AND DEGREES:

University of California, Berkeley, Ph.D. 1977
Geology
Stanford University, M.S. 1972
Geophysics
Stanford University, B.S. 1970
Geophysics

PROFESSIONAL EXPERIENCE:

October 2009-Current. Principal, Tenaya Water Resources, LLC. Conducting investigations on hydrology and river mechanics, especially river channel changes in response to variations in flow and sediment supply due climate change, land use, and water resources development that have altered aquatic and riparian ecosystems.

October 2009-2013. Research Professor and Fellow, Institute for Arctic and Alpine Research, University of Colorado. Conducting research on the hydrology and climate of polar and alpine regions.

November 1980-July 2009. Chief, River Mechanics Project, National Research Program, USGS, WRD. Conducting research on river mechanics, especially river channel change in response to variations in flow and sediment supply due to climate change, land use, and water resources development.

January 1986-December 1990 and January 1997–January 2002 Research Advisor, Geomorphology and Sediment Group, Responsible for staffing, budget, and scientific excellence for a group of approximately 35 research scientists.

July 1976-November 1980. Project Chief, Colorado District Office, USGS, WRD. Conducted research on sedimentation and reclamation of stream channels in surface mined areas.

March 1975-July 1976. Western Region Staff, USGS, WRD. Conducted research on channel scour and fill, and hydraulic adjustment of a channel to an altered sediment load.

SPECIAL ASSIGNMENTS AND RESPONSIBILITIES:

International Poplar River Water-Quality Board, International Joint Commission, 1978-1980.

Fellow, Institute for Arctic and Alpine Research, University of Colorado, 2009-Current.

Investigator, Joint Japan-United States Project on River Meanders, National Science Foundation, 1985-88.

U.S. Geological Survey Representative, National Academy of Sciences Review Panel for Glen Canyon Environmental Studies, 1985-88.

Expert Witness for the U.S. Government in application for federal reserved water rights for: the four National Forests of Colorado, 1989-91; Zion National Park, 1992-1996, Idaho Wild and Scenic Rivers, 1998-2006.

Expert Witness for the U.S. Government concerning river channel management and regulation under the Clean Water Act (1972), 2011-Current.

Expert Witness for The Republic of India before the Court of Arbitration concerning the operation of a hydroelectric power project located on an Indus River tributrary in the western Himalaya, 2013-Current.

Principal Investigator, Experimental Colorado River Flood through Grand Canyon National Park, 1994-1998.

Science Advisory Committee, U.S. Geological Survey, 1995-1998.

Scientific Advisor, Trinity River Restoration Program, U.S. Bureau of Reclamation, 2003-2008.

PROFESSIONAL SOCIETIES:

Geological Society of America
American Geophysical Union
American Alpine Club

AWARDS AND HONORS:

Certificate of Commendation, Dept. of Justice
Certificate of Merit, U.S. Forest Service
Meritorious Service Award, Department of the Interior

EDMUND D. ANDREWS

BIBLIOGRAPHY

Andrews, Edmund D., 1973, Review of hydrologic impacts of oil shale mining and processing, in A Scientific and Policy Review of the Prototype Oil Shale Leasing Program: Washington, D.C., Final Environmental Impact Statement of the U.S. Department of the Interior; Fletcher, K. and Baldwin, M. F. (eds.), Institute of Ecology.

---------- 1977, Hydraulic adjustment of an alluvial stream channel to the supply of sediment: unpublished Ph.D. Dissertation, University of California, Berkeley, 152 p.

---------- 1978, Present and potential sediment yields in the Yampa River basin, Colorado and Wyoming: U.S. Geological Survey Water-Resources Investigations 78-105, 33 p.

---------- 1979a, Scour and fill in an alluvial stream channel: U.S. Geological Survey Professional Paper 1117, 49 p.

---------- 1979b, Hydraulic adjustment of the East Fork River to the supply of sediment, in Adjustments of the Fluvial System, Rhodes, D. D. and Williams, G. P. (eds.): Proceedings, Tenth Annual Geomorphology Symposium, Binghamton, N.Y., p. 69-94.

---------- 1979c, Effects of reduced streamflows on the hydraulic and geomorphic characteristics of channels in the Poplar River Basin, Montana, in Final Report of the Biological Resources Committee-Environmental Impact Assessment and Recommendations: International Poplar River Water-Quality Board, United States - Canada International Joint Commission, p. 93-110.

---------- 1980, Effective and bankfull discharges of streams in the Yampa River basin, Colorado and Wyoming: Journal of Hydrology, v. 46, p. 311-330.

Andrews, E. D., and Steele, T. D., 1980, A preliminary assessment of water-quality effects of emerging energy technologies on selected impact areas of the Upper Colorado River Basin: U.S. Water Resources Council, 116 p.

Andrews, Edmund D., 1981a, Measurement and computation of bed material discharge in a shallow sandbed stream, Muddy Creek, Wyoming: Water Resources Research, v. 17(1), p. 131-141.

---------- 1981b, Assessment of stream channel response to altered streamflow and sediment load, in Proceedings Workshop on Downstream river channel changes resulting from diversions or reservoir construction; Simons, D. B., Li, R. M., Lagasse, P., and Milhous, R. T. (eds.): U.S. Fish and Wildlife Service, Washington, D.C., p. 102-108.

---------- 1982a, Bank stability and channel width adjustment, East Fork River, Wyoming: Water Resources Research, v. 18(4), p. 1184-1192.

---------- 1982b, Adjustment of the East Fork River to bedload sediment contributed by Muddy Creek: Field Guide, First Annual Meeting, Pinedale, Wyoming, American Geomorphological Field Group, p. 57-68.

---------- 1983a, Entrainment of gravel from naturally sorted riverbed material: Bulletin, Geological Society of America, v. 94, p. 1225-1231.

---------- 1983b, Denudation of the Piceance Creek Basin, Colorado: Proceedings of the Hamburg Symposium, August 1983, on Dissolved Loads of Rivers and Surface Water Quantity/Quality Relationships, IAHS Publication no. 141, p. 205-215.

---------- 1984, Bed-material entrainment and hydraulic geometry of gravel-bed rivers in Colorado: Bulletin, Geological Society of America, v. 95, p. 371-378.

Parker, Gary, and Andrews, E. D., 1985, Sorting of bedload sediment by flow in meander bends: Water Resources Research, v. 21(9), p. 1361-1373.

Andrews, Edmund D., 1986, Downstream effects of Flaming Gorge Reservoir on the Green River, Colorado and Utah: Bulletin, Geological Society of America, v. 97, p. 1012-1023.

Andrews, E. D., and Erman, D. C., 1986, Persistence in the size distribution of surficial bed-material during an extreme snowmelt flood: Water Resources Research, v. 22(2), p. 191-197.

Parker, Gary, and Andrews, E. D., 1986, Time Development of Meander: Journal of Fluid Mechanics, v. 162, p. 139-156.

Andrews, E. D., and Parker, Gary, 1987, Formation of a coarse surface layer as the response to gravel mobility, in Gravel-Bed Rivers; Hey, R. D., Bathurst, J. C., and Thorne, C. R. (eds.), John Wiley and Sons, New York, p. 269-300.

Andrews, E. D., 1987, Longitudinal dispersion of trace metals in the Clark Fork River, Montana, in Chemical Quality of Water and the Hydrologic Cycle; Averett, R. C., and McKnight, D. M. (eds.), Lewis Publishers, Ann Arbor, Michigan, p. 179-191.

Andrews, E. D., and Webb, B. W., 1987, Emerging issues in surface water quality research, in Hydrology 2000; Kundzewicz, Z. W., Gottschalk, L., and Webb, B. (eds.): Wallingford, U.K., International Association of Hydrological Sciences, Publication no. 171, p. 27-33.

Erman, D. C., Andrews, E. D., and Yoder-Williams, M., 1988, Effects of winter floods on fish in the Sierra Nevada, California: Canadian Journal of Fisheries and Aquatic Sciences, v. 45(12), p. 2195-2200.

McKnight, D. M., Aiken, G. R., Andrews, E. D., Bowles, E. C., Smith, R. L., Duff, J. M. and Miller, L. G., 1988, Dissolved organic material in desert lakes in the dry valleys: U.S. Antarctic Journal, v. 23, p. 152-153.

Andrews, E. D., and Nelson, J. M., 1989, Topographic response of a bar in the Green River, Utah to variation in discharge, in Ikeda, Syunsuke and Parker, Gary (eds.): American Geophysical Union, Water Resources Monograph, v. 12, p. 463-485.

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Andrews, E. D., 1991, Sediment transport in the Colorado River basin, in Colorado River Ecology and Dam Management; Marzolf, G. R. (ed.): National Academy Press, Washington, D.C., p. 54-74.

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McKnight, D. M., Aiken, G. R., Andrews, E. D., Bowles, C. and Harnish, R. A., 1993, Dissolved organic material in Dry Valley lakes: A comparison of Lake Fryxell, Lake Hoare, and Lake Vanda, in Physical and Biogeochemical Processes in Antarctic Lakes; Green, William (ed.): American Geophysical Union, Monograph Series, Washington, D.C., v. 59, p. 119-133.

McKnight, D. M., and Andrews, E. D., 1993, Hydrologic and geochemical processes at the stream-lake interface in a permanently ice-covered lake in the McMurdo Dry Valleys, Antarctica: Verh. Internat. Verein. Limnol., v. 25, p. 957-959.

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McKnight, D. M., Andrews, E. D., Spaulding, S. A., and Aiken, G. R., 1994, Aquatic fulvic acids in algal-rich antarctic ponds: Limnology and Oceanography, v. 39(8), p. 1972-1979.

Andrews, E. D., and Nankervis, J. M., 1995, Effective discharge and the design of channel maintenance flows for gravel-bed rivers, in Natural and Anthropogenic Influences in Fluvial Geomorphology; Costa, John (ed.): American Geophysical Union, Monograph 89, p. 151-164.

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Alger, A. S., McKnight, D.M. Spaulding, S.A., Tate, C.M., Shupe, G.H., Welch, K.A., Edwards, R., Andrews, E.D., and House, H.R., 1996, Ecological processes in a cold desert ecosystem: the abundance and species distribution of algal mats in glacial meltwater streams in Taylor Valley, Antarctica: Institute of Arctic and Alpine Research Occasional Paper No. 51.

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Andrews, E.D., and Pizzi, L.A., 2000, Origin of the Colorado River experimental flood in Grand Canyon: Hydrological Sciences, v. 45, p. 607-627.

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Freidman, J. M., Auble, G. T., Andrews, E. D., Kittel, G. Madole, R. F., Griffin, E. R., and Allred, T. M., 2006, Transverse and longitudinal variation in woody riparian vegetation along a montane river, Western North American Naturalist, V. 66(1), p. 78-91.

Andrews, E. D. and Vincent, K.R., 2007, Sand deposition in shoreline eddies along five Wild and Scenic Rivers, Idaho, River Research and Applications, V. 23, p. 7-20.

McKnight, D. M., Tate, C. M., Andrews, E. D., Niyogi, D. K., Cozzetto, K., Welch, K. Lyons, W. B. and Capone, D. G., 2007, Reactivation of a cryptobiotic stream ecosystem in the McMurdo Dry Valleys, Antarctica: a long-term geomorphologial experiment, Geomorphology, V. 89, p.186-204.

Vincent, K.R., and Andrews, E.D., 2007, Depositional settings of sand beaches along whitewater rivers, River Research and Applications, V. 24, p 771-788.

Gaeuman, D., Andrews, E.D., Krause, A. and Smith, W., 2009, Predicting fractional bed load transport rates: Application of the Wilcock-Crowe equations to a regulated gravel bed river. Water Resources Research, V. 45, W06409, doi:10.1029/2008WR007320.

Andrews, E.D., 2012. Hydrology of the Sierra Nevada Network National Parks: Status and Trends. Natural Resource Report NPS/SIEN/NRR-2012/500., National Service Park, Fort Collins, Colorado.

http://science.nature.nps.gov/im/units/sien/monitoring/Reports/SierraNevadaHydrology_Andrews_20120330.pdf

Andrews, E.D. and Antweiler, R.C., 2012. Sediment Fluxes from California Coastal Rivers: The influences of climate, geology and topography. Journal of Geology. V. 120, p349-366, doi:1086/665733.

Andrews, E.D., 2013, Evaluation of alternative streamflows to improve aquatic and riparian habitat using an analysis of sediment transport in the Walker River Basin, NV. Draft report submitted to the US Fish and Wildlife Service, In Review, 125p.

Frank Lan, Ph.D., P.E.

Principal Water Resources Engineer

Areas of Expertise

Surface and groundwater hydrology
Surface and groundwater hydraulics
Computer modeling
Flood hazard mapping & mitigation
River engineering & sedimentation
Fate and transport
Statistical analysis

Years of Experience

With URS: 20 Years
With Other Firms: 2 Years

Education

PhD/Civil Engineering/ 1990/Colorado State University
MS/Civil Engineering/1986/Colorado State University
BS/Water Resources/1983/Wuhan University, Wuhan, China

Registration/Certification

Professional Engineer: Colorado
Certified Floodplain Manager

Professional Societies/Affiliates

American Society of Civil Engineers (ASCE), 1998 to date.
Colorado Association of State Floodplain Managers, 2000 to date.
Association of State Floodplain Managers, 2000 - 2011.

Overview

Dr. Lan is a principal water resources engineer with more than 20 years of successful experience in the application of surface water and groundwater hydraulic/hydrologic analysis and modeling to the planning and design in various water resources projects for international and domestic clients. His expertise includes multi-dimensional surface and groundwater flow and solute transport modeling and analysis, hydrologic modeling/analysis, sediment transport and river engineering, hydraulic structure design, dam break analysis, floodplain delineation, mitigation, and management, storm water planning and modeling, urban drainage design, alluvial geomorphology, water management modeling, and statistical analysis. Dr. Lan is best known for his extensive experience in applying numerical models to various water resources application. He is an expert in applying three-dimensional CFD models to solve hydraulic problems in dam and spillways and has clients from the states (USBR, USFWS, NRCS, local governments, etc.) and other countries (Australia, Spain, Argentina, Canada). He is also experienced with numerous other surface and subsurface flow and sediment transport models, such as FLOW-3D, FLO-2D, HEC models (HEC-1, 2, 5, 6, RAS, HMS, ResSim), FEQ, DAMBRK, FLDWAVE, GoldSim, TAB2, RMA2, FESWM, SED2D, RMS, SWMM, SedCAD, HSPF, MOUSE, MIKE-11, MODFLOW, MODPATH, PATH3D, MT3D, MOC.

Project Specific Experience

Pine Gulch Dam Outfall System Plan, Parker, Colorado. Client – UDFCD, Town of Parker and Douglas County. Project manager to lead the development of an outfall system plan for the Pine Gulch watershed which is impacted by the presence of the Pine Gulch Dam. The planning considered alternatives with and without the dam. Watershed hydrology was evaluated by both the HEC-HMS and EPA-SWMM models. Geotechnical investigation was conducted to evaluate the integrity of the dam for hazard classification purpose. A spillway hydraulics and dam breach analysis, based on HEC-RAS and FLO-2D was conducted to evaluate the adequacy of the spillway and critical inflow design flood.

Ruby Dam Rehabilitation, Montana. Client – Montana Department of Natural Resource Commission, Montana. Lead hydraulic engineer to develop a three-dimensional CFD model based on **FLOW-3D** to evaluate the performance of the proposed replacement spillway and outlet works so the design criteria could be met. Also lead engineer to develop a hydrologic model based on Goldsim™ to estimate the probability that the cofferdam might be overtopped during the spillway repair so the optimum cofferdam height and starting reservoir water level could be selected to avoid overtopping of the cofferdam.

Dartmouth Dam and Spillway Upgrade, Victoria, Australia. Lead hydraulic engineer to develop 3-dimensional CFD models (FLOW-3D), in combination with a physical model study, to evaluate and optimize the performance of the Labyrinth and Piano-Key replacement spillway with high H/P ratio to enhance the spillway capacity to meet the new dam safety criteria. The CFD models were also used to evaluate the scour potential for the stepped spillway section and the stilling basin further downstream. The project won a national award from the **American Council for Engineering Companies**.

Burrendong Dam Spillway Enhancement, Queensland, Australia. Lead hydraulic engineer to develop FLOW-3D models to evaluate the spillway hydraulics for Burrendong Dam to determine the outflow rating curves, hydraulic dynamic forces on the spillway, the piers, as well as the radial gates. FLOW-3D results were subsequently used in structural analysis to determine the appropriateness of the structure under the new hydrology.

Ashton Dam Modification, Ashton, ID. Lead hydraulic engineer to conduct various hydrologic, hydraulic and sediment transport analysis for the dam rehabilitation that consists of a diversion tunnel, modification of the embankment, and spillway. The analysis includes development of diversion tunnel outflow rating curves for various gate operations, sediment movement and control plan during diversion operations, construction plan for minimizing cofferdam overtopping, erosion protection for the cofferdam, portal erosion protection, and risk management during the construction. CFD (**FLOW-3D**) modeling was conducted for various hydraulic analysis including wave impact at the diversion exit, outflow rating curves through the spillway and over the dam, hydrodynamic loading on the structures, and others. Various statistical analysis and hydrologic modeling were conducted to prepare management plans for various phases of the construction.

Lake Roberts Dam Spillway Rehabilitation, New Mexico, USA. Lead hydraulic engineer to apply CFD for optimizing the design of the new two-stage spillway for the dam. The model was used to identify negative hydraulic conditions that could significantly reduce the efficiency of the spillway, improvement options, and overall discharge rating curve for the final design. The model was also used to evaluate the hydraulics in the stilling basin exit where the flow could post serious threat to the toe of the dam.

Memorial Park Pump Station CFD Modeling, Tauranga, New Zealand. Lead engineer to conduct a CFD for evaluate the hydraulics at a proposed 20 MGD pump station at the Memorial Park for Tauranga City Council. The CFD was used to evaluate turbulence, circulation, air entrainment and other hydraulics for several design alternatives so the optimal design could be selected.

Lyneham Wetland Sediment Mitigation Design, Victoria, Australia. Lead engineer to develop a CFD model for the Lyneham Wetland in Victoria, Australia to help evaluate mitigation options for the sediment that is being brought in from the stormwater runoff. The model was used to evaluate the flow circulations inside the wetland under various flow conditions (1-yr to 10-yr inflows) for the existing conditions and subsequently used to help identify an applicable alternative to maintain sufficient velocity to keep the incoming sediment load from depositing in the wetland.

Hinze Dam Stage 3 Enhancement, Queensland, Australia. Lead hydraulic engineer to develop 3-dimensional hydrodynamic models based on **FLOW-3D** to evaluate the hydraulic performance of the proposed fish trap/ladder and its surrounding pertinences, with the ultimate goal of optimize the design so the hydraulics would meet the design criteria for the fishes affected.

Walkers Dam Rehabilitation, Virginia, USA. Lead engineer to apply **FLOW-3D** to evaluate different fishway designs so the fishway flow characteristics for the protected fish species could be satisfied. Fishways considered include pool-type (slot) fishway and Denil fishway. The model was also used to determine the hydraulics around the dam abutments as well as at the toe of the dam so proper erosion protection could be designed.

Northfield Mountain Reservoir Sediment Study, Maryland, USA. Lead engineer to develop CFD models to analyze the sediment movement in the intake channel and subsequently into the powerhouse under various power operating conditions that could be used in developing the operation plan.

Fountain Creek Watershed Study, Colorado Springs, CO, USACE: Task Lead in the development of a hydrologic model based on HEC-HMS and HEC-GeoHMS for 10 tributaries for the Fountain Creek watershed that were calibrated gauging/USGS regression data. Conducted a sediment transport and geomorphologic analysis to determine erosion hazard zones along these streams, based on historical aerial photos, field reconnaissance, and sediment transport modeling by applying the HEC-RAS model. Also acted as a technical advisor for applying the

HEC-RAS model for preliminary floodplain delineation for the main channel as well as major tributaries for the entire watershed.

Winter Park Water Treatment Plant, Winter Park, Colorado. Lead engineer to develop CFD models to investigate the mixing in the water tank under various inlet locations at various inflow and outflow rates.

Rocky Pen Run Dam, Stafford County, Virginia. Lead hydraulic engineer to develop FLOW-3D models to help optimize the spillway design to pass the inflow design flood with minimal construction cost. The model was used to determine the height/shape of the weir, any negative hydraulic impacts from the converging chute, height of the spillway chute, and the performance of the stilling basin.

Copeton Dam and Spillway Upgrade, Australia. Lead hydraulic engineer to develop a 3-dimensional CFD model (**FLOW-3D**) to evaluate the performance of the proposed emergency spillway: 1) it has sufficient capacity to pass the design inflow flood; 2) proper erosion protection will be implemented immediately downstream of the spillway; 3) it does not threat the toe of the dam.

USFWS Dam Rehabilitation, various locations, USA. Lead hydraulic engineer to develop 3-dimensional model based on **FLOW-3D** software to evaluate the performance of the proposed spillways of various shapes for several USFWS dams in the country. Used the model to identify undesirable hydraulic conditions and the alternative to mitigate these negative hydraulic impacts.

Eureka Creek GS4 Dam Spillway Rehabilitation, Queensland, Australia. Lead hydraulic engineer to develop a 3-dimensional hydrodynamic model to evaluate the performance of spillway that is complicated by the under-the-highway entrance and downstream conditions. The results from the model were used to evaluate the scour potential and protection measures for the spillway.

Pathfinder Dam, WY: Lead hydraulic engineer to develop a 3-dimensional model (**FLOW3D**) to evaluate the performance of the emergency spillway with its hydraulics complicated by the complex entrance and exit topography, as well as the surrounding auxiliary structures. The model was subsequently used to evaluate alternatives to improve the efficiency of the spillway while increasing the capacity of the reservoir.

Chaffey Dam Spillway Enhancement, Australia. **FLOW-3D** was used to optimize the design of the emergency spillway with an irregular cross section from the entrance to the exit. Subsequently, the model was used to evaluate the erosion potential downstream of the spillway where the natural rock is much soft and the erosion could potentially impact the stability of the dam.

Cottonwood Dam, Oklahoma. Lead hydraulic engineer to conduct a 3-dimensional CFD analysis (**FLOW-3D**) to evaluate the hydraulic performance of an Ogee weir sitting on a broad-crest weir, the performance of the stepped-spillway downstream. Flow-3D model was also used to evaluate alternatives to eliminate adverse hydraulic impacts for the proposed emergency spillway.

City of Albuquerque Rio Grande Surface Water Diversion: Developed both 1D (HEC-RAS) and 2D (RMA2 + SED2D) numerical models to analyze how local flow dynamics and sediment movement would be impacted by the proposed diversion dam and intake structure at different operation alternatives. The results were used in determining the proper measures for sediment control at the intake and erosion control downstream of the diversion.

Homestake Dam Rehabilitation, Colorado Springs Utilities, CO. Lead engineer to develop a reservoir routing model based on **Goldsim** modeling platform to develop a risk-based management plan during the rehabilitation of the dam outlet works and tunnel outlet works. The model was used to determine the most favorable construction schedules based on the uncertainty of the inflow hydrology.

Upper Dublin Township, Pine Run and Rapp Run Dams, PA. Lead Hydraulic Engineer responsible for the determination of the IDF, dam breach analysis and flood hazard classification, and spillway hydraulics for these two dams. Applied HEC-HMS, HEC-RAS and two-dimensional hydrodynamic model **FLO-2D** for dam breach and flood inundation analysis for use in the preparation of an Incremental Damage Assessment (IDA) and Emergency Action Plan.

Phelps Dodge Mine, Inc.: Conducted tailing dam breach and flood inundation studies for several tailing dams at the Bagdad and Morenci PDMI mine sites. Prepared emergency action plans from these studies. Used both DAMBRK and FLO-2D for the analysis.

Confidential Client, AR: Applied two-dimensional flood routing model FLO-2D to determine flood inundation boundary downstream of a high tailing dam due to a hypothetical sudden seismic failure of the dam. Evaluated various scenarios that would produce different rheological parameters for the mud/debris flow out of the reservoir. Also evaluated soil erosion and flow management for the tailing surface reclamation activities.

Confidential Client, South America: Applied two-dimensional flood routing model FLO-2D to determine flood inundation boundary downstream of a high tailing dam due to a hypothetical sudden seismic failure of the dam. Evaluated various scenarios that would produce different rheological parameters for the mud/debris flow out of the reservoir.

New Mexico Dam Mapping Project, New Mexico. Served as technical advisor in applying 2-dimensional hydrodynamic models based on FLO-2D to evaluate the consequence of dam breach of several dams in the state of New Mexico. Dam breach inundation maps and Emergency Preparedness Plans were prepared based on the dam breach and inundation studies.

Stawell Gold Mine, Victoria, Australia. Conducted a dam breach and flood inundation analysis for the Stawell tailings dam under various flood conditions using FLO-2D model, assuming various failure modes, to determine the flood inundation limits downstream of the dam, which is highly urbanized. The results were used to develop the emergency action plan for the facility.

Riotinto Tailings Dam, Spain. Conducted a dam breach and flood inundation analysis for the Riotinto tailings dam under various flood conditions using FLO-2D and DAMBRK models to determine the flood inundation limits for a stretch of more than 30 km downstream of the dam. The results were used to develop the emergency action plan for the facility.

Four-Corner Power Plant, New Mexico. Lead engineer to utilize Flo-2D and DAMBRK for a dam breach and flood inundation study for the Four-Corner Ash Pond facilities under various flood and runout conditions at various locations. The breach flood with high viscosity was routed downstream for about 11 miles using the FLO-2D model. The results were used for the preparation of an emergency action plan for the facility.

US Fish and Wildlife, Nationwide, Dam Breach and Flood Inundation Study. Provided technical advising on conducting dam breach and flood inundation modeling using DAMBRK and FLO-2D on a number of dams operated by USFW throughout the country, such as the New Elmer Thomas Dam in Oklahoma, the Prescott Dams in Texas, etc.

Lend Lease Communities, Denver, CO: Lead engineer to prepare a Master Drainage Study for the Horizon City Center in Aurora, Colorado. Performed H&H analysis based on EPA-SWMM and UDFCD's soft wares for design of stormwater conveyances, detentions to meet the City's stormwater criteria.

Lowry Development Authority, Westerly Creek, Denver, CO: Lead engineer to prepare a Conditional Letter of Map Revision (CLOMR) to FEMA for Westerly Creek for the proposed development near the creek at this site. Also lead engineer to conduct a groundwater flow model to evaluate the impact of the proposed detention facility/creek to the existing groundwater at the site, particularly to the existing remediation effort for the site.

Phelps Dodge Tyrone Mine, Inc.: Lead hydrologist to conduct a site-wide study to collect high water marks so site-specific hydrologic information could be estimated and be used in a hydrologic model calibration. The calibrated model was proposed for future hydrologic analysis for the mine site. Also led a site-specific geomorphologic study to assess the channel geomorphologic changes for the Redrock Diversion Channel in the last few decades and how that would affect the stability of the channel in the future. Uses the results as a reference for designing grade-control check structures for the channel. A 3-dimensional hydrodynamic model based on **FLOW-3D** was developed to evaluate the hydraulics near the dam crest to make sure that proper stability control measures were implemented.

Buckhorn Mountain Mine EIS, Chesaw, WA: Lead engineer in performing a hydrologic analysis to determine stream baseflow for the site that is strongly influenced by the recharges from snow melting in the spring. The analysis also includes the determination of long-term drought conditions at the site, all to assist the future water management at the mining site.

DuPage County DEC, IL, Fawell Dam Rehabilitation: Technical Lead for a thorough hydrologic/hydraulic evaluation for Fawell Dam, West Branch DuPage River, Illinois. Tasks include assessment of dam safety and evaluation of alternatives to bring the dam to current dam safety standards, hydrologic/hydraulic analysis to evaluate

the effectiveness of the dam & its spillway for flood control purposes, and hydraulic evaluation of spillway operation to maximize the benefit of the structure.

FEMA 2003 California Post-Fire Flood Mapping, CA: Technical lead in developing GIS-based hydrologic and hydraulic models (HEC-HMS and HEC-RAS) for developing the post-fire floodplain mapping for two streams at the Paradise Burn area. All the analysis was completed over a weekend and the results were quickly submitted for development of the digital flood maps.

Urban Drainage and Flood Control District, CO, Cherry Creek Corridor Master Drainage Plan: Technical lead in the development of a basin-wide hydrologic model (based on UDSWM) and a hydraulic model (HEC-RAS based on GEO-RAS) for the main corridor to be used in the development of the Master Drainage Plan for the main corridor. Prepared the FHAD that was served as the new regulatory floodplain mapping for the corridor.

City of Fort Collins, CO, Lower Dry Creek Hydrologic Study: Acted as technical advisor and peer reviewer for developing a hydrologic model (MODSWMM) and a hydraulic model (HEC-RAS) for the lower Dry Creek watershed to develop new floodplain mapping (CLOMR Submittal) and to evaluate flood mitigation alternatives.

City of Fort Collins, West Vine Watershed Master Drainage Plan, Ft. Collins, CO: Project lead modeler. Developed both hydrologic (SWMM) and hydraulic models (HEC-RAS) for the watershed that has a very complicated flow network. Applied the models for flood mitigation alternative analyses, including on-site storage facilities, channel improvements, and additional conveyances.

DuPage County DEC, Cross Street Drainage Plan, IL: Developed a hydrologic model (XP-SWMM) to simulate the 2-year to 100-year frequency storms under existing and proposed conditions to evaluate the effectiveness of several alternatives to minimize the flooding problem in the area.

Village of Cahokia, Flood Mitigation Analysis for Dead River, MO: Used hydrologic and FEQ hydraulic model to evaluate the hydraulics in Dead Creek and perform alternative analysis to mitigate the overbank flooding problem within the city.

DuPage County DEC, IL, Ferry Creek Watershed Improvement, DuPage, IL: Lead engineer. Conducted thorough hydrologic and hydraulic analysis using HSPF and FEQ to establish watershed flood mitigation alternatives for the Ferry Creek Watershed in Du Page County, IL.

DuPage County DEC, IL, Flood Plain Mapping with Unsteady River Hydraulic Modeling, DuPage, IL: Lead modeler. Developed a one-dimensional (quasi-2D) unsteady river hydraulic model (FEQ) to simulate the flood hydraulics of the West Branch Du Page River near Chicago, Illinois. Long-term (54 year) continuous simulations were conducted along with statistical analysis to establish a platform to assist the flood plain mapping and surface water management for the Du Page County.

U.S. Air Force, Colorado Springs, Kettle Creek Basin Sediment Study: Led in sediment transport analysis task to evaluate the sediment yield from the Kettle Creek watershed by using USDA's WEPP model and other geomorphologic investigations. Proposed and evaluated alternatives to alleviate problems at the USAF facilities near the creek that is caused by excessive sediment from the upper watershed.

U.S. Bureau of Reclamation, WA, Elwha River Reclamation Project: Performed hydraulic analysis to assess the impact of removing several dams along the Elwha River, including flood inundation, sediment degradation/aggradation, and water quality.

City of Naperville, IL, West Branch DuPage River Tail Project: Applied both an unsteady-flow and a steady-flow models to evaluate the impact of a proposed pedestrian trail along the West Branch DuPage River. Also used the models to evaluate several alternatives to mitigate the impacts.

Colorado Springs Utilities (CSU), Dam Breach and Flood Inundation Study, CO: Developed unsteady-flow model (DAMBRK) to simulate the hypothetical sudden failure and subsequent downstream flooding of the Montgomery Dam, the Upper Blue Dam, and the Highline Dam. Developed inundation mapping for updating of the emergency action plan for the dams.

Loveland Water District, Loveland, CO: Performed dam breach and flood inundation analysis using DAMBRK for inundation mappings for Green Ridge Glade Dam and Reservoir located near Loveland, Colorado. Inundation mapping was prepared for a reach of approximately 22 miles downstream of the dam.

City of Newark, DE: Design the emergency spillway and performed dam breach and inundation analysis for the new proposed reservoir. Breach and flood routing from three possible locations were evaluated to provide inundation mapping for all possibly impacted areas downstream of the reservoir. More than 10 bridges were simulated in the modeling.

US Bureau of Reclamation, CA, Dam Breach Flood Inundation Study: Applied state-of-the-art unsteady-state flow models (DAMBRK, FEQ, etc.) to simulate flood inundation from dam breach for numerous dam sites in the U.S., including two of the tallest dam in the United States, New Melones Dam and San Luis Dam (both in California). These inundation studies include dam breach simulation, flood routing downstream of dam, and floodplain mapping. A computer model based on sediment transport mechanism was also developed to simulate the embankment overtopping failures.

Greybull Valley Irrigation District, WY: A sunny-day and a PMF failure were performed as part of the dam hazard classification for the newly constructed Greybull Valley Dam located near Greybull, Wyoming. National Weather Service's DAMBRK program was used to simulate the dam breach and breach flood routing downstream along the Greybull River and Bighorn River. Inundation mapping was prepared for a river reach of approximately 80 miles from the dam site to Bighorn Canyon National Recreation Area.

USACE, Los Alamos Dam Breach and Flood Inundation Study: Performed several dam breach and flood inundation studies for the post-fire Los Alamos Flood Detention Project at Los Alamos, New Mexico. The purpose of the study was to determine the impact of a sudden failure of several dams and embankments upstream of Los Alamos to the Los Alamos National Laboratory due to the changes in post-fire hydrology. The National Weather Services' latest dam breach model, FLDWAV, was used for all scenarios.

DuPage County DEC, IL, Fawell Dam Dam Breach and Inundation Study: Performed a dam breach and flood inundation analysis as part of the rehabilitation project for Fawell Dam, West Branch DuPage River, Illinois. The dam is a 20-foot high earth dam. The study includes a sunny-day failure and a failure under the inflow design hydrograph (PMF). Unsteady-flow models DAMBRK and FEQ were used to handle the complicated flood routing downstream of the dam through a very populated area that include more than 10 bridges.

Confidential Client, Stillwater Pond, Monument, CO: Performed a dam breach and flood inundation analysis for the newly constructed recreation reservoir for a residential developer to meet the State Dam Safety regulations. An Incremental Damage Analysis (IDA) was also conducted to reconfirm the classification of the reservoir.

Sierra Pacific Power, Stepped Spillway Design, Reno, NV: Lead design engineer. Designed a stepped chute on the Truckee River at Reno, Nevada for the Sierra Pacific Power. Also wrote a technical report on RCC stepped spillway hydraulics and design for the State Engineer's office, Colorado.

City of Portland, OR, Numerical Groundwater Flow Modeling. Tested, evaluated, and applied a 3D groundwater flow model previously developed by SSP&A (DEQ model) and later modified by Landau & Associates (LAI Model) to evaluate the movement of existing contaminants in the aquifers near the City of Portland's South Shore well field under different proposed pumping scenarios. The model results were used to assist decision making for water supply for the City of Portland, and also were used to evaluate alternatives for future contaminant plume control.

U.S. ARS and University of Mississippi, Watershed Modeling, MS: Tested and modified a watershed hydrologic model (WEPP) which includes simulation of climate, infiltration, percolation, evapotranspiration, plant growth, runoff, soil erosion, and pollutant transport. The project was sponsored by the USDA Agricultural Research Service to select optimal watershed management. Several watershed solute transport models, such as HSPF, CREAMS, ANSWER, and KINEROS were used.

Colorado State University, 3-D Surface Flow Modeling, Ft. Collins, CO: Developed a quasi-3D numerical model to simulate river flow, bank erosion, and migration of meandering alluvial channels. Designed and conducted experiments on meandering channel migration.

Christian Romeyn, PE

Water Resources/River Engineer

Areas of Expertise

Hydraulic Modeling

Floodplain Management

Water Rights

Hydraulics

Hydrology

Years of Experience

With URS: < 1 Year
With Other Firms: 11 Years

Education

MS/Civil Engineering/ 2004/University of Colorado, Boulder, CO

BS/Civil Engineering/ 2004/University of Colorado, Boulder, CO

BS/Environmental Studies/ 1993/University of Vermont, Burlington VT

Registration/Certification

Professional Engineer: (#43882), Colorado

ASFPM Certified Floodplain Manager (#31221)

Overview

Mr. Romeyn specializes in stream restoration and alterations, hydraulic and floodplain modeling, hydrologic analysis and modeling and sediment transport analysis. He has extensive experience in geomorphic evaluation, water rights, water resources and civil engineering design. He also has experience with well, ISDS design and land development.

Project Specific Experience

Water Rights Analysis, Colorado Water Trust, CO: Lead water resource engineering for the assessment of two water rights proposed for the Colorado Water Trust's Request for Water 2012, temporary lease program. Performed detailed Historic Consumptive Use analysis using the Colorado Water Conservation Board (CWCB)/Department of Water Resources (DWR) Colorado Decision Support System (CDSS) State CU consumptive use model and a delayed depletion analysis using The Analytical Steam Depletion method (Schroeder, 1987) as applied in the Integrated Decision Support (IDS) group's Alluvial Water Accounting System (AWAS).

2011 Flood Damage Assessment, Riverdale City, UT: Lead engineer for detailed assessment of flood damage incurred during 2011 spring runoff on the Weber River. Performed all field work and developed GIS database of damaged sites. Developed preliminary designs and cost estimates for repairs and mitigation. Performed geomorphic assessment of the Weber River and developed concept plan for comprehensive flood mitigation for three mile reach through City. Developed recommendations for recreational and environmental enhancements. Assisted with FEMA post disaster documentation.

Ogden River Restoration Construction Observation, Ogden City, UT: Lead construction observation engineer in charge of construction oversight for a $7 Million urban river restoration project. The project includes numerous bridge crossings, a bike path, a whitewater feature, and numerous stormwater wetland treatment basins. Engineering design plans required significant field interpretation necessitating fluid communication and collaboration with the contractor.

Hunter Creek Stream Restoration Design, Old Snowmass, CO: Engineer in charge and principal designer for a stream restoration project on Hunter Creek in Old Snowmass, CO to address significant stream degradation caused by historic agricultural land use practices. Performed all aspects of design including developing alternative site plans for client approval, developed stream hydrology, performed hydraulic and sediment transport modeling, drafted final plans and specifications, prepared all necessary documentation for the Pitkin County Land Use Process and USACE 404 permit.

River Mechanics Research, USGS National Research Program, Boulder, CO: Worked under the supervision of Edmund D. Andrews, Ph.D. performing fluvial geomorphology research focusing on river mechanics and sediment transport; extensive data collection and analysis of flow phenomena; and computer modeling of fluid flow.

Collaborated with John Buffington, Ph.D. and E.D. Andrews, Ph.D. to develop a technique for measuring and a model for calculating cross-stream shear stress distribution in gravel and cobble channels.

Water Supply Plan, Sunlight Mountain Development, CO: Developed a reliable water supply plan and performed all water rights engineering in support of Sunlight's application for a plan for augmentation in Colorado Water Court. Performed yield analysis of Four Mile Creek; developed water supply alternatives that included estimates of demand and depletions for residential, commercial, irrigation, and snowmaking uses; performed delayed depletion and delayed return flow analysis; analyzed impact of snowmaking activity on Four Mile Creek watershed hydrology using the Water Resources Evaluation Of Non-Point Silviculture Sources (WRENSS) methodology; supported stipulation negotiations with twelve objectors; provided expert witness testimony in District Court, Water Division 5 (Case No. 07CW0058).

Water Rights Engineering, Change of Use Case, MTW Ranch, Meeker, CO: Performed all engineering in support of ongoing water rights change of use case in District Court, Water Division 5. Performed historic consumptive use analysis and delayed depletion/return flow analysis to quantify in excess of 165 AF of historic consumptive use available for Industrial Use. Supported stipulation negotiations with multiple objectors including Puckett Land Company and Exxon (Case No. 04CW052).

4-MGD Municipal Raw Water Intake, Town of Rangely, CO: Led permitting and design efforts for improvements to a 4-MGD WTP intake on the White River (critical habitat for Federally Listed Colorado pikeminnow); designed improvements to existing water intake structure which improved hydraulic performance, eliminated safety and maintenance issues, and provided exclusion protection for the endangered fish; developed a preliminary design for a center of the river Coanda type intake which will enable diversion during extreme drought while providing fish and boat passage. Applied for and received largest grant ever awarded by the Colorado River Water Conservation District (CRWCD) Grant Program.

Dam Hazard Analysis and Spillway Hydrology, Mt. Crested Butte Water and San. Dist., CO: Performed a dam break analysis to develop the Dam Hazard Classification for Meridian Lake Park #1 Dam. Developed a full unsteady HEC-RAS model of over seven miles of river in the Crested Butte valley using HEC-GeoRAS. Responsible for development of the spillway hydrology using HEC-GeoHMS/HMS to model an eight square mile basin. All calculations and reports were prepared using the Colorado State Engineer's new guidelines for dam hazard classification and hydrologic basin response.

Drainage Design, Snowmass Village Entryway and Rodeo Place Homes, Snowmass Village, CO: Performed all drainage analysis, engineering and design for the Snowmass Village Entryway Project and the Rodeo Place affordable housing (11 single family residences and four duplex units). The Entryway Project involved redevelopment of nearly 37 acres with construction of a new transit center, a new parking lot, bike path underpass, a recreation center, playground's, and a soccer field.

Aspen Music School Castle Creek Campus Redevelopment, Aspen Music Festival and School, Aspen, CO: Worked with interdisciplinary team to develop a debris flow mitigation design for Keno Gulch. Performed hydrologic and hydraulic analysis of Castle Creek for floodplain and bridge design. Tasks included developing a detailed HEC-HMS model of Keno Gulch and Aspen Mountain; a detailed HEC-RAS model of Castle Creek; and performing Bridge Hydraulics and Scour Analysis used in the design of two proposed bridges.

Master Drainage Plan, Mack, CO: Developed a Master Drainage Plan for the Mesa County Lower Valley Public Improvement District. Performed all engineering analysis. Identified long-term capital improvements and rehabilitation measures for the existing drainage system. Provided a basis for prioritizing and scheduling required improvements. Identified uniform criteria for the planning and design of major drainage way facilities and defined detention criteria. Provided the basis for development of basin impact fees to fund construction of the stormwater capital improvement projects and made recommendations for $500K in capital improvements to address system inadequacies

Chris Rey

Geologist

Areas of Expertise

Construction Management
Drilling
Geotechnical services
Slope Stability
Surface and Ground Water sampling

Years of Experience

With URS: 4.5 Years
With Other Firms: 6 Years

Education

BS/Earth Science/2007/University of Northern Colorado, Greeley

Overview

Chris Rey has 4.5 years of experience with the URS Glenwood Springs office Water Group. As a geologist, Chris Rey provides construction management, developing and optimizing designs for rock and soil mechanics, geologic mapping, geotechnical drilling and sampling, as well as oil and gas industry projects for various private and public clientele. He is familiar with inspections and investigations, including sampling protocols for surface and ground water, production water, condensate, and natural gas.

Mr. Rey came to URS with Six years of slope stabilization, drilling, and blasting experience. His vast experience with slope stability and construction back ground are highly utilized in the Glenwood Springs office. He has applied these talents to support the wide variety services URS offers from our Glenwood Springs office.

Project Specific Experience

Noble Energy, Piceance Basin, CO: Mr. Rey has provided many services over the 4.5 years he has been with URS including; construction management for roads, drilling pads, compressor pads, and pipelines; geotechnical services; geologic mapping; pad and road design; and consulting. On-site duties included inspection of pad stabilization work on cut and fill slopes, monitoring landslides at pad sites and field locating future access roads and drill pad sites.

Denver Water Boulder Diversion Stability, Strontia Springs, CO: Mr. Rey provided rock fall analysis, mitigation options and review portal stability and blasting plans. Activities included analysis of potential rock fall to portal, review of blast plans and rock bolting, and construction management.

Fruitland Mesa Irrigation Company, Crawford, CO: Mr. Rey provided geometric, geotechnical mapping, and stability analysis of two irrigation tunnels, to develop a plan to enhance the stability of the tunnels. Mr. Rey developed a long range plan for operations, repair and maintenance of the water delivery system.

Noble Energy Water Sampling, Battlement Mesa, CO: Mr. Rey assisted in the collection of composited water samples from frac-tanks located prior to initiation of injection. The samples of the make-up water were collected to document initial conditions of water. The project will also include the eventual collection of samples from liquids recovered from the well during the blow-back phase, after the fracturing has been completed.

Conoco Phillips Baseline Water Sampling, Piceance Basin, CO: Mr. Rey conducted groundwater sampling activities for domestic, livestock, and monitoring wells, and collected samples from springs and surface water. Mr. Rey assisted in field sampling, collection of field parameters, documentation of sampling using photography and video, monitoring.

Zeigler Reservoir Geotechnical Investigation, Snowmass, CO: Mr. Rey conducted initial geotechnical investigations, drilling and sampling, test pit mapping, and geologic mapping.

Topock Marsh Needles, AZ: Mr. Rey conducted initial geotechnical investigations, drilling and sampling for the design of a canal system. Tasks included logging drill holes collecting soil samples and providing a summary report of findings.

Freeport McMoRan Decant Closure, Miami, AZ. Bisbee, AZ. Ajo, AZ. Urad, CO. Climax, CO. Mr. Rey assisted in the development of technical construction specification, RFP, and construction award. Mr. Rey also performed construction management and oversight of drilling and grouting through the core of the dams.

Climax Mayflower Flood Bypass Tunnel System, FMI Climax Molybdenum Company, Climax, CO: Mr. Rey Performed geotechnical investigations on numerous projects where sampling (drilling and/or test pits) was required. Familiar with various drilling techniques including auger, casing advanced, ODEX and roto-sonic, along with associated sampling methods. Also responsible for the installation of various down-hole instruments (piezometer, inclinometers) and testing (falling and constant head permeability tests, packer tests). Mr. Rey also prepared and coordinated construction drawings and specifications for a tunnel system along with associated portal and access roadways. Provided construction services for the project and operated as the resident engineer overseeing construction consisting of portals and access roads, construction documentation, monitoring compliance with the contract documents, processing of submittals and meeting with Climax representatives

Specialized Training

MSHA Training
Confined Space
H2S
First Aid/CPR

Eric S. Petterson

Senior Biologist/Project Manager

Areas of Expertise

Consultation with USFWS

Wildlife Habitat Assessments and Impact Reporting

Wetland Delineations and Permitting

Fire Ecology and Vegetation Management

Project Management

NEPA Compliance

Years of Experience

With URS: >1 Year
With Other Firms/US Forest Service: 22 Years

Education

MS/Rangeland Ecosystem Science/1999/Colorado State University

BS/Wildlife Biology/1994/ Colorado State University

Registration/Certification

MSHA Certification (surface miner-metal & non-metal, coal)

H_2S Safety Training

SafeLand Trained

USACE Certified Wetland Delineator

CDOT Certified Wetland Delineator – Functional Assessment (FACWet)

Overview

Mr. Petterson is a senior biologist specializing in assessing potential impacts to Threatened, Endangered, and sensitive species, and species of concern for various agency requirements. His experience includes Endangered Species Act and NEPA Compliance, Forest Management Plan and Resource Management Plan compliance, wetland and riparian management for multiple resource benefit, use of multiple protocols for surveys of wildlife species and plant species, and accurate impact assessments. He is a certified USACE Wetland Delineator with extensive 404 permitting experience in Colorado & Utah.

Mr. Petterson has supported large Environmental Impact Statement projects and many Environmental Assessments by producing wildlife, vegetation and wetlands assessments. Clients include the U.S. Forest Service, Bureau of Land Management, Department of Energy, various State and local government agencies, as well as clients in the energy, mining, development and recreation sectors.

Project Specific Experience

Wildlife Impact Assessments and Wetland Delineations, Encana Oil & Gas (USA) Inc., Noble Energy, Energy Transfer (now Summit Midstream), Enterprise Products Partners, and SG Interests: Senior Ecologist for multiple natural gas clients performing wildlife impact assessments, wetland delineations, and 404 permitting for a variety of exploration and development projects for NEPA, Clean Water Act, and County regulatory compliance. Duties have also included assisting in developing site-suitability models, team leader for NEPA compliance, and assisting clients in development of proposed actions. Other duties have included environmental oversight for sensitive construction projects, reclamation and bond-release studies, environmental compliance database development and environmental technician supervision.

EIS Reauthorization of Transmission Lines, Western Area Power Administration, US Forest Service Lands in CO, UT, and NE: Author of wildlife impact assessments (Biological Assessments, Evaluations & Management Indicator Species Reports) for Western Area Power Administration's EIS reauthorization transmission lines on all US Forest Service lands in Colorado, Utah, and Nebraska. Duties included on-site assessments of riparian habitats and consultation with US Fish & Wildlife Service for potential impacts to upland and aquatic resources.

Wetland Delineations, Rio Tinto, Kennecott Utah Copper, UT: Senior Ecologist supporting wetland delineations and 404 permitting, as well as support of EIS for mine expansion activities and 1,200 acre tailings expansion project adjacent to the Great Salt Lake. Tasks also included

production of wetland permitting documents for various mine-related projects, and a detailed functional assessment of wetland habitats.

Wildlife Impact Assessments, Vail Ski Area, Vail, CO: Senior Ecologist performing wildlife impact assessments (BA, BE & MIS reports) for 1,000 acre mountain pine beetle mitigation and forest health projects.

Wildlife Impact Assessments, White River National Forest, Breckenridge: Senior wildlife biologist producing wildlife impact assessments for 5,500 acre mountain pine beetle salvage projects.

Wildlife Impact Assessments and Wetland Delineations, Bolts Lake CERCLA Site, Battle Mountain Resort, Minturn, CO: Biological team lead performing wetland delineations, wildlife surveys, and biological assessments for Battle Mountain Resort's proposed remedial activities at the Eagle Mine superfund site for ARAR compliance.

Wildlife Impact Assessments and Wetland Delineations, River Bend Project, Garfield County, CO: Biological team lead performing wetland delineations & permitting, wildlife surveys, and biological assessments for the River Bend (Cattle Creek) proposed residential development project.

Wildlife Impact Assessments and Wetland Delineations, TCI Lane Project, Garfield County, CO: Biological team lead performing wetland delineations & permitting, wildlife surveys, and biological assessments for the TCI Lane proposed residential development project. Mr. Petterson's team also discovered the presence of Ute ladies-tresses orchid, and led the consultation process with US Fish and Wildlife Service, and authored protection measures adopted by the Roaring Fork Conservancy for the conservation easement protecting the orchid and its habitats.

Wildlife Impact Assessments, Battle Mountain Resort, Minturn, CO: Biological team lead performing wildlife impact assessments for Battle Mountain Resort's proposed ski area and residential development project.

State Parks Resource Management Plans, Colorado State Parks, CO: Team member and primary biologist performing management plans for 10 Colorado State Parks, including wildlife and vegetation assessments.

Ski Area NEPA Support, Aspen Ski Company, Sunlight Mountain Resort, Loveland Ski Area, Vail Ski Area, Ski Eclipse, CO: Wildlife Biologist supporting ski area projects and NEPA efforts including biological assessments, biological evaluations and management indicator species reports.

Wetland Mitigation and Restoration Projects, Pitkin, Eagle, Gunnison and Garfield Counties, CO: Eric has been the biological

lead in designing wetland mitigation projects as well as wetland restoration projects for the past 8 years.

Aquatic Macroinvertebrate Indices Studies, Gunnison County, CO: Eric performed pre- and post-construction monitoring of aquatic macroinvertebrates used as an indicator of stream and aquatic health conditions for a large construction project in Gunnison County.

Baseline Assessments for Conservation Easements, Garfield, Eagle, and Pitkin Counties, CO: Provided baseline assessments for Conservation Easements in Garfield, Eagle, and Pitkin Counties.

Professional Societies/Affiliates

The Wildlife Society
Society for Ecological Restoration
Society for Wetland Scientists

Awards

2000/Certificate of Merit (USDA Forest Service)/Outstanding project coordination in wildlife and fire/fuels

1999/Certificate of Merit (USDA Forest Service)/For self-direction, attitude, leadership and assisting other units on the Forest

1999/Letter of Appreciation (Bureau of Land Management)/For re-writing course guide and teaching effects of prescribed fire on vegetation communities in Rx-340

1998/Certificate of Merit (USDA Forest Service)/For successfully receiving grants from Rocky Mountain Elk Foundation to assist in funding Prescribed Fire Program

1998/Certificate of Merit (USDA Forest Service)/For meeting deadlines and completing field work with exceptional quality and innovation

1994/Certificate of Merit (USDA Forest Service)/For exceeding requirements and expectations while effectively collecting data on Mexican Spotted Owl habitat

Specialized Training

SafeLand Trained

H_2S Safety Training

MSHA Surface Miner- Metal & Non-Metal, Coal (2013)

CDOT Certified Wetland Delineator – Functional Assessment (FACWet) Training

Chronology

1/00-5/13: Rocky Mountain Ecological Services, Inc., Glenwood Springs, CO

1/97-1/00: Canyon Lakes Ranger District, Arapaho & Roosevelt National Forest, Fort Collins, CO

5/94-1/97: Redfeather Ranger District, Arapaho & Roosevelt National Forest, Fort Collins, CO

5/91-10/93: Arapaho & Roosevelt National Forest, Fort Collins, CO & Medicine Bow-Routt National Forests, Yampa, CO

Contact Information

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