Lake Fork of the Gunnison River Enhancement Project
Lake City, Colorado

Phase II Design Grant Application

Prepared by:

Lake Fork Valley Conservancy
P.O. Box 123
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Submitted to:

Colorado Water Conservation Board
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1.0 PROJECT PROPOSAL SUMMARY SHEET

Project Title: Lake Fork River Enhancement Project: Phase II Design

Project Location: Lake City, Colorado

Grant Type: Watershed/Stream Restoration

Grant Request Amount: $21,300

Cash Match Funding: $21,650

In-kind Match Funding: $0

Project Sponsors: Lake Fork Valley Conservancy

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Brief Project Description:

The goal of the Lake Fork River Enhancement Project is to enhance and protect the ecological health and recreational quality of the Lake Fork of the Gunnison and its main tributary, Henson Creek, in the vicinity of Lake City. CWCB funding is instrumental in realizing our main objectives of the Project, which are to:

1) Increase fisheries habitat quality resulting in a 50% increase in brown and rainbow trout biomass;
2) Improve the hydraulics of the river to maintain existing or even reduce base flood elevation and facilitate effective bed load movement;
3) Improve bank stability to protect private and public assets along the river; and,
4) Provide quality recreational experiences along the river via improved fishing and boating opportunities, safer access to its banks, educational opportunities, and reduction in trespass.

Following a 5 year community planning effort, the Lake Fork Valley Conservancy (LFVC) is currently completing construction of Phase I of the River Enhancement Project, which began in the fall of 2013. When completed this fall over a half mile stretch of Henson Creek and the Lake Fork near the confluence will be restored. Phase II of the river project will continue downstream approximately 0.8 mile to the north end of town. Conceptual planning and design work was completed for this stretch in 2012, but we now need to complete final design and apply for permits and construction funding.

Specific tasks to be funded by CWCB and other sources are:

1) Complete 60% engineered in-channel design for the Lake Fork downstream of the confluence to north end of Town (Phase II of river project).
2) Design and produce outreach materials for an interpretative trail system along Henson Creek and the Lake Fork;
3) Clearly demarcate public and private land boundaries along the river with production of a public access guide.

Total estimate to complete this work is $42,950. We request $21,300 from CWCB. Cash match of $21,650 is already secured.

2.0 PROJECT DESCRIPTION

2.1 Problem the Project Addresses

Over the past 130 years, the important cold water fisheries of the Lake Fork of the Gunnison and Henson Creek have been significantly modified by channelization, heavy metal contamination, and catastrophic failure of large upstream tailings dams. These changes have led to steep, eroding banks, declining trout populations, and a shallow, braided channel in the riparian zone running through the Town of Lake City.

Henson Creek has been identified as a significant stream segment in the Gunnison Basin's Environmental and Recreational Non-Consumptive Needs Assessment, primarily for environmental criteria due to its listing on the EPA's 303 (d) list of impaired streams for Cd and Zn (sculpin). The Assessment also lists the Lake Fork of the Gunnison, including the segment through Lake City, as significant for recreational purposes and is recommended for stream flow augmentation for fisheries. The LFVC has prioritized both chemical and physical improvements to Henson and the Lake Fork as part of their Ten-Year Strategic Watershed Stewardship Plan. Environmental remediation is already underway to address the chemical impacts through cleanup of abandoned mines in the upper watershed through LFVC's partnership with BLM and Colorado's Division of Reclamation, Mining and Safety. The river enhancement project addresses the physical impacts by creating good drought and overwintering fish habitat that complements (but does not augment) existing flows and replaces Gold Metal waters lost with the construction of Blue Mesa Reservoir on the Gunnison River.

LFVC and the Town government began enhancement of lower Henson Creek in October 2013 to complement the ongoing cleanup and remediation upstream, using funds from CWCB's Water Supply Reserve Account, Upper Gunnison Water Conservancy District, Colorado Parks and Wildlife Fishing is Fun Program, and local donations. This is Phase I of a two-phase project designed to enhance and protect the ecological health and recreational quality of a two mile stretch of the Lake Fork and Henson Creek, its main tributary (Figures 1 and 2). Phase I of the project covers 2740 feet of river within the Town along lower Henson and its confluence with the Lake Fork. It also includes 560 feet of Henson Creek that is leased by the Town from the BLM for its public trail system.

In September 2013, LFVC hired Webco, Inc. through a competitive bidding process, to complete the design/build specifications and in-channel construction for the CWCB-funded portion of the project. They have 30 years of experience with heavy equipment and a decade of experience in river enhancement work. Webco, Inc. collaborated with Brett Jordan (PhD, PE, CPESC), the Principle Hydraulic Engineer of HydroGeo Designs, LLC, to complete the 60% design (Attachment A and Statement of Qualifications Attachment B). Swift progress and relatively smooth implementation speak to the efficiency of this partnership and to each party's aptitude for managing large projects. Phase I construction will be completed this fall.

Phase II of the River Project covers 4,350 linear feet of the Lake Fork from the confluence down to the north end of Town downstream of the sewage treatment plant. Part of this Phase includes the design and implementation of a comprehensive river education component designed to educate residents and visitors of the ecology and history of the river corridor, and to help prevent private land trespass. LFVC requests funding from CWCB to complete the engineered design work for river channel construction on the Lake Fork below the confluence with Henson and for design of the interpretive trail and education program. Successful completion of Phase I construction and Phase II design will in turn leverage future funds for construction work downstream on the Lake Fork.

2.2 <u>River Project Objectives</u>

Our overall goal of the river enhancement project is to improve the ecological health and recreational quality of Henson Creek and the Lake Fork River in the vicinity of Lake City.

Specific objectives are the following:

1) Increase fisheries habitat quality resulting in a 50% increase in brown and rainbow trout biomass;
2) Improve the hydraulics of the river to maintain existing or even reduce base flood elevation and facilitate effective bed load movement;
3) Improve bank stability to protect private and public assets along the river;
4) Provide quality recreational experiences along the river via improved fishing and boating opportunities and safer access to its banks.

Our educational objectives aim to increase visibility and appreciation of our river as follows:

1) Increase ecological knowledge of our river amongst those who use it through development of an interpretive river trail;
2) Create a permanent outdoor laboratory for the local school through curriculum development and implementation along the river trail;
3) Increase early childhood environmental education programming with the local child care center through curriculum development and implementation.
4) Educate river users regarding proper public access areas and private land boundaries and restrictions.
5) Increase skills of local youth with regard to river restoration and monitoring techniques.

2.3 <u>Project Tasks</u>

Specific tasks to be funded under this grant request include the following:

1) *Complete the engineered design (60%) for Phase II from the confluence to the north end of Lake City.*

Phase II of the river project covers the segment of the Lake Fork from the confluence down to below the sewage treatment facility at the north end of Town, approximately 4,350 linear feet (Figure 1). The LFVC has just initiated the second phase of its "Build a Trout a Home" fundraising campaign, which will go toward purchase of construction costs. Our goal is to raise $50,000 in local donations by the end of summer 2015 (over $5,000 raised so far) to cost match several potential foundation and state grants. With the engineered design completed (through UGRWCD and CWCB funding), LFVC can obtain necessary permits and begin construction along the Lake Fork as early as fall of 2015, as funds are secured.

2) *Design and produce ecological guides for an interpretive trail system along Phase I and Phase II sections of the river.*

LFVC will coordinate the design and implementation of an interpretive trail system along existing trails along Henson Creek and the Lake Fork. This system will help to increase knowledge of river systems and appreciation for the asset this river provides the community. The target audiences for these efforts are local residents and their children and the numerous seasonal visitors who are repeat visitors to Lake City. LFVC plans to implement an environmental education program with local youth and adults using the interpretive trail, once constructed. Youth and children will be actively introduced to the river trail through formal education programs through the school, the local child care center and the County Public Health Department that runs a youth program in the summer.

3) *Prepare a public access guide that clearly demarcates public and private lands along the river in Town.*

To date, river users have not really understood where the public-private interface exists and trespass inevitably results, especially if recreational use increases with river enhancements. A public access map will be produced to guide users to public portions of the river. This effort will help to reduce potential conflicts and improve support of local land owners for current and future restoration efforts.

3.0 RIVER PROJECT MONITORING AND DESIGN MILESTONES

3.1 Project Monitoring, Evaluation, and Maintenance

LFVC selected seven cross-section locations in the project reach under low-flow conditions before construction. At each cross section we: 1) identified and monumented cross section end points; 2) performed detailed survey of each cross section; 3) performed a pebble count at each cross section; and, 4) established photo points at each cross section (upstream, downstream and left and right bank directions).

After completion of channel construction and revegetation activities, the project area will be monitored in late summer and fall of 2015. The above methods will be repeated at the same locations, and an assessment of structures will be conducted. Warranty inspection of the structures will occur at low flow in 2015. Sapling survival rate will be assessed via counts, and macro-invertebrate sampling will provide a basis of comparison to 2009-2010 macro-invertebrate data.

LFVC and the Town will continue to monitor structures annually for three years following completion of the project (summer/fall 2016-2018), documenting the condition of treatments and identifying problems that may develop. These monitoring protocols will be incorporated into the Town of Town of Lake City's Master River Recreation Plan. Costs for river maintenance and monitoring will be paid for via the LFVC's annual Frozen River Film Festival fundraiser, which is matched by the Town of Lake City (total is a minimum of $2000 annually). Periodic maintenance (average every five years) is planned just below the confluence of the Lake Fork and Henson to remove bed load that will accumulate during years of high flow (bank full or higher). This has been incorporated into the engineered design. In-channel structural maintenance will be dealt with as needed (e.g. after larger flood events).

The most effective way to monitor our progress in outreach is to monitor both quantitative use of the outreach materials (number of brochures taken from access points, and from the Chamber of Commerce), and qualitative satisfaction with the various outreach programs, via interviews with teachers, children, tourists, and partner entities.

3.2 Design Milestones

The project will successfully achieve the following milestones by the end of December, 2015.

Milestone	Responsible party	2015 Q1	Q2	Q3	Q4
In-channel 60% engineered design below confluence (Phase II)	LFVC, Webco, Inc.'s Engineer Hydro-Geo Designs (HGD)	X	X		
Design work interpretive trails, map production, and brochures	LFVC, Consultant	X	X		
Permit Application to US Army Corps of Engineers, CDOT, and Hinsdale County for subsequent construction	LFVC, HGD			X	X
Distribution of outreach materials (interpretive trail ecological brochures, access maps)	LFVC			X	X
Preparation of design report	LFVC				X

4.0 PROJECT BUDGET

	Work Activity	Unit of Measure-ment	Quantity	Cost/ Unit	Total Cost	CWCB CWRP	UGRWCD	LFVC
Engineering Design work (60%) for Phase II								
1	Engineered Design (60%) - confluence to north of town - HydroGeo Engineering	linear feet	4350	$7	$30,450	$19,950	$0	$10,500
2	Resurvey of river area that flooded	linear feet	1500	$2	$3,000	$0	$0	$3,000
Environmental Outreach and monitoring								
3	River access map - design and production costs	each	1000	$2	$2,000	$0	$2,000	$0
4	ecological guide - design and production costs	each	1000	$2	$2,000	$0	$2,000	$0
5	Design Consultant	hours	100	$20	$2,000	$0	$0	$2,000
Project Management								
6	Executive Director - project coordination (salary plus fringe)	hours	100	$45	$4,500	$1,350	$3,150	$0
7	SW Conservation Corps - VISTA volunteer - volunteer coordination and outreach	hours	100	$20	$2,000	$0	$0	$2,000
	TOTAL				**$42,950**	**$21,300**	**$7,150**	**$14,500**

5.0 ORGANIZATIONAL CAPACITY

5.1 Applicant Qualifications and Accomplishments

The Lead Sponsor for this project is the Lake Fork Valley Conservancy (LFVC). In its entire 15 year history (see newsletter in Attachment C) LFVC and its partners have successfully implemented a number of restoration and conservation initiatives, including remediation of seven abandoned mine sites, protection of 156 acres of wetlands at Lake San Cristobal, and this river project. Total income over the life of the organization exceeds $2.4 million. LFVC became a fully functioning 501(c) 3 non-profit corporation in 2010 and has fiscally managed over $400,000 in grants and donations out of this total. This includes project and fiscal oversight of Phase I construction for the River Project. The organization has an effective Board of Directors with sound fiscal policies in place and is fully insured.

The LFVC Executive Director will coordinate all project activities and manage contracts and funds (approximately 100 hours). Our OSM/VISTA, Stephen Norton, will oversee the education component of the project (approximately 100 hours). Our graphic design consultant, Katherine Daly, will prepare the interpretive trail design and outreach materials (approximately 100 hours). Brett Jordon from HydroGeo Designs will complete all survey and engineered design work. All resumes and statement of qualifications are in Attachment B.

5.2 Planning Documents

Concerns regarding river impacts in town from legacy mining and development were addressed in the LFVC Ten Year Watershed Stewardship Plan for 2010-2019 with recommendations to initiate a river restoration project in and near Lake City (See summary in Attachment D).

River construction work currently being implemented is initially founded upon a five year conceptual planning and design phase that began in 2009 with funding from CWCM and EPA 319 Nonpoint Source Program. The final report for this phase was submitted in 2012 and is viewable on the CWCB Watershed Restoration Program website. The Phase I construction work is being completed as part of a Design-Build process with the completion of a 60% engineered design report and drawings (final report in Attachment A).

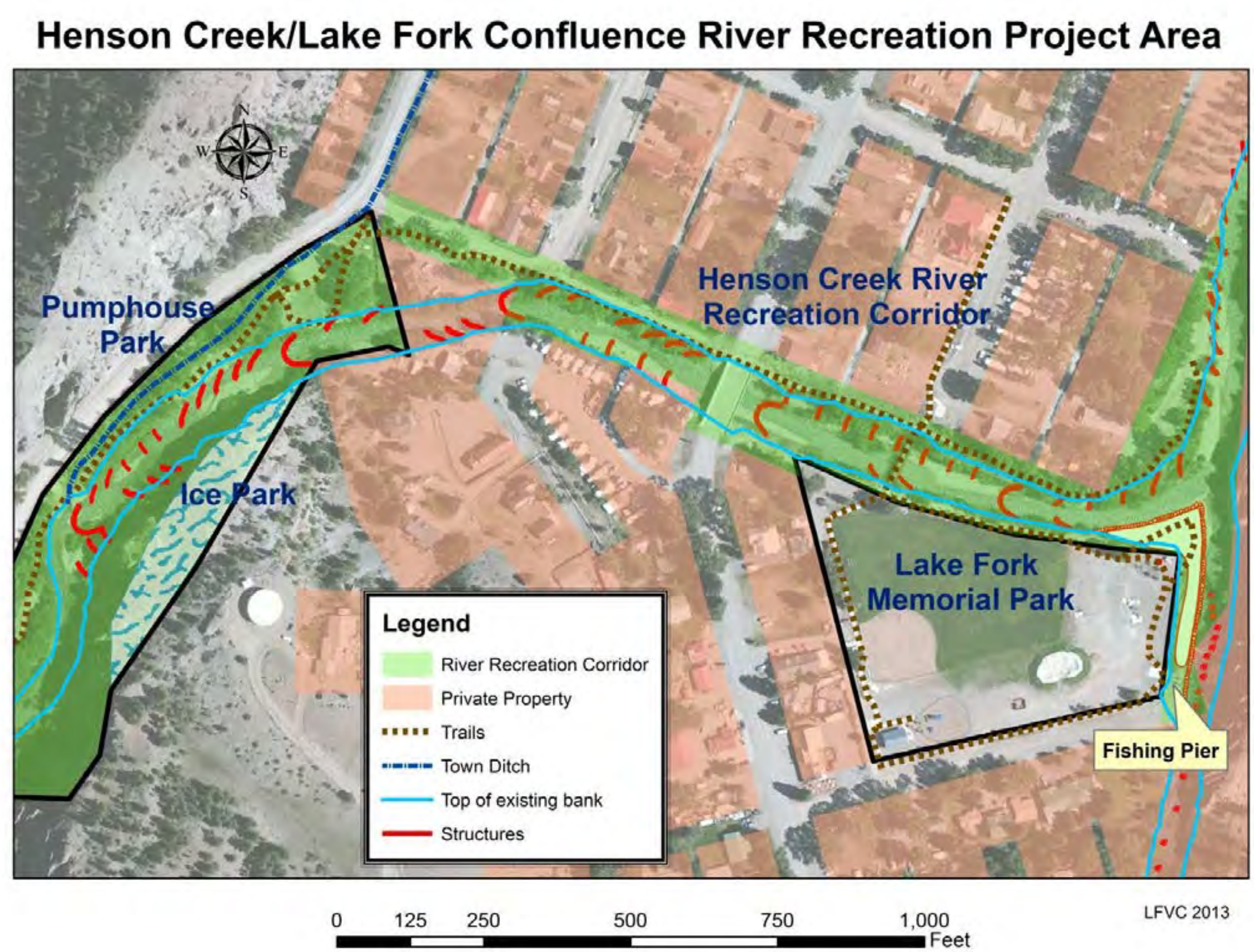
5.3 Project Partnerships

LFVC has built strong partnerships over the past 6 years through the initial conceptual design phase up through construction. The table below highlights key partnerships for the current construction and education components being implemented.

Organization	Roles
CWCB	CWCB has invested over $350,000 in planning and implementation for this river project since 2009.
Gunnison Basin Round Table	GBRT has invested $28,906 in this project for construction work on Henson. The work addresses their priorities as identified in their non-consumptive needs assessment.
UGRWCD	UGRWCD has annually supported the LFVC since 2008. Recently they awarded $37,400 to LFVC for Phase I construction and partial design work for the trail education system.
CO Division of Parks and Wildlife	DPW has been involved in planning for this project since 2009. Their Fishing is Fun program is providing $25,000 toward the construction and revegetation in Phase I.
BLM	BLM benefits with fisheries and riparian habitat improvements along 560 feet of Henson. Also safer bank access means reduced hazards for public land users. BLM has assisted with NEPA and design work and contributed rocks to the project.
Town and County residents and visitors	Locals and visitors alike will enjoy a more aesthetically pleasing river front, safer access along its banks, a trail system that offers environmental education as well as exercise, and better fishing and boating experiences.
River front land owners	Seven land owners have signed agreements for construction work along lower Henson and around the Lake Fork confluence and have contributed funds to pay for the majority of construction work on their property. An additional 30 have sighed access agreements for design work in Phase II. Some have pledge to contribute toward design and construction work in Phase II (see support letter in Attachment E).
Lake City Community School	The LFVC has been engaged with the school for environmental education since 2008. The school will benefit by having a living outdoor laboratory for their students.

Figure 1. Comprehensive River Enhancement Project Area. Phase I is in the black portion of the figure. Phase II is to the north.

Figure 2. Locations of cross vanes (semi-circles), vanes (angular lines in channel) and sills (perpendicular lines on flood terraces). These structure locations have changed with completion of the 60% design. The boulder rock terrace is located at the confluence. See Attachment A for details.



LIST OF ATTACHMENTS

A. **Phase I 60% Engineered Design Report (drawings available upon request)**

B. **Staff and Consultant Resumes and Statement of Qualifications**

C. **LFVC 15 year newsletter**

D. **LFVC Summary of Ten Year Strategic Watershed Plan**

E. **Letters of Support**

Final 60% Design/Build Summary Report for:

Henson Creek and Lake Fork Confluence Channel Improvement Project

Prepared for:

Webco Inc. (Webco)
Lake Fork Valley Conservancy (LFVC)

Prepared by:

HydroGeo Designs LLC. (HGD)
P.O. Box 775
Buena Vista, CO 81211

1.0 INTRODUCTION

HydroGeo Designs LLC. (HGD) has prepared this 60% design summary report for Webco Inc. and the Lake Fork Valley Conservancy (LVFC) as a concise summary of the 60% design build plan for the Henson Creek and Lake Fork Confluence Channel Improvement Project which began construction in the Fall of 2013. The purpose of this report is to provide a conceptual basis of design for the proposed project as well as provide project details that will be useful in the design build phase of the project. This document will also be a work in progress to document the as-built project elements as the “design build” process progresses through a value engineering approach.

This project was designed with a rapid implementation schedule of 4 weeks from contract award to implementation of the 60% design plans. HGD work built on and made modifications to the conceptual design presented in the feasibility and planning project (LFVC and BCH 2012). Detailed project background data can be found in this report. The design elements of the project were separated into two basic phases:

1. Design of 2200 linear feet (LF) of Henson Creek from the town of Lake City headgate structure downstream to the confluence with the Lake Fork and design of 4 vane structures and 9 boulder clusters along 1500 LF of the Lake Fork from 500 feet upstream of Spring Street to 200 feet downstream of 2nd Street.
2. Design of the Henson Creek/Lake Fork confluence area including a 348 LF rock terrace adjacent to the park which will add additional usable space for the park are and attractive boulder access points to the depositional beach area at the confluence.

The initial contract related to this report includes construction budget to accomplish Phase 1. Fundraising efforts are currently being conducted to support the construction of Phase 2.

The design elements covered in this report will include:

1. Site and Basin Setting
2. Design concepts
3. Sediment Transport
4. Proposed design in-stream structure quantities and cost estimates
5. Structure rock sizing and scour analysis
6. Hydraulic modeling and flood risk assessment
7. Headgate maintenance and town ditch improvements

2.0 Site and Basin Setting

Henson Creek is a (83.6 mi^2) watershed draining the San Juan mountain range on the east side of Engineer Pass. The watershed can be characterized by steep volcanic terrain with peaks over 14,000 feet draining narrow valleys into the alluvial Henson Creek valley bottom. The upstream reaches have been impacted by historic mining activities and a large dam breach in the 1970s (**Figure 1**) that have resulted in a high bedload sediment supply rate to the design reach. The design reach on Henson Creek is approximately 2200 linear feet (LF) and drops in elevation from 8693 to 8665 FT (28 FT) over the full reach length with an average gradient of 1.2%. The Lake Fork of the Gunnison at the project site has a similar volcanic geologic setting with an upstream drainage area of 124 mi^2. Water flows in the Lake Fork are moderated by Lake San Cristobal which was formed approximately 700 years ago when the Slumgullion Earthflow created a natural dam across the outlet. The lake currently holds about 11,000 acre-feet. In the project reach on the Lake Fork the channel bed elevation drops 8 feet over the 1500 LF reach length for an average slope of 0.53%. Upstream sediment loads in the Lake Fork are primarily captured by Lake San Cristobal and an on-channel hydroelectric forebay and it does not have the high bedload supply associated with Henson Creek.

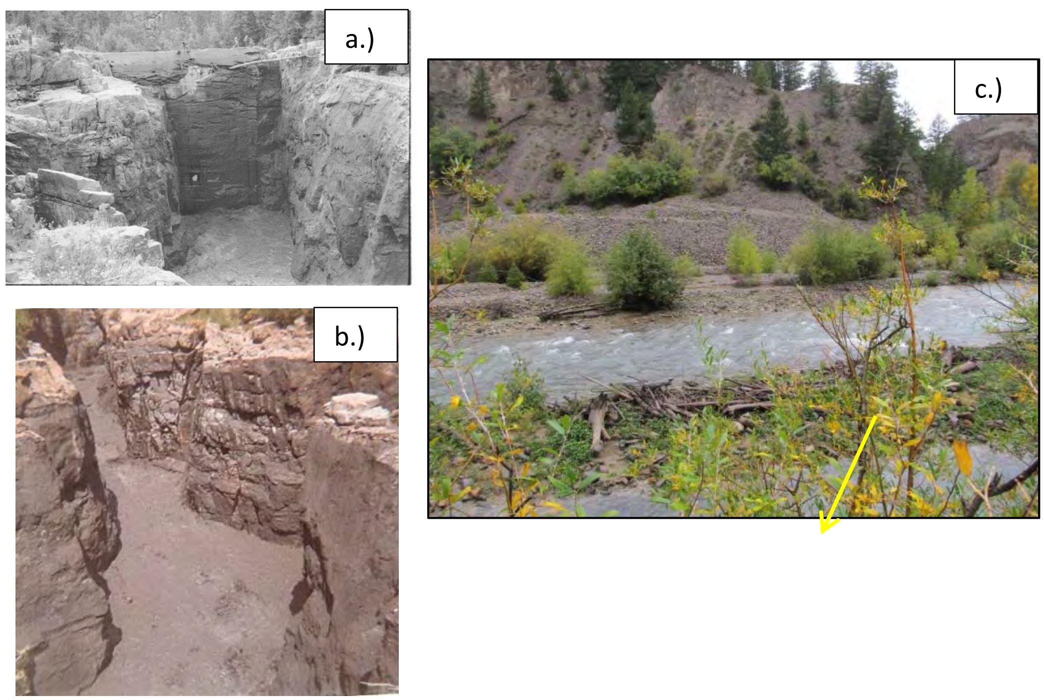


Figure 1 Example of upstream impairments on Henson Creek a.) Treasure dam before failure, b.)Treasure dam after failure, and c.) bedload supply adjacent to the floodplain area.

3.0 DESIGN CONCEPTS

Significant effort and time were placed into the feasibility design developed from 2008-2012. When awarded the design build contract Webco and HGD recognized the importance of maintaining as many of the initial design concepts as possible while operating within a limited 4 week time window to allow for construction in the Fall of 2013. A multi-disciplinary team consisting of an engineer, riparian biologist and fisheries biologist collaborated to produce a design that would provide the best value, construction feasibility and habitat enhancement design for the project. Some elements of the feasibility design were altered however, the over-arching concepts and project elements were retained. The goals of the project design were as follows:

- Improve fish habitat conditions throughout the reach.
- Restore channel stability and improve sediment transport conditions to the project reach.
- Improve recreational access to the river corridor from existing walking paths.
- Provide geomorphic and flow hydraulic complexity to the reach to improve aquatic habitats.
- Provide recreational water features (i.e. Kayak waves, eddies) through the construction of stream boulder structures.
- Improve riparian habitat conditions.
- Improve hydraulic conditions in the vicinity of the town ditch headgate to maintain flow rates in the ditch.
- Improve overall stream reach aesthetics

These goals also had to be within the project constraints that include:

- Time limited 4 week design modification period.
- Fixed project budget to construct the modified design.
- Limited access to adjacent floodplains along the reach due to private land ownership and town infrastructure.
- Limited potential for planform adjustment along the reach.

The goals of the project design were met within the project constraints by incorporating the following design concepts and elements.

- Design a stable bankfull channel along the reach with a 50-60 top width and depth of 3 feet and a stable slope to maintain sediment transport capacity and channel stability in the reach.
- Reduce the channel width/depth ratio to mimic a stable Rosgen B stream type (w/d=20).
- Incorporate J-Hook, Cross Vane and Single Vane boulder structures to enhance habitat, provide pool depth, re-direct erosive flows and provide recreational amenities.
- Restore single thread channel morphology in an unstable bar/braided reach in the upper reach of Henson Creek that was causing significant erosion problems.
- Excavate deep water pool habitat and provide structural boulder design to maintain pool sediment flushing and pool depth.
- Remove excess bedload resulting from historic impairments to the reach.

Figure 2 illustrates some of the pre-construction channel impairments prior to the construction of the project.

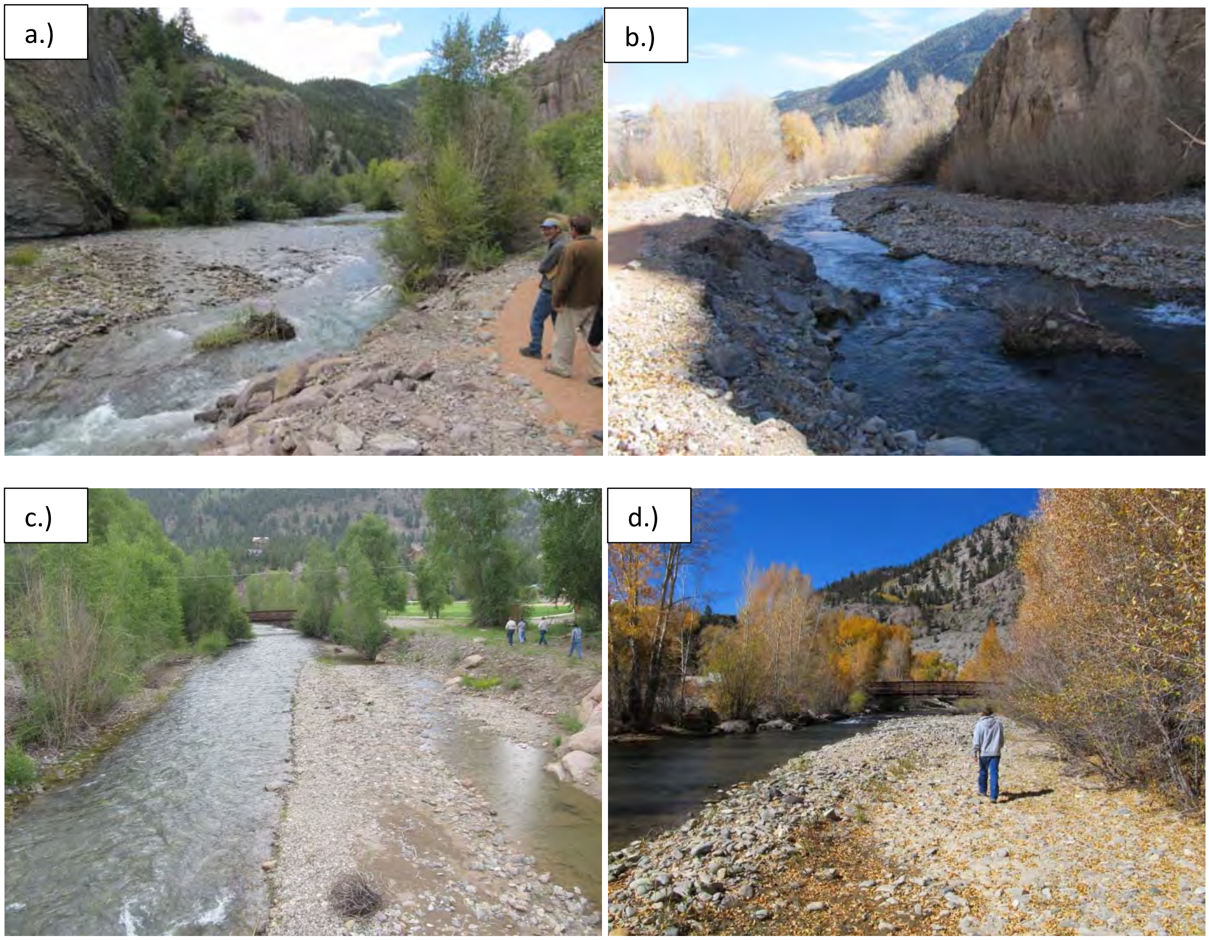


Figure 2 Henson Creek pre-construction channel impairments a,b: bedload deposition, channel braiding, impinging flow patterns and channel bank erosion. c,d: bedload deposition and limited fisheries habitat.

4.0 Sediment Transport

Effective Discharge Concept

Channels typically adjust channel geometry to an equilibrium state or central tendency in response to the water and sediment supplied to the system. A singular, “effective”, “dominant” or “channel forming” flow that can be utilized for design purposes to characterize the cumulative channel forming impacts of the full flow regime (Knighton 1998) is an extremely useful tool in stable channel design. Many definitions of the channel forming or effective discharge have been offered including:

1.) The flow rate where floodplain formation occurs (Leopold et al. 1964) and,

2.) The flow rate that transports the largest amount of the cumulative annual sediment load thereby exerting the largest amount of work/energy on the channel boundaries in terms of sediment transport (Wolman and Miller 1960, Andrews 1980).

The effective discharge analysis utilizes the second interpretation of “channel forming” flow, investigating the flow rate that transports the largest amount of the cumulative annual sediment load for a watershed. This effective discharge flow rate can be considered to exert the largest amount of stream energy on the channel system. The effective discharge is computed by formulating a sediment transport rating curve (transport as a function of discharge), calculating an annual flow duration curve (frequency of flow rate occurrence on an annual basis) and multiplying the predicted sediment discharge by the frequency of occurrence. The end result is a curve of annual sediment transport (tons/yr) as function of stream discharge (ft^3/s). A conceptual diagram of the effective discharge process is shown in **Figure 3**. There are many inherent sources of potential error in effective discharge calculations including:

- Selection of suitable sediment rating curve data
- Uncertainty in sediment transport measurements
- Use of sediment transport equations
- Bin sizing and grouping in flow duration analysis

However, the methodology does provide multiple lines of evidence in determining the appropriate sizing for a stream channel design (Doyle et al. 2007). Previous studies have shown a reasonable correlation between the effective discharge and bankfull discharge for alluvial river systems (Wolman and Miller 1960, Andrews 1980). In addition to information provided on stream sizing the effective discharge analysis results can be tabulated to predict the annual sediment yield at the site in tons/year, which is useful for maintenance planning.

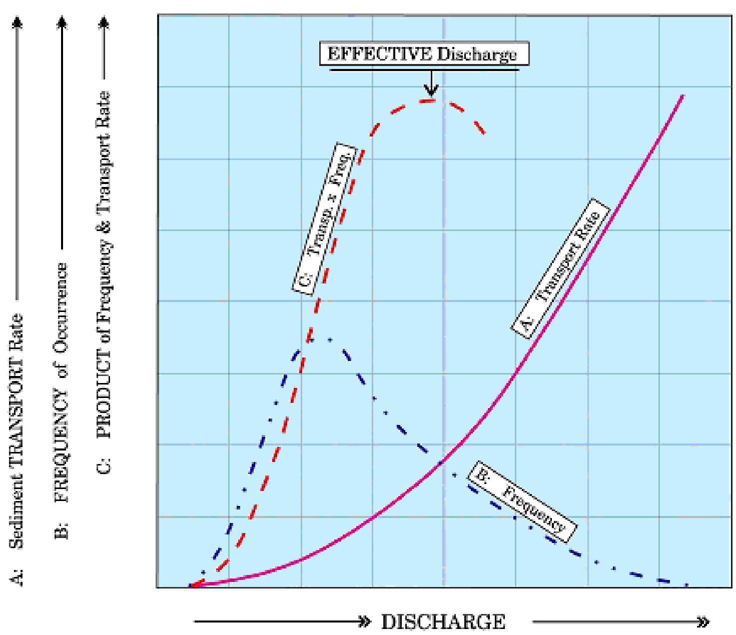


Figure 3 Conceptual effective discharge diagram (USEPA (adapted from Wolman and Miller 1960)).

Effective Discharge Results

HGD ran an effective discharge analysis for the design reach of Henson Creek. The two primary data sources for the analysis were:

1. Bedload sediment transport data collected upstream of the project site for the feasibility study.

2. USGS gaging data from the Uncompahgre River Near Ouray, Colorado (Gage 09146020)

The Uncompahgre gage was selected because no current stream gaging sites are present on Henson Creek. This gaging has a similar drainage area (76.9 mi^2), elevation (7600 ft) and drains similar mountainous topography. The position of the drainage on the west facing slopes of the San Juan mountains results typically in greater snowpack and runoff volumes for the site however for the purposes of developing a flow duration relationship for Henson Creek the site is suitable. The flow duration relationship was scale by the ratio of the Henson Creek bankfull discharge of 700 cfs to the estimated bankfull discharge at the Uncompahgre gaging site of 1045 cfs. The estimate of the Uncompahgre site bankfull discharge was based on the computed 1.5 year recurrence interval flow based on the annual maximum series analysis of the site. This resulted in a scaling factor of 0.67 to scale the Uncompahgre flows to the predicted Henson Creek flow duration curve (**Figure 4**).

The Henson Creek bedload data was tabulated to produce a sediment rating curve for the stream. This curve predicts bedload transport as a function of discharge (**Figure 5**).

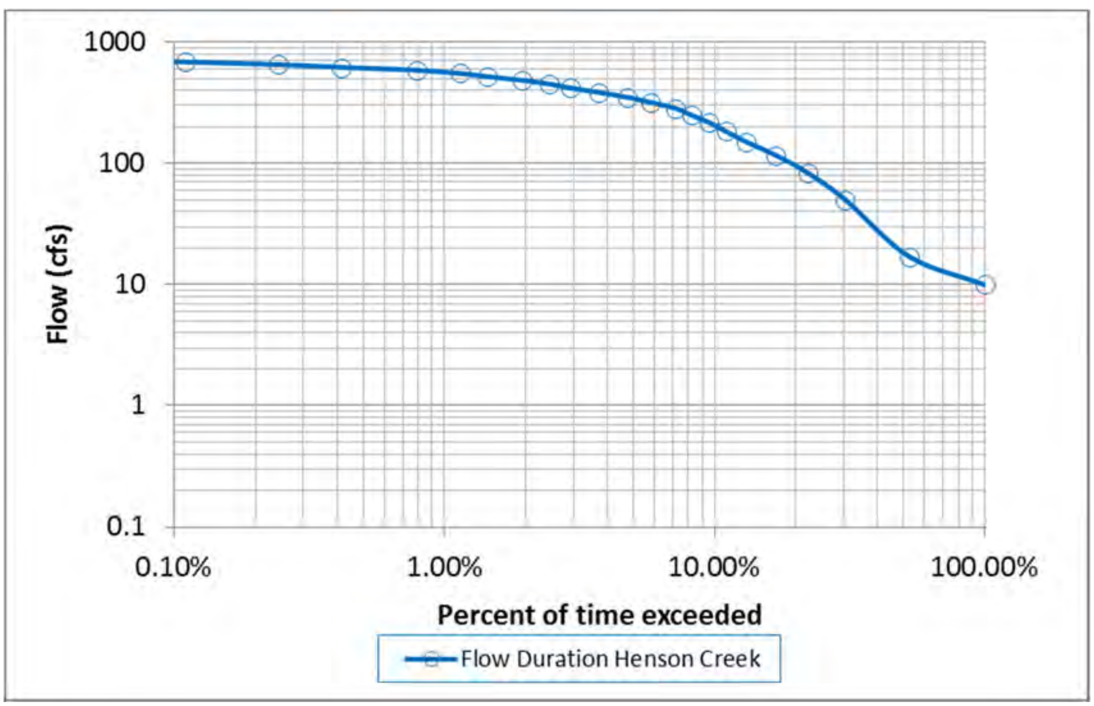


Figure 4 Henson Creek flow duration curve.

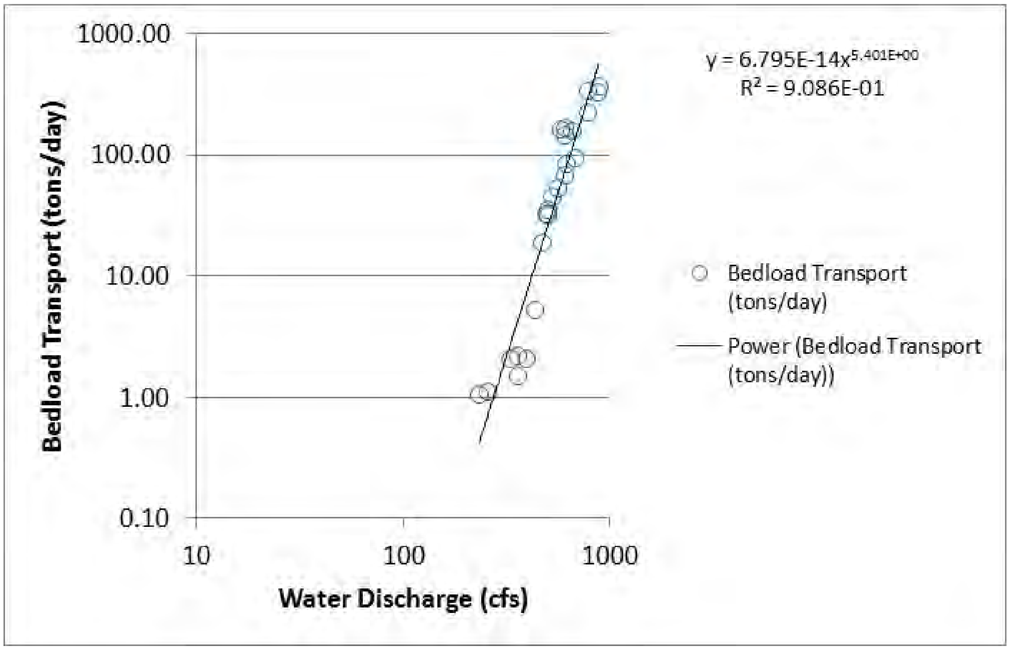


Figure 5 Henson Creek beload rating curve.

The results of these two relationships were integrated to determine the effective discharge curve for Henson Creek (**Figure 6**). The effective discharge of 620 cfs, can be predicted by identifying the peak in the effective discharge curve. This is in close agreement to the bankfull discharge estimate at the site of 700 cfs and was the justification in sizing the design channel to this discharge. By integrating the area under the effective discharge curve the annual bedload sediment yield of 689 tons/year was determined. The channel design utilized the bedload sediment transport because this coarse gravel and cobble material transport is the critical component in shaping and maintaining channel form. The high stream power energy associated with Henson Creek will likely move all the suspended sediment through the system and not have an impact on the design reach.

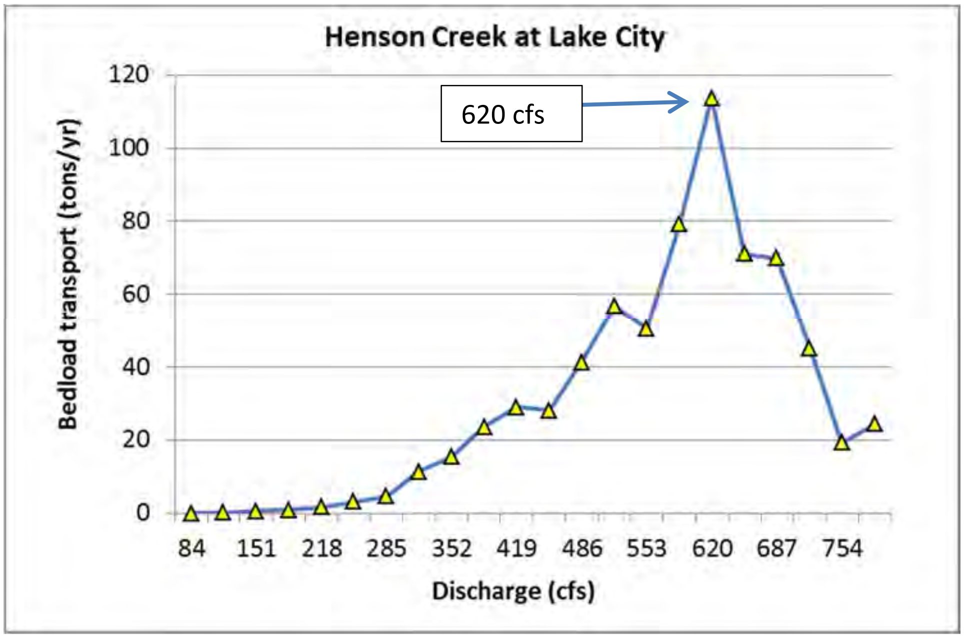


Figure 6 Effective discharge curve for Henson Creek.

FlowSed/PowerSed Analysis

FLOWSED and POWERSED models (Rosgen 2006) were run for design reaches to compare design transport capacity to existing conditions sediment transport capacity. The modeling process consists of two components FLOWSED and POWERSED.

The FLOWSED model utilizes sediment transport rating curve data and stream gaging flow duration data normalized to the measured bankfull flow rate and sediment transport rate to define dimensionless flow duration and sediment rating curves for a region. The dimensionless relationships are scaled to other watershed reaches based on the bankfull flow rate and transport rate in the reach of interest. This method allows one dataset to analyze annual sediment yield over a range of drainage areas given the watershed conditions and channel stability characteristics are similar.

The POWERSED model converts the sediment rating curves from FLOWSED for a particular cross section from stream discharge to unit stream power. The hydraulic geometry by stage is computed and utilizing the energy slope the unit stream power can be computed by stage. Unit stream power has been demonstrated to have the best potential to predict bedload sediment transport rates (Bagnold 1980, Gomez and Church 1989) in river systems.

Unit Stream Power is defined by:

ω *(lb/ft/s) =* τV

where:

τ = bed shear stress (lb/ft^2) and

V = cross section average velocity (ft/s)

And;

Average bed shear stress (τ) is defined by:

$$\tau\ (lb/ft^2) = \gamma RS$$

where:

γ= specific weight of water (62.4 lb/ft^3)

R= cross section hydraulic radius (ft) and,

S= Slope of the energy grade line (ft/ft)

The POWERSED model can be used to compare proposed channel designs to existing conditions to examine the anticipated changes in stream power and sediment transport due to modifications of the channel cross section or longitudinal profile.

We performed this modeling for Henson Creek using RiverMorph software to investigate anticipated impacts of channel design changes on sediment transport in the reach. Stream gaging data from the Uncompahgre near Ouray (Gage 09146020) was utilized as the reference gage in the FLOWSED flow duration model development. These flows were scaled with the bankfull discharge for each stream to downscale their magnitude for the Henson Creek reach. The bedload sediment transport data collected for the feasibility analysis was utilized to develop a dimensionless bedload sediment rating curve for Henson Creek. HGD performed detailed cross section measurement for two stable reference sections within a mile upstream of the design reach (**Figure 7**) and these hydraulic characteristics were utilized to develop the reference stage vs. stream power relationship for the design sections. The upstream reference sections were computed and compared to:

1. Existing channel conditions downstream of the pedestrian bridge (**Figure 2d**).

2. Proposed channel design section (with a 50 ft. bankfull width, 3 ft. deep bankfull depth and 35 ft. width inner berm section, see details in channel design plans **Appendix A**).

The modeling results are presented in **Table 1**. The modeling results indicate that the upstream reaches of Henson Creek transport 689 tons of bedload which is in perfect agreement to the effective discharge analysis. The existing channel section downstream of the pedestrian bridge is predicted to only transport 69 tons/year indicating significant deposition which corroborates with the field observations at the site. The proposed design shows significant improvement in the routing of bedload through the reach with a predicted annual transport rate of 538 tons/year nearly a seven fold increase over existing bedload transport in the reach. The results still indicate some deposition will occur in the reach which should be expected given the gradient flattening in the alluvial valley near the confluence area which is a naturally depositional environment. The modeling indicates that the design is promising for reducing bedload sedimentation in the reach dramatically over existing flow conditions.

Sediment transport modeling is subject to great uncertainties in measurement and prediction, therefore it is tenuous to make precise quantitative predictions of the anticipated increase in quantity of bedload delivery to the downstream reaches. However, modeling results indicate that potentially 469 tons of sediment (approximately 312 cuyd) per year will be delivered to the Lake Fork in the confluence area and downstream. Hydraulic modeling results show that the reach average bankfull stream power in the Lake Fork downstream of the Henson Creek confluence exceeds the stream power in the lower reaches of Henson Creek (**Figure 8**). This indicates that bedload routed to this reach of the Lake Fork from Henson Creek should be routed to downstream reaches and distributed amongst point bars in the downstream areas. It is suggested that cross sections in the lower reaches of Henson Creek and the Lake Fork reaches downstream of the confluence be re-surveyed annual to measure depostional or erosional trends and long-term maintenance protocols be developed based on quantity calculations from these field measurements.


Figure 7 Stable reference sections utilized for Henson Creek design.

Table 1 FlowSed/PowerSed modeling results for Henson Creek.

Section	Annual Bedload Sediment Transport (tons/year)	% Change from upstream Reference
Upstream Reference	689	
Existing Channel downstream of Highway 149	69	-90%
Design Section	538	-22%

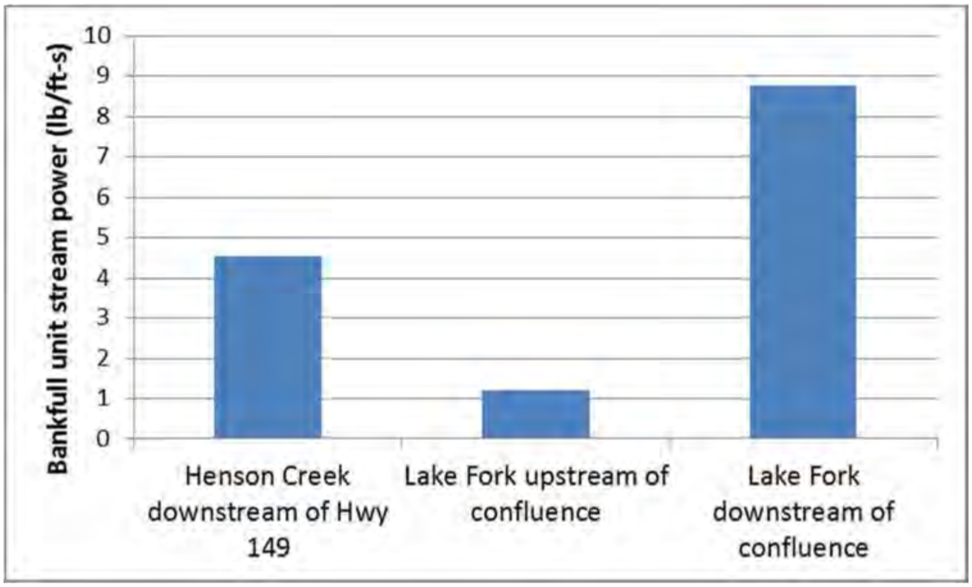


Figure8 Reach average bankfull stream power calculations.

5.0 Proposed Design In-stream Structure Quantities and Cost Estimate

Design quantities and cost estimates were developed by Webco and HGD to adhere to the project budget constraints. The design implementation was divided into two phases.

The project design for phase 1 called for 1371 CUYD of 3.5-4 ft. stream boulders. Cut and fill analysis on the proposed project sections predicted approximately 1500 CUYD of stream bed shaping and gravel removal. The primary component for phase 2 is a 348 LF rock terrace at the confluence. Summary tables of the construction quantities and cost estimate is provided in **Tables 2 and 3**.

Table 2 Phase 1 project design element quantities and cost estimates

Phase 1 -60% COST ESTIMATE										
ITEM	UNIT	QUANTITY	COST /UNIT	TOTAL COST ITEM	EST ROCK CUYD/ EA	TOTAL CUYD	ROCK COST/EA ($96.00/C UYD)	ROCK COST TOTAL	LABOR COST/EA	LABOR COST TOTAL
CROSS VANE	EA	6	$12,520.00	$75,120.00	95	570	$9,120.00	$54,720.00	$3,400.00	$20,400.00
J HOOK WITH CUT OFF SILL	EA	6	$9,230.00	$55,380.00	67.5	405	$6,480.00	$38,880.00	$2,750.00	$16,500.00
BED SILL	EA	6	$1,043.20	$6,259.20	6.7	40	$643.20	$3,859.20	$400.00	$2,400.00
BOULDER SPUR/VANE	EA	14	$2,804.40	$39,261.60	21.4	300	$2,054.40	$28,761.60	$750.00	$10,500.00
HABITAT CLUSTERS	EA	14	$699.00	$9,786.00	4	56	$384.00	$5,376.00	$315.00	$4,410.00
GRAVEL EXCAVATION/RESHAPING/REMOVAL	CUYD	1500	$10.00	$15,000.00						$15,000.00
TRANSPLANTS	LS		N/A	$2,500.00						$2,500.00
HEADGATE WORK	LS		N/A	$3,500.00						$3,500.00
RESLOPE RIPRAP BANKS WHERE FEASIBLE	LS		N/A	$1,250.00						$1,250.00
CONSTRUCTION ROCK SAFETY/EROSION CONTROL	LS		N/A	$1,500.00						$1,500.00
BOND	LS		N/A	$6,425.00						
TOTAL				**$215,981.80**		**1371**		**$131,596.80**		**$77,960.00**

Table 3 Phase 2 project design element quantities and cost estimates

PHASE 2-60% COST ESTIMATE										
ITEM	UNIT	QUANTITY	COST/UNIT	TOTAL COST ITEM	EST ROCK CUYD/EA	TOTAL CUYD	ROCK COST/EA ($96.00/CUYD)	ROCK COST TOTAL	LABOR COST/EA	LABOR COST TOTAL
CROSS VANE	EA	1	$12,520.00	$12,520.00	80	80	$9,120.00	$7680.00	$3,400.00	$3,400.00
ROCK TERRACE	EA	1	$62,400.00	$62,400.00	400	400	$38,400.00	$38,400.00	$24,000.00	$24,000.00
BOULDER SPUR/VANE	EA	2	$2,804.40	$5,608.80	21.4	43	$2,054.40	$4,108.80	$750.00	$1,500.00
GRAVEL EXCAVATION/PLACEMENT/REMOVAL	CUYD	900	$10.00	$9,000.00						$9,000.00
CONSTRUCTION ROCK SAFETY/EROSION CONTROL	LS		N/A	$500.00						$500.00
TOTAL				$90,028.80		538		$50,188.80		$38,400.00

6.0 Structure rock sizing and scour analysis

Boulder sizing for rock structures

NRCS (Rosgen 2007) provides a rock sizing method for J-hook, Vane and Cross Vane structures provided by Rosgen based on the bankfull (or design flow) tractive stress. This relationship is provided in **Figure 9** and provides a stable rock sizing criteria for J-hooks and cross vanes.

The regression relationship for the Rosgen data is

ϕ (m) =0.1724 LN (T) +0.6349

Where:

ϕ= stable rock size (m)

T=tractive force (kg/m^2) and;

Tractive Force (T) (kg/m^2) =1000* Depth (m)* Energy Slope (m/m).

Both top rocks and footer rocks should be designed using these criteria for stability.

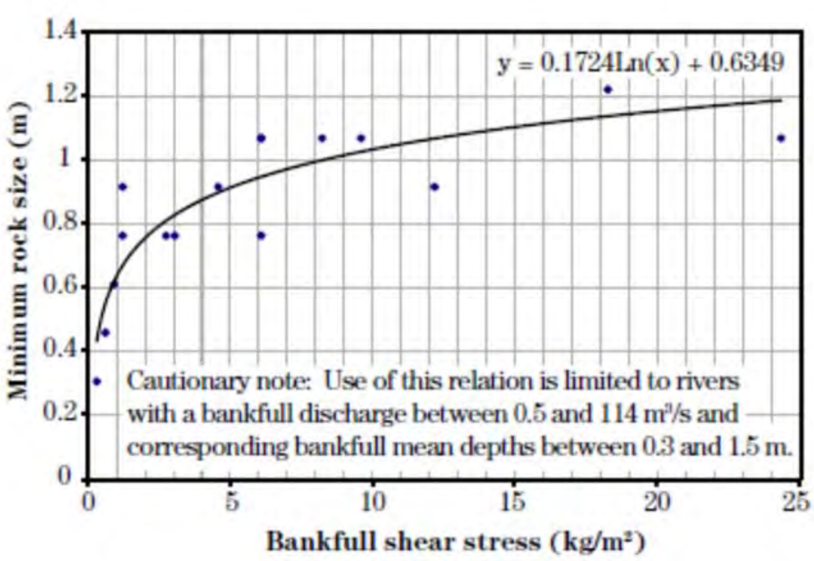


Figure 9 Rock sizing criteria for J-hooks, Vanes and Cross Vanes (NRCS 2007).

The HEC RAS hydraulic models of the proposed design were utilized to determine the reach average design parameters for rock sizing in the Henson Creek reach based on two flow rates:

1. Bankfull flow (700 cfs)

2. 10-year recurrence interval flow (1400 cfs).

The design calculations were tabulated and converted into a nominal rock sizing converted to feet. The results of this analysis are presented in **Table 4**. The resulting value of 3.67 feet for the 10-year event was utilized for the design and construction of the project. The resulting nominal boulder size for the in-stream structures was determined to be 4 feet.

Table 4 Rock Sizing Summary

Input Parameter	**Description**	**Value 10 yr (1400 cfs)**	**Value BKF (700 cfs)**
D-d (m)	Flow depth at design discharge	1.46	1.07
S-ed (ft/ft)	Energy Slope at design discharge	0.0114	0.0114
T (kg/m2)	Tractive force at design discharge = 1000*Dd*Sed	16.644	12.198
Output Parameter	**Description**	**Value 10 yr (1400 cfs)**	**Value BKF (700 cfs)**
Rs (m)	Stable boulder size in meters= 0.1724*ln (T)+0.6349	1.12	1.07
Rs (ft)	stable boulder size in feet	3.67	3.50

Scour depth calculations for footer placement

Three equations were tested to determine the suitable depth for footer rock placement on cross vane and J-hook structures in the design. These equations were developed for coarse grained steep mountain streams similar to Henson Creek and the Lake Fork. The equations utilized were:

1. Veronese Equation.

2. Lenzi et al. 2002.

3. Thomas et al. 2000.

Definition sketches of these equations and methods along with the accompanying calculations can be viewed in **Appendix B**. The results of the analysis vary in predicting the depth of the downstream scour pool below the structures. The predicted scour depth varies between 1.83-5.48 ft. below the top rock elevation on the structures. The design utilized the 10-year design flow of 1400 cfs and selected the average of the two most conservative scour predictions of 3.62 and 5.48 feet. Therefore, the footer depth of the downstream footer rock was specified to be a minimum of 4.5 feet below the top rock elevation. Also the scour pools were dug during the construction of the projects and located a minimum of 8 feet downstream of the overflow weir to resisting footer erosion. Deep scour pools provide excellent fisheries habitat and the design will allow for this while still providing structure stability for the 1400 cfs design flow.

7.0 Hydraulic modeling and flood risk assessment

The proposed project design elements were modeled for impacts to the 100 year water surface elevation using the HEC-RAS 4.1 modeling software. Extensive work had been during the feasibility study phase of the project to develop the hydraulic model of the existing conditions for the project reach using total station and LIDAR data sources. HGD utilized the existing model and added:

- Obstructions to represent in-stream structures
- Obstructions to model the rock terrace
- Channel shaping and profile alterations
- Additional cross sections in key structure locations

This model was utilized to determine the potential impacts of the project on the 100-year water surface and to investigate channel hydraulic changes for the bankfull flow rate of 700 cfs. The reaches in the project area are zoned FEMA floodzones AE with base flood elevations. However floodway is not defined within the reach so the FEMA tolerance for rise in the floodzone is +1 foot. The results of the proposed conditions model were compared to the existing conditions (**Table 5**). In the Henson Creek reach the model predicts an average draw down of 0.18 feet throughout the reach for the 100 year flow. There are some localized spikes in water surface in the immediate vicinity of structures with a maximum spike of 0.53 feet just downstream of the Highway 149 bridge. This rise is negligible upstream and downstream of the structure. The Lake Fork has an average 100 year flood rise of 0.14 feet with a maximum spike downstream of Second Street of 0.54 feet in the vicinity of boulders vanes constructed at this location. Modeling results Tables are provided in **Appendix C**.

Table 5 HEC-RAS 100 year flood rise summary modeling results

Reach	100 year flow rate (cfs)	Average change in 100 yr water surface (ft)	Maximum rise in 100 yr water surface (ft)
Henson Creek	2300	-0.18	+0.53
Lake Fork	3600	+0.14	+0.54

8.0 Headgate maintenance and town ditch improvements

As a part of the project design scope Webco Inc. and HGD were required to provide a design that at a minimum would not impair flow rates at the existing headgate and ideally would improve those flow rates. As a part of the design the existing flow diversion structure was reconstructed and the invert was raised 0.3 feet to improve the hydraulic head entering the headgate area. The project budget allotted for $3500 to improve the headgate area, the feasibility plan called for replacing the existing headgate structure and the pipe leading to the ditch. Webco and HGD determined that this would not likely improve flow conditions in the reach because the flow rate is currently limited by the flat gradient downstream leading to the existing siltation pond. It was determined that the best use of the funding for the ditch improvements would be to re-grade and clear obstructions from the ditch downstream of the current outlet. After this grading is complete the sediment should be flushed from the existing headgate pipe to further improve flow conditions. It was determined that the existing headgate was functional and operational but the headgate metal could possibly be re-shaped to improve the closure seal. HGD surveyed the profile of the existing ditch from the headgate outlet downstream to the point where it re-enters the Lake Fork near Second Street. This profile is shown in **Figure 10**.

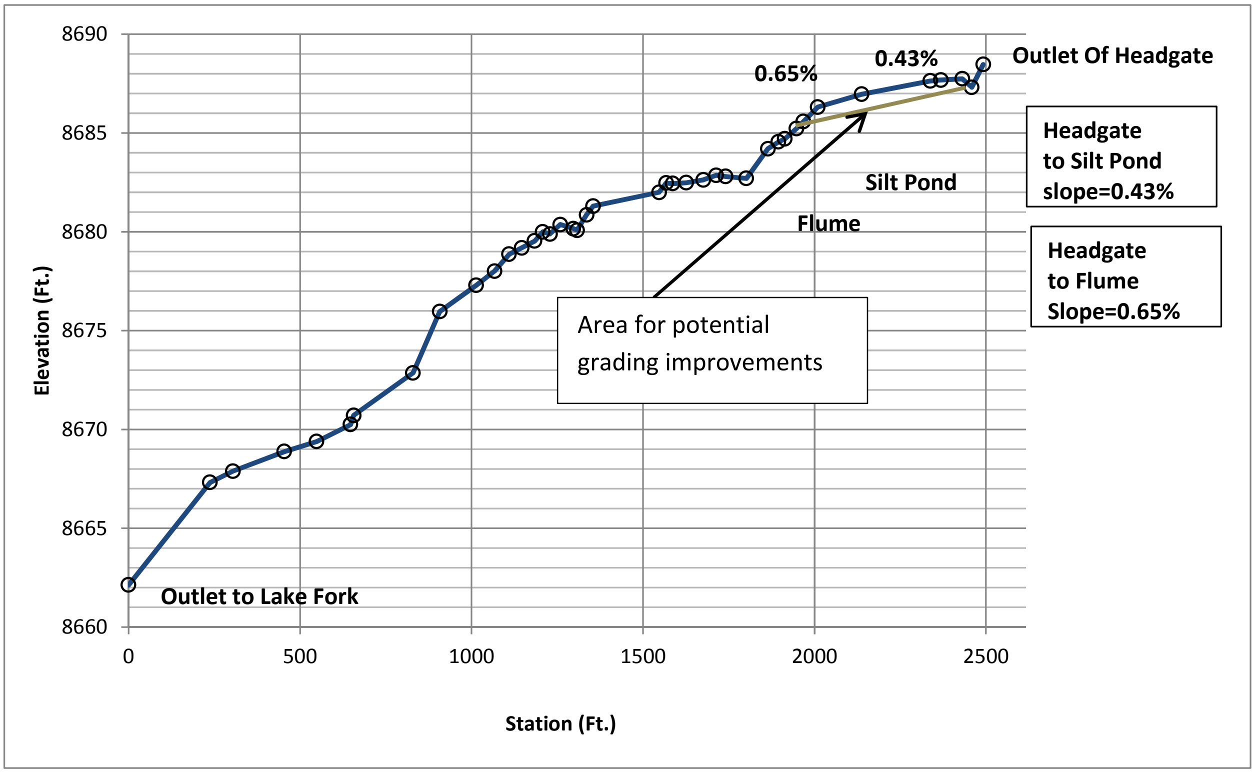


Figure 10 Lake City town ditch profile survey November 2013.

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Appendix A

Design Plans

Appendix B Scour Definition Sketches and Calculations

Veronese Equation (1937)

Input Parameters	Description	Value
Ht (ft)	hydraulic head differential between headwater and tailwater	0.5
weir width (ft)		50
Qd (cfs)	design discharge	1400
q (cfs/ft)	unit discharge per length of weir at design flow rate	28.00
downstream tailwater depth (ft)		5
Output scour prediction	**Description**	**Value**
ds (ft)	predicted scour depth below tailwater elevation	6.83
d bs(ft)	depth of bed scour (tailwater depth-ds)	1.83

Lenzi et al. 2002

Input Parameters	Description	Value
D50 (mm)	median bed material size	102
D50 (ft)	median bed material size	0.33
delta Sg	submerged density of rock	1.65
weir width (ft)	width of flow weir	50
g	gravity (ft/s2)	32.2
Qd (cfs)	design discharge	1400
q (cfs/ft)	unit discharge per length of weir at design flow rate	28.00
So	initial bed slope (ft/ft)	0.012
Seq	equilibrium bed slope (ft/ft)	0.01
Ls	horizontal distance between structures	124
a1	morphological jump= (So-Seq)*Ls	0.248
Hs	specific energy of critical flow over the weir (ft)=1.5*(q^2/g)^1/3	12.2

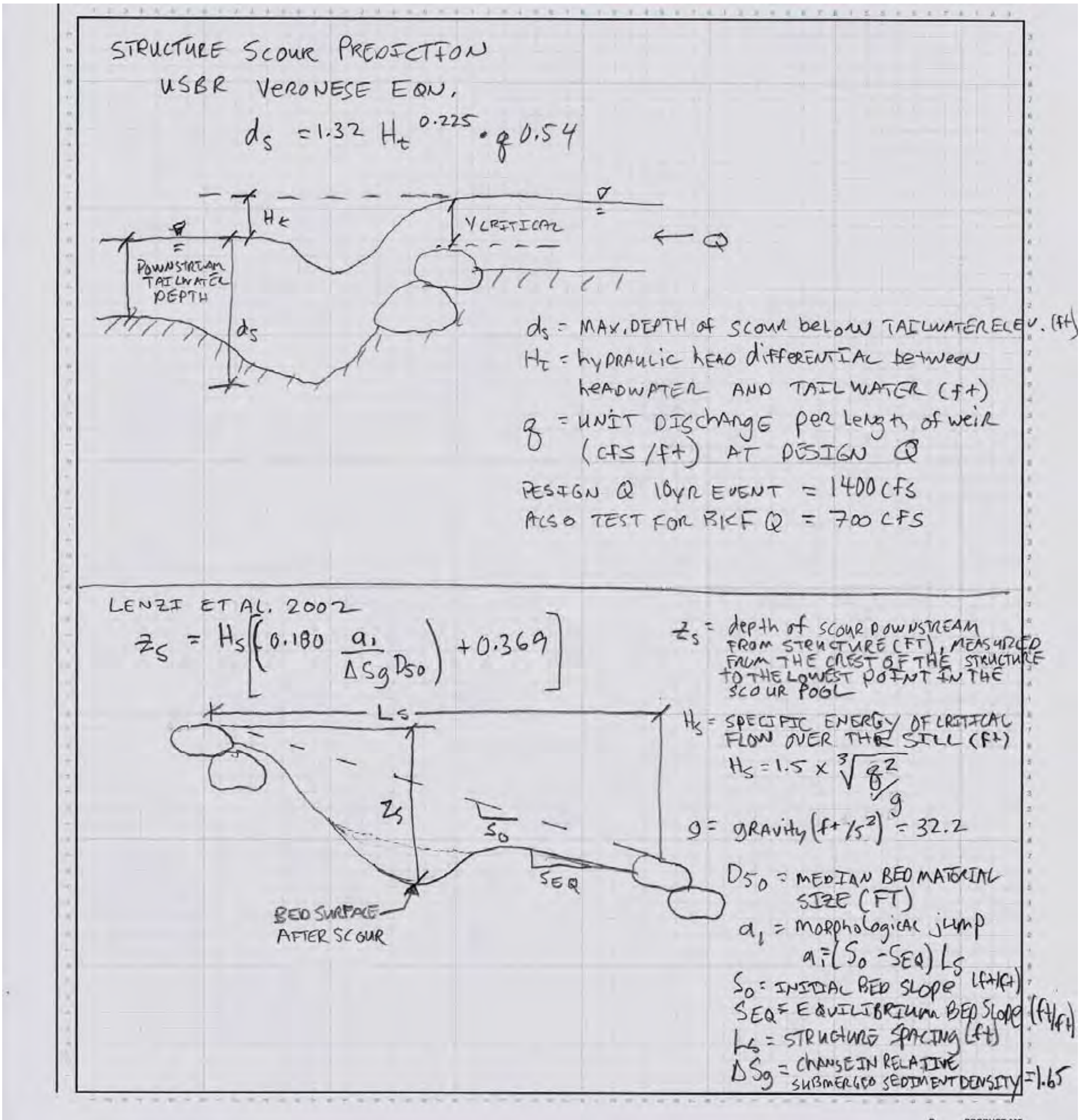
Output scour prediction	Description	Value
zs (ft)	predicted scour depth downstream from the structure measured from the structure crest	5.48

Thomas et al. 2000

Input Parameters	Description	Value
W (ft)	active channel width	50
S (ft/ft)	average channel slope	0.011
hd (ft)	height of step crest above controlling bed elevation at downstream end of pool	3.00
weir width (ft)	width of flow weir	50
g	gravity (ft/s2)	32.2
Qd (cfs)	design discharge	1400
q (cfs/ft)	unit discharge per length of weir at design flow rate	28.00

Output scour prediction	Description	Value
zs (ft)	predicted scour depth downstream from the structure measured from the structure crest	3.63

Scour Equation Definition Sketches.



THOMAS ET AL. 2000 (DEVELOPED FOR STEP-POOL COLORADO DATA)

$$Z_s = W\left[-0.0118 + 1.394\left(\frac{hd}{W}\right) + 5.514\left(\frac{S \cdot q_{10}}{W^{3/2}\sqrt{g}}\right)\right]$$

Where:

Z_s = depth of scour downstream of structure (ft) measured from crest of structure to low point in pool

W = average active channel width (ft)

hd = height of step crest above controlling bed elev. at downstream end of pool (ft)

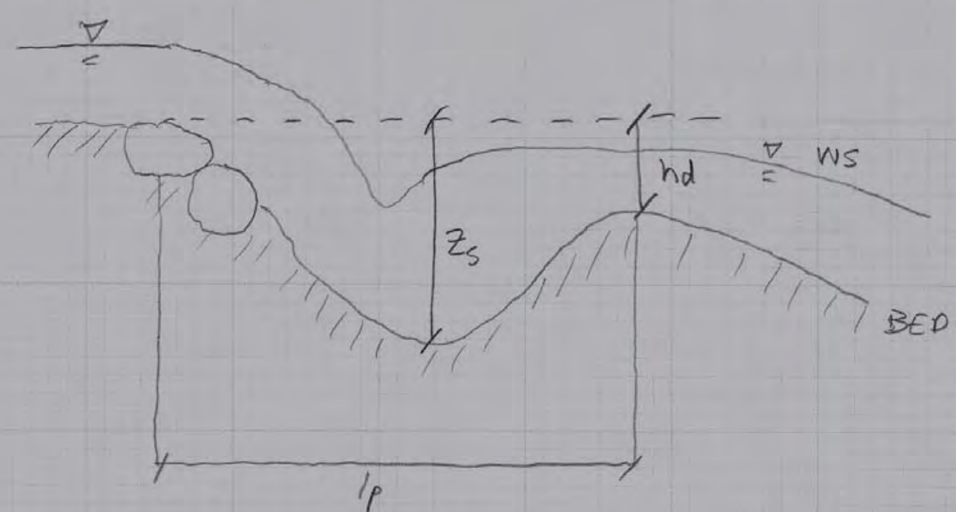
S = average channel slope (ft/ft)

q = flow per unit width over sill at design discharge (cfs/ft) i.e. 10-year event q_{10}

g = gravity 32.2 (ft/s²)

l_p = length of scour pool (ft)

DEFINITION SKETCH



Appendix C HEC-RAS modeling results for 100 year flood flows.

Henson Creek 100 year flow modeling results

Reach	River Sta	Profile	Plan	Q Total	W.S. Elev	Vel Chnl	Flow Area	Top Width	WSEL Diff.
				(cfs)	(ft)	(ft/s)	(sq ft)	(ft)	(ft)
1	2356.731	100-yr	EXISTING	2300	8698.89	9.7	324.53	133.24	0
1	2356.731	100-yr	proposed rock t	2300	8698.89	9.7	324.53	133.24	
1	2275.736	100-yr	EXISTING	2300	8697.85	9.09	314.15	135.81	0
1	2275.736	100-yr	proposed rock t	2300	8697.85	9.09	314.15	135.81	
1	2213.673	100-yr	EXISTING	2300	8696.72	9.35	262.4	108.52	0
1	2213.673	100-yr	proposed rock t	2300	8696.72	9.35	262.62	108.56	
1	2166.895	100-yr	EXISTING	2300	8695.97	9.03	257.76	99.14	0.06
1	2166.895	100-yr	proposed rock t	2300	8696.03	9.31	250.12	95.87	
1	2147.827	100-yr	EXISTING	2300	8695.75	8.36	279.32	96.64	0.17
1	2147.827	100-yr	proposed rock t	2300	8695.92	6.89	338.53	97.15	
1	2134.156	100-yr	EXISTING	2300	8695.87	6.96	335.95	100.14	0.27
1	2134.156	100-yr	proposed rock t	2300	8696.14	4.84	482.82	100.91	
1	2120.156	100-yr	EXISTING	2300	8695.85	6.62	356.88	96.83	0.37
1	2120.156	100-yr	proposed rock t	2300	8696.22	3.78	621.69	99.17	
1	2097.115	100-yr	EXISTING	2300	8694.85	9.66	246.24	100.73	0
1	2097.115	100-yr	proposed rock t	2300	8694.85	9.66	246.24	100.73	
1	2017.2	100-yr	EXISTING	2300	8694.05	8.39	285.01	121.05	0.05
1	2017.2	100-yr	proposed rock t	2300	8694.1	8.25	290.97	121.68	
1	1943.288	100-yr	EXISTING	2300	8693.56	7.74	321.56	122.53	-0.36
1	1943.288	100-yr	proposed rock t	2300	8693.2	8.91	277.9	119.06	
1	1872.55	100-yr	EXISTING	2300	8692.2	9.61	239.25	80	-0.51
1	1872.55	100-yr	proposed rock t	2300	8691.69	9.72	236.62	78.35	
1	1802.141	100-yr	EXISTING	2300	8690.81	9.4	244.71	90.87	-0.19

Reach	River Sta	Profile	Plan	Q Total	W.S. Elev	Vel Chnl	Flow Area	Top Width	WSEL Diff.
				(cfs)	(ft)	(ft/s)	(sq ft)	(ft)	(ft)
1	1802.141	100-yr	proposed rock t	2300	8690.62	6.76	340.31	90.51	
1	1744.487	100-yr	EXISTING	2300	8690.42	7.6	302.65	92.07	0.01
1	1744.487	100-yr	proposed rock t	2300	8690.43	6.26	367.47	91.39	
1	1694.46	100-yr	EXISTING	2300	8690.19	7.13	322.62	95.94	0.04
1	1694.46	100-yr	proposed rock t	2300	8690.23	6.31	364.35	96.71	
1	1659.211	100-yr	EXISTING	2300	8689.96	7.33	313.95	79.68	0.2
1	1659.211	100-yr	proposed rock t	2300	8690.16	6.07	378.83	83.04	
1	1627.621	100-yr	EXISTING	2300	8689.74	7.51	306.55	78.09	-0.08
1	1627.621	100-yr	proposed rock t	2300	8689.66	7.68	299.77	77.8	
1	1607.71	100-yr	EXISTING	2300	8688.86	9.95	231.26	65.97	0
1	1607.71	100-yr	proposed rock t	2300	8688.86	9.81	234.44	65.97	
1	1593.24	100-yr	EXISTING	2300	8688.93	8.9	258.45	64.56	-0.06
1	1593.24	100-yr	proposed rock t	2300	8688.87	9.02	254.92	64.36	
1	1548.899	100-yr	EXISTING	2300	8688.6	8.74	263.22	69.13	-0.1
1	1548.899	100-yr	proposed rock t	2300	8688.5	8.92	257.78	68.06	
1	1518.245	100-yr	EXISTING	2300	8688.63	7.46	308.34	75.37	-0.15
1	1518.245	100-yr	proposed rock t	2300	8688.48	7.72	297.79	74.8	
1	1482.565	100-yr	EXISTING	2300	8688.35	7.73	297.45	82.95	-0.21
1	1482.565	100-yr	proposed rock t	2300	8688.14	8.15	282.28	74.65	
1	1417.361	100-yr	EXISTING	2300	8687.88	8.03	286.35	495.49	-0.09
1	1417.361	100-yr	proposed rock t	2300	8687.79	7.78	295.57	478.41	
1	1382.662	100-yr	EXISTING	2300	8687.68	8.04	291.44	526.08	0.02
1	1382.662	100-yr	proposed rock t	2300	8687.7	7.33	319.49	528.53	
1	1355.896	100-yr	EXISTING	2300	8686.79	10.23	224.81	88.19	0.52
1	1355.896	100-yr	proposed rock t	2300	8687.31	8.28	277.87	106.8	
1	1318.04	100-yr	EXISTING	2300	8686.62	9.36	245.61	80.13	-0.46

Reach	River Sta	Profile	Plan	Q Total	W.S. Elev	Vel Chnl	Flow Area	Top Width	WSEL Diff.
				(cfs)	(ft)	(ft/s)	(sq ft)	(ft)	(ft)
1	1318.04	100-yr	proposed rock t	2300	8686.16	10.84	212.24	72.81	
1	1298.04*	100-yr	EXISTING	2300	8686.69	8.2	280.37	85.07	-0.95
1	1298.04*	100-yr	proposed rock t	2300	8685.74	7.99	287.9	64.7	
1	1293.04*	100-yr	EXISTING	2300	8686.63	8.34	275.77	84.66	-0.93
1	1293.04*	100-yr	proposed rock t	2300	8685.7	8.08	284.75	64.26	
1	1288.04*	100-yr	EXISTING	2300	8686.54	8.51	270.24	84.2	-0.9
1	1288.04*	100-yr	proposed rock t	2300	8685.64	8.17	281.44	63.79	
1	1283.04*	100-yr	EXISTING	2300	8686.45	8.73	263.6	83.67	-0.86
1	1283.04*	100-yr	proposed rock t	2300	8685.59	8.28	277.72	63.26	
1	1278.04*	100-yr	EXISTING	2300	8686.33	9	255.53	83.05	-0.81
1	1278.04*	100-yr	proposed rock t	2300	8685.52	8.4	273.9	62.72	
1	1273.04*	100-yr	EXISTING	2300	8685.85	10.3	223.27	65.61	-0.39
1	1273.04*	100-yr	proposed rock t	2300	8685.46	8.52	269.88	62.14	
1	1242.335	100-yr	EXISTING	2300	8685.34	10.19	225.75	68.65	-0.77
1	1242.335	100-yr	proposed rock t	2300	8684.57	10.42	220.8	63.63	
1	1203.98	100-yr	EXISTING	2300	8684.59	10.14	226.78	69.79	-0.59
1	1203.98	100-yr	proposed rock t	2300	8684	10.34	222.42	65.15	
1	1169.856	100-yr	EXISTING	2300	8684.82	7.04	327.75	102.01	-0.66
1	1169.856	100-yr	proposed rock t	2300	8684.16	6.49	354.62	79.88	
1	1142.057	100-yr	EXISTING	2300	8683.85	9.69	238.5	81.31	0.38
1	1142.057	100-yr	proposed rock t	2300	8684.23	5.36	431.41	85.18	
1	1100.992	100-yr	EXISTING	2300	8683.7	7.87	292.38	81.23	-0.49
1	1100.992	100-yr	proposed rock t	2300	8683.21	8.86	259.47	78.95	
1	1071.789	100-yr	EXISTING	2300	8683.23	8.71	263.93	70.75	-0.1
1	1071.789	100-yr	proposed rock t	2300	8683.13	8.03	286.55	70.66	
1	1038.272	100-yr	EXISTING	2300	8683.01	8.37	274.72	77.63	-0.07

Reach	River Sta	Profile	Plan	Q Total	W.S. Elev	Vel Chnl	Flow Area	Top Width	WSEL Diff.
				(cfs)	(ft)	(ft/s)	(sq ft)	(ft)	(ft)
1	1038.272	100-yr	proposed rock t	2300	8682.94	7.85	292.92	77.77	
1	996.4161	100-yr	EXISTING	2300	8682.81	7.69	299.06	83.16	0.09
1	996.4161	100-yr	proposed rock t	2300	8682.9	6.64	346.33	84.26	
1	958.7118	100-yr	EXISTING	2300	8682.61	7.42	310.18	85.16	0.13
1	958.7118	100-yr	proposed rock t	2300	8682.74	6.64	346.83	86.49	
1	930.475	100-yr	EXISTING	2300	8682.5	7.11	323.27	81.43	0.25
1	930.475	100-yr	proposed rock t	2300	8682.75	5.85	393.46	96.37	
1	909.3434	100-yr	EXISTING	2300	8682.3	7.49	306.99	79.58	0
1	909.3434	100-yr	proposed rock t	2300	8682.3	7.49	306.99	79.58	
1	900			Bridge					
1	853.5319	100-yr	EXISTING	2300	8680.6	8.34	275.92	79.5	-0.2
1	853.5319	100-yr	proposed rock t	2300	8680.4	8.84	260.13	78.23	
1	834.8418	100-yr	EXISTING	2300	8680.07	9.47	242.8	71.84	0.53
1	834.8418	100-yr	proposed rock t	2300	8680.6	6.97	330.18	74.49	
1	799.3808	100-yr	EXISTING	2300	8679.86	8.74	263.09	74.68	-0.07
1	799.3808	100-yr	proposed rock t	2300	8679.79	9.1	252.64	73.6	
1	761.9077	100-yr	EXISTING	2300	8679.66	8.05	285.59	83.47	0.23
1	761.9077	100-yr	proposed rock t	2300	8679.89	6.96	330.24	84.65	
1	734.178	100-yr	EXISTING	2300	8679.42	8.1	283.9	84.33	0
1	734.178	100-yr	proposed rock t	2300	8679.42	8.09	284.23	84.35	
1	709.7996	100-yr	EXISTING	2300	8679.03	8.69	264.67	81.83	0.06
1	709.7996	100-yr	proposed rock t	2300	8679.09	8.54	269.47	82.19	
1	680.6747	100-yr	EXISTING	2300	8678.48	9.36	245.71	82.23	-0.12
1	680.6747	100-yr	proposed rock t	2300	8678.36	9.76	235.55	81.62	
1	649.9501	100-yr	EXISTING	2300	8678.57	7.35	312.71	90.52	-0.52
1	649.9501	100-yr	proposed rock t	2300	8678.05	8.93	257.49	88.13	

Reach	River Sta	Profile	Plan	Q Total	W.S. Elev	Vel Chnl	Flow Area	Top Width	WSEL Diff.
				(cfs)	(ft)	(ft/s)	(sq ft)	(ft)	(ft)
1	619.0444	100-yr	EXISTING	2300	8678.46	6.87	334.68	94.2	-0.55
1	619.0444	100-yr	proposed rock t	2300	8677.91	7.92	290.24	92.16	
1	591.9453	100-yr	EXISTING	2300	8678.32	6.82	337.48	91.38	-0.54
1	591.9453	100-yr	proposed rock t	2300	8677.78	7.43	309.55	89.69	
1	573.8367	100-yr	EXISTING	2300	8677.76	8.47	271.42	85.1	0.09
1	573.8367	100-yr	proposed rock t	2300	8677.85	6.38	360.76	85.52	
1	570			Bridge					
1	553.1844	100-yr	EXISTING	2300	8677.72	7.61	302.24	84.53	-0.28
1	553.1844	100-yr	proposed rock t	2300	8677.44	7.63	301.26	83.51	
1	530.8878	100-yr	EXISTING	2300	8677.18	8.84	260.04	81.74	0.02
1	530.8878	100-yr	proposed rock t	2300	8677.2	7.96	289.1	81.8	
1	510	100-yr	proposed rock t	2300	8676.38	9.75	235.99	78.19	
1	458.6881	100-yr	EXISTING	2300	8676.91	7.39	311.19	73.44	-0.33
1	458.6881	100-yr	proposed rock t	2300	8676.58	6.73	341.75	71.12	
1	419.7087	100-yr	EXISTING	2300	8676.79	6.97	330.15	76.35	-0.68
1	419.7087	100-yr	proposed rock t	2300	8676.11	7.87	292.07	73.68	
1	361.8581	100-yr	EXISTING	2300	8677.05	4.3	879.34	432.62	-1.65
1	361.8581	100-yr	proposed rock t	2300	8675.4	8.85	259.99	262.42	
1	316.6288	100-yr	EXISTING	2300	8676.96	4.51	859.99	395.41	-1.32
1	316.6288	100-yr	proposed rock t	2300	8675.64	6.29	366.99	272.6	
1	278.7011	100-yr	EXISTING	2300	8675.69	9.16	259.63	287.45	-0.4
1	278.7011	100-yr	proposed rock t	2300	8675.29	7.27	316.47	181.49	
1	237.41	100-yr	EXISTING	2300	8674.74	10.8	215.08	166.12	0.49
1	237.41	100-yr	proposed rock t	2300	8675.23	6.72	361.72	261.46	
1	184.3618	100-yr	EXISTING	2300	8675.05	6.57	385.86	238.8	0.15

Reach	River Sta	Profile	Plan	Q Total	W.S. Elev	Vel Chnl	Flow Area	Top Width	WSEL Diff.
				(cfs)	(ft)	(ft/s)	(sq ft)	(ft)	(ft)
1	184.3618	100-yr	proposed rock t	2300	8675.2	5.85	436.46	247.04	
1	149.4	100-yr	EXISTING	2300	8675.18	4.82	508.95	239.91	0.12
1	149.4	100-yr	proposed rock t	2300	8675.3	4.35	563.41	258.37	
1	116.8756	100-yr	EXISTING	2300	8675.21	3.9	612.97	286.35	0.07
1	116.8756	100-yr	proposed rock t	2300	8675.28	4.06	591.34	294.54	
1	91.36159	100-yr	EXISTING	2300	8675.25	3.19	736.6	264.84	0.05
1	91.36159	100-yr	proposed rock t	2300	8675.3	3.48	675.49	267.13	

Lake Fork 100 year flow modeling results

Reach	River Sta	Profile	Plan	Q Total	W.S. Elev	Vel Chnl	Flow Area	Top Width	WSEL Diff.
				(cfs)	(ft)	(ft/s)	(sq ft)	(ft)	(ft)
US	15016.34	100-yr	EXISTING	3600	8676.06	6.92	1042.99	561.73	
US	15016.34	100-yr	proposed rock t	3600	8676.13	6.27	1131.82	565.05	0.07
US	14972.03	100-yr	EXISTING	3600	8675.93	7.34	1015.65	580.2	
US	14972.03	100-yr	proposed rock t	3600	8676.07	6.59	1109.51	592.57	0.14
US	14924.7	100-yr	EXISTING	3600	8676.01	6.1	1295.38	629.45	
US	14924.7	100-yr	proposed rock t	3600	8676.11	5.46	1372.64	638.53	0.1
US	14877.37	100-yr	EXISTING	3600	8676.07	5	1526.13	671.94	
US	14877.37	100-yr	proposed rock t	3600	8676.14	4.5	1681.49	677.43	0.07
US	14831.97	100-yr	EXISTING	3600	8675.95	5.47	1247.15	628.41	
US	14831.97	100-yr	proposed rock t	3600	8676.08	4.63	1404.94	640.84	0.13
US	14771.26	100-yr	EXISTING	3600	8675.91	5.23	1322.59	635.65	
US	14771.26	100-yr	proposed rock t	3600	8676.01	4.9	1372.07	638.41	0.1
US	14716.06	100-yr	EXISTING	3600	8675.85	5.69	1254.42	621.06	
US	14716.06	100-yr	proposed rock t	3600	8675.92	5.57	1281.66	622.68	0.07
US	14666.31	100-yr	EXISTING	3600	8675.82	5.48	1287.75	594.75	
US	14666.31	100-yr	proposed rock t	3600	8675.88	5.38	1312.48	619.73	0.06
US	14630.89	100-yr	EXISTING	3600	8675.76	5.56	1202.25	604.39	
US	14630.89	100-yr	proposed rock t	3600	8675.85	5.16	1282.93	611.93	0.09
US	14594.16	100-yr	EXISTING	3600	8675.69	5.13	1040.67	573.94	
US	14594.16	100-yr	proposed rock t	3600	8675.83	4.58	1153.07	581.33	0.14
US	14569.94	100-yr	EXISTING	3600	8675.44	6.17	726.05	387.5	
US	14569.94	100-yr	proposed rock t	3600	8675.57	5.95	807.43	450.04	0.13
US	14542.4	100-yr	EXISTING	3600	8675.4	6	707.89	311.61	
US	14542.4	100-yr	proposed rock t	3600	8675.46	6.1	701.86	330.31	0.06
US	14524.66	100-yr	EXISTING	3600	8675.37	6.03	690.22	207.5	
US	14524.66	100-yr	proposed rock t	3600	8675.52	5.36	779.42	228.92	0.15

Reach	River Sta	Profile	Plan	Q Total	W.S. Elev	Vel Chnl	Flow Area	Top Width	WSEL Diff.
				(cfs)	(ft)	(ft/s)	(sq ft)	(ft)	(ft)
US	14505.72	100-yr	EXISTING	3600	8675.39	5.54	751.05	244.96	
US	14505.72	100-yr	proposed rock t	3600	8675.57	4.68	894.34	259.94	0.18
US	14490.3	100-yr	EXISTING	3600	8675.37	5.52	734.62	237.23	
US	14490.3	100-yr	proposed rock t	3600	8675.29	6.12	662.95	231.77	-0.08
US	14473.83	100-yr	EXISTING	3600	8675.34	5.55	728.58	243.22	
US	14473.83	100-yr	proposed rock t	3600	8675.32	5.67	710.05	242.48	-0.02
US	14455.53	100-yr	EXISTING	3600	8675.18	6.22	638.84	234.84	
US	14455.53	100-yr	proposed rock t	3600	8675.36	5.06	786.66	240.19	0.18
US	14437.65	100-yr	EXISTING	3600	8675.17	6.05	650.96	233.95	
US	14437.65	100-yr	proposed rock t	3600	8675.21	5.77	681.23	235.89	0.04
US	14421.67	100-yr	EXISTING	3600	8675.22	5.39	722.56	250.77	
US	14421.67	100-yr	proposed rock t	3600	8675.28	5.01	776.4	253.41	0.06
US	14400.52	100-yr	EXISTING	3600	8675.15	5.65	681.86	256.6	
US	14400.52	100-yr	proposed rock t	3600	8675.28	4.74	809.86	257.59	0.13
US	14371.98	100-yr	EXISTING	3600	8675.16	5.23	779.95	253.35	
US	14371.98	100-yr	proposed rock t	3600	8675.29	4.43	920.35	253.42	0.13
US	14346.81	100-yr	EXISTING	3600	8675.17	4.84	776.2	155.61	
US	14346.81	100-yr	proposed rock t	3600	8675.24	4.59	819.06	155.64	0.07
DS	14181.1	100-yr	EXISTING	5800	8673.99	8.56	688.95	111.7	
DS	14181.1	100-yr	proposed rock t	5800	8674.08	8.45	699.11	112.11	0.09
DS	14152.4	100-yr	EXISTING	5800	8673.28	10.32	571.95	105.34	
DS	14152.4	100-yr	proposed rock t	5800	8673.44	10.06	590.09	118.84	0.16
DS	14126.63	100-yr	EXISTING	5800	8672.89	10.86	544.26	145.28	
DS	14126.63	100-yr	proposed rock t	5800	8673.25	10.17	602.18	168.97	0.36
DS	14058.48	100-yr	EXISTING	5800	8672.9	9.15	727.98	291.06	
DS	14058.48	100-yr	proposed rock t	5800	8673.06	9.37	716.92	292.45	0.16

Reach	River Sta	Profile	Plan	Q Total	W.S. Elev	Vel Chnl	Flow Area	Top Width	WSEL Diff.
				(cfs)	(ft)	(ft/s)	(sq ft)	(ft)	(ft)
DS	14011.98	100-yr	EXISTING	5800	8673.04	7.52	959.38	298.53	
DS	14011.98	100-yr	proposed rock t	5800	8673.17	7.75	935.21	299.5	0.13
DS	13970.44	100-yr	EXISTING	5800	8672.96	7.43	1042.15	279.82	
DS	13970.44	100-yr	proposed rock t	5800	8673.11	7.42	1042.87	281.85	0.15
DS	13929.23	100-yr	EXISTING	5800	8673.01	6.36	1191.07	269.22	
DS	13929.23	100-yr	proposed rock t	5800	8673.11	6.61	1151.78	270.22	0.1
DS	13893	100-yr	EXISTING	5800	8671	12.15	528.94	174.75	
DS	13893	100-yr	proposed rock t	5800	8671.22	11.98	552.95	177.91	0.22
DS	13860.99	100-yr	EXISTING	5800	8671.5	9.61	760.29	184.49	
DS	13860.99	100-yr	proposed rock t	5800	8671.68	9.53	777.45	201.3	0.18
DS	13802.35	100-yr	EXISTING	5800	8670.82	11.25	700.03	186.66	
DS	13802.35	100-yr	proposed rock t	5800	8671.36	10.2	803.94	207.77	0.54
DS	13749.15	100-yr	EXISTING	5800	8669.48	13.25	472.59	102.06	
DS	13749.15	100-yr	proposed rock t	5800	8669.72	13.13	486.34	119.67	0.24
DS	13693.46	100-yr	EXISTING	5800	8669.05	12.85	481.26	126.25	
DS	13693.46	100-yr	proposed rock t	5800	8669.26	12.73	495.39	132.95	0.21
DS	13643.06	100-yr	EXISTING	5800	8668.73	12.44	505.92	130.53	
DS	13643.06	100-yr	proposed rock t	5800	8669.01	12.06	532.16	133.84	0.28
DS	13578.96	100-yr	EXISTING	5800	8668.76	10.58	635.32	170.25	
DS	13578.96	100-yr	proposed rock t	5800	8668.9	10.59	639.94	174.98	0.14

CAMILLE RICHARD
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CAREER PROFILE

Natural Resource Management Specialist with international and domestic experience in integrated ecological and social research, conservation and development planning and implementation, ecological restoration, and natural resources training program development and instruction.

EDUCATION

MASTER'S CERTIFICATE IN GEOGRAPHICAL INFORMATION SYSTEMS. **2008.** University of Western Florida.

MASTER OF SCIENCE RANGE MANAGEMENT**. 1990.** Colorado State University. Research conducted on revegetation of short grass prairie species.

BACHELOR OF ARTS ENVIRONMENTAL BIOLOGY**. 1984.** Trinity University, Texas

PROFESSIONAL EXPERIENCE:

2008-present *PROJECT DIRECTOR*, Lake Fork Valley Conservancy, Lake City, CO, USA

- Oversee the implementation of EPA and state funded watershed restoration planning initiatives in the Lake Fork of the Gunnison River Watershed in SW Colorado.
- Responsible for strategic planning, annual work plans, budgeting, and reporting for the organization.
- Facilitate partnerships with State, Federal and non-profit organizations for research, restoration and outreach activities.
- Coordinate stakeholder input into the organization's ten year strategic plan for the watershed.
- Responsible for a staff of two, one hired through the Americorps VISTA program.
- Spearheaded the organizational development of LFVC to become a fully functioning 501(c)(3) non-profit entity.
- Successfully raised over $1,700,000 in state, federal and private foundation funds for various restoration and conservation initiatives.

2003-07 (6 mo/yr) *SENIOR PROGRAM ADVISOR/INTERIM PROGRAM DIRECTOR,* The Bridge Fund, China

- Developed TBF's multi-year community development strategy in nomadic regions of the Tibetan plateau in China (3 million annual budget).
- Facilitated strategic and project planning with TBF staff and local partners, conducted training programs in participatory development methodologies, and provided technical backstopping for rangeland management and resource user group formation. Using results of feasibility studies and planning, TBF raised over 2 million Euro to establish successful rangeland/livestock cooperatives on the Plateau.
- Served as interim Program Director in 2007 (ending in July), overseeing strategic planning for 2007-9 and responsible for project reporting to USAID.

2004-07 (1 mo/yr) *RANGELAND SPECIALIST,* Ramboll Natura, Sweden, and WWF Mongolia

- Facilitated the organisation of community resource user groups and trained groups and government officials in rangeland management.
- Formulated a working policy document for sustainable grazing and rangeland resource use in Khar Us Nuur National Park. This document was reviewed and revised by a local stakeholder committee, which is now being implemented by local communities and government authorities.

2006 (1 mo) *RANGELAND CO-MANAGEMENT SPECIALIST,* Fauna and Flora International, China

- Conducted awareness raising workshops with government and non-government organizations (NGO) and herder communities about rangeland co-management processes and policy implications
- Conducted training on grazing management for local community representatives
- Assisted NGO staff to develop process for co-management in project sites to manage and protect state owned but communally managed rangelands.

2002-05 (1 mo/yr) *PASTURE ASSESSMENT AND RESTORATION PLANNING CONSULTANT,* Tibet Poverty Alleviation Fund, China.

- Developed technical plans for rangeland recovery and cooperative livestock marketing for three sites in Tibet that resulted in significant income generation and improved pasture management after three years.
- Facilitated formation and trained local management committees to manage rangeland recovery and development activities.

1998-2003 *RANGELAND MANAGEMENT SPECIALIST*, International Centre for Integrated Mountain Development (ICIMOD), Nepal.

- Coordinator for ICIMOD's Regional Rangeland Program in five countries (Bhutan, China, India, Nepal and Pakistan).
- Responsible for regional information synthesis and policy advocacy, coordination of regional networking activities, reporting to donors, and financial and contract management.
- Successfully established a functioning network of regional scientists and development workers to generate and share information on rangeland management innovations across the partner countries.
- Compiled and edited regional outreach materials.
- Developed five-year strategy for the next phase of the Regional Rangeland Programme, focusing on co-management processes for rangelands, which has been successfully funded (US$600,000).

1998 (1 mo) *ALPINE PASTURE MANAGEMENT CONSULTANT,* Wildlife Institute of India (WII)/Winrock International.

- Advised on the technical aspects of field data collection and methodologies for determining grazing impacts on wildlife habitat in regards to WII's research on alpine rangelands at the Great Himalayan National Park, Himachal Pradesh, India.

1995-97 (half-time) *PROJECT COORDINATOR,* Range Science Department. Colorado State University

- Developed and conducted greenhouse and field test plot studies to investigate reclamation alternatives at Summitville Mine Super Fund Site, Colorado (sub-alpine and alpine areas).
- Conducted site evaluation to determine potential natural communities and completed wetland delineation.
- Designed native revegetation trial and collected seed. All species collected established successfully.
- Prepared ecological restoration site plan based on outcome of research trials, as part of inter-agency design team.

1995-96 (half-time) *ECOLOGIST,* Colorado Natural Heritage Program, Colorado State University

- Conducted Rapid Biodiversity Assessments of potential research natural areas in the White River National Forest. Evaluated site quality and prioritized areas for conservation actions.
- Inventoried and classified riparian/wetland communities in the San Juan National Forest.
- Responsible for coordination of field activities, data analysis and report writing.

1993 *NATURAL RESOURCE SPECIALIST,* King Mahendra Trust for Nature Cons., Annapurna Conservation Area Project/US Peace Corps, Nepal.

- Led multi-disciplinary research team to determine community development needs and investigate land use impacts in alpine rangelands along the Nepal/Tibet border.
- Assessed extent of leopard predation and its impact on livestock holdings within the context of prevailing land use systems as part of a multi-disciplinary natural resource management team.
- Formulated recommendations and guidelines for conservation and development activities that were subsequently implemented by KMTNC.

1990-92 *RANGE AND WATERSHED MANAGEMENT SPECIALIST*, His Majesty's Government Tribhuvan University - Institute of Forestry/ US Peace Corps, Nepal.

- Taught range and watershed management, and geology at the Bachelor of Science level.
- Designed and implemented field practicum for students to conduct baseline biophysical surveys and needs assessments in rural communities.
- Developed new natural resource curriculum incorporating participatory rural appraisal methodologies.
- Coordinated research, training, and student tour programs with NGO's and government staff.
- Supervised students in preparing watershed management plans and research projects.

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HydroGeo Designs LLC. (HGD) is a private consulting firm specializing in watershed analyses, stream restoration, applied fluvial geomorphology, hydrology, hydraulic engineering, storm water management and erosion control projects. We are committed to addressing each project using a scientific approach to understand the baseline conditions, natural processes and project constraints. The high quality baseline data collected serves as a foundation for thorough problem understanding, project alternative analysis and recommended solutions. Our focus is superior customer service and innovative cost effective project solutions that represent state of the art science to ensure project success.

Our Scientific and Engineering Specialties Include:

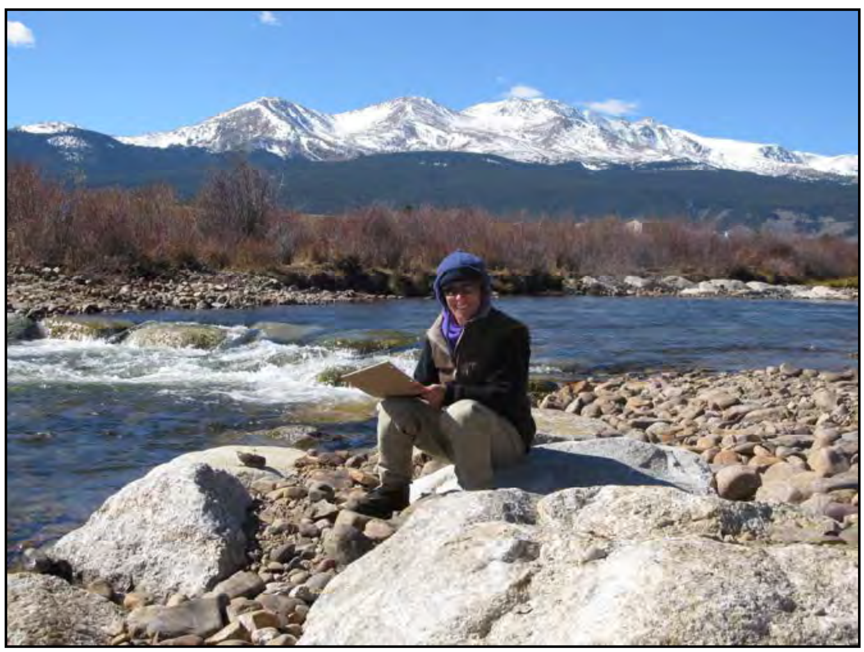
- Fluvial geomorphology
- Channel restoration and rehabilitation design
- Stream and lakeshore bank stabilization analysis and design (using bioengineering and traditional engineering approaches)
- Fish habitat structure designs
- Detailed topographic surveying of site terrain and geomorphic channel features
- Hydraulic and geomorphic field data collection including water flow measurement, stream bed sediment sampling, sediment transport measurement and water quality monitoring.
- HEC-RAS and HEC-HMS modeling of floodplains, river hydraulics, watershed hydrology and sediment transport
- Hydraulic design of channels, floodplain and infrastructure including culvert design, bridge scour analysis and scour countermeasure designs
- Storm water management solutions to reduce off-site runoff impacts
- Coastal and tidal breakwater and marsh creation design
- Innovative erosion control BMP measures for soil stabilization and construction runoff management
- On-site construction management services to transfer plan details into constructed projects

Through a focused business strategy that emphasizes hydrology, hydraulics and fluvial geomorphology projects investigated by highly trained professionals **HGD** guarantees top quality customer service and personal attention to our clients. Our Principal Hydraulic Engineer **Brett Jordan PhD, PE** has 12 years of experience in hydrology, fluvial geomorphology, open channel hydraulics, storm water management, erosion control, sediment transport and stream restoration design in the academic and private consulting sectors. He has worked on over 60 different river systems ranging from steep mountain headwater streams to low gradient sand bed streams and coastal marshlands in the Pacific Northwest, Inter-Mountain West, Southeast and Gulf Coast regions. These projects have ranged from watershed scale analysis of sediment and nutrient transport, reach scale stream and coastal marshland restoration designs and site specific analysis of hydraulic structures.

Brett has also has taught graduate level courses in the Civil Engineering Department at Colorado State University and short courses to government agencies focusing on field data collection and analysis of river systems. The courses emphasize quantitative measurement of river attributes necessary for understanding natural channel geomorphic processes. Topics include bed material measurement, longitudinal, cross-section and planform surveys, bankfull stage identification, water and sediment discharge measurement, channel roughness estimation and channel classification systems including those proposed by (Rosgen, Montgomery and Buffington and Schumm). In addition to teaching the field data analysis techniques, he has **implemented** identical techniques on successful stream and river projects in the Inter-Mountain West, the Pacific Northwest, and California.

HGD recognizes that there is a direct connectivity between physical geomorphic river characteristics and the biologic components that define the aquatic habitat and ecologic health of the system. Our Principal Biologist **Dr. Barbara Gray** uses her scientific background to document the biologic health associated with aquatic and terrestrial habitats. Dr. Gray's extensive biological background provides **HGD** expertise in both the geomorphic and biologic components of watershed and stream assessments. Dr. Gray is also experienced with topographic surveying, construction management and channel design implementation for our projects.

At **HGD** our focus is providing superior customer service and exceeding our client's expectations through rigorous data collection, modeling, scientific analysis, design and turn-key implementation services. We utilize state of the art innovative techniques and a collaborative decision making process to meet client objectives for every project. Our philosophy is to approach each project with a thorough understanding of the client objectives and goals and then couple those objectives with an understanding of the fundamental science that drives the hydrologic system to provide successful long-term solutions for the client that will solve the problems and work with the river system.



Project Experience

Upper Arkansas River Restoration Project; Leadville, Co. (2009-current)

Stream Channel Design /Geomorphic Assessment/ Stream Channel Surveys/ Hydrologic, Hydraulic and Sediment Transport Analysis/Bank Stabilization Design/Construction Management

The riparian areas and stream channel along this reach of the Arkansas River have been damaged by historic mining activities in the upstream watershed that have deposited contaminated sediments along the channel floodplain denuding vegetation and leading to excessive bank erosion. Erosion problems have been exacerbated by flow regime changes in the channel tributaries resulting from trans-basin diversions. A **Natural Resources Damages (NRD)** settlement project has been implemented by State and Federal Agencies to remedy the damages to the Upper Arkansas River HGD has been contracted by the NRCS, Lake County Conservation District and U.S. Fish and Wildlife Service to plan, design and implement stream restoration and bank stabilization practices along **4 miles** of the **Upper Arkansas River** and **5 miles** of **Lake Fork Creek** along private lands to remedy these damages. **This project has required communication and collaboration with 10 different private land owners with varying objectives and constraints concerning the stream corridors on their property. HGD has been able to bridge these differing objectives to bring consensus in moving forward with the large scale restoration project.** HGD has also guided LCCD through the construction contracting process, pre-qualification process and provides detailed construction management services to the restoration implementation process. The overall budget of this project is 5 million dollars over a 5 year implementation period. This work will tie in with public agency restoration on government owned lands ultimately resulting in restoration of **15 continuous miles** of stream channel along this headwater stream. *Client: NRCS, Lake County Conservation District, U.S. Fish and Wildlife Service, private landowners*

Henson Creek and Lake Fork Stream Restoration Design/Build, Lake City CO (2013-current)

Stream Channel Design /Geomorphic Assessment/ Stream Channel Surveys/ Hydrologic, Hydraulic and Sediment Transport Analysis/Bank Stabilization Design/Construction Management

HGD has teamed with Webco Inc. on a design/ build project for 3300 LF of stream restoration on Henson Creek and the Lake Fork of the Gunnison River in the Town of Lake City, CO. This project utilizes in-stream structures, channel grading and vegetation transplants to improve fish habitat, sediment transport and recreational kayaking opportunities along Henson Creek and the Lake Fork of the Gunnison in town. HEC-RAS FEMA flood analysis, sediment transport analysis and habitat design components were instrumental in getting public support and approval for this project. This project is a part of a larger effort to improve conditions on several miles of stream in the adjacent reaches. *Client: Lake Fork Valley Conservancy.*

Natural Stable Channel Design Guidance Manual, Harris County Flood Control District, Houston TX, (2012-current)

Expert Consultation on Stream Channel Design /Geomorphic Assessment/ Stream Channel Surveys/ Hydrologic, Hydraulic and Sediment Transport Analysis/Bank Stabilization Design

HGD is currently writing a Natural Stable Channel Design (NSCD) Guidance Manual for the Harris County Flood Control District (HCFCD). This manual provides detailed information for project planning, geomorphic assessment, field data collection, natural channel design, sediment transport analysis, riparian re-vegetation, construction sequencing and project monitoring for natural channel projects for HCFCD. It will be utilized as the basis for natural channel design projects both internally by HCFCD and engineering consultants working on HCFCD projects. *Client: Harris County Flood Control District.*

Halls Bayou Watershed Planning and Natural Channel Design Houston, TX. (2011-current)

Stream Channel Design /Geomorphic Assessment/ Stream Channel Surveys/ Hydrologic, Hydraulic and Sediment Transport Analysis/Bank Stabilization Design

Halls Bayou consists of 20 miles of urban stream channel located within the 43 mi^2 watershed in the Houston, TX metro area. This watershed has a long history of flooding and erosion problems leading to impaired channel conditions. HGD has been contracted by the Harris County Flood Control District (HCFCD) to provide geomorphic analysis, bank erosion documentation, detailed geomorphic topographic surveys and **Natural Channel Design (NCD)** recommendations for the watershed planning and flood damage reduction components of the project. The natural channel design elements of the project will provide additional flood conveyance capacity along with bankfull channel and geomorphic floodplain components which will improve channel stability, riparian habitats and provide linear recreational parks throughout the watershed. HGD is part of a collaborative team that includes urban design, flood damage reduction and public relations components. Client: HCFCD.

Mill Branch Stream Mitigation Bank Denton, TX (2010-current)

Stream Mitigation Banking /TXRAM/Geomorphic Assessment/ Stream Channel Surveys/ Design Review

HGD was an integral part of the design team for the first stream mitigation bank created to service the Dallas/Fort Worth metro area. This stream mitigation bank has been approved for 22,768 linear feet (LF) (4.31 miles) of TXRAM mitigation credits for intermittent and ephemeral stream types in the Upper Trinity Basin. Working with RiverBank Ecosystems and Environmental Services Inc. (ESI), we provided detailed topographic surveys and monumented cross sections for 30,335 LF (5.7 miles) of stream channel and upland areas for the project as well as reference reach surveys that were utilized in the design process. HGD has also provided design review of the project and existing conditions TXRAM mitigation assessment of all of the mitigation stream channels following the USACE Fort Worth district protocols. Client (RiverBank

Ecosystems)

Tidal Marsh Creation and Restoration, Clear Lake TX (2010-2011)

Tidal Marsh Design/Living Shoreline Design/Bathymetric Surveys

The Galveston Bay system has lost over 35,000 acres (20%) of its wetlands and marshes over the past fifty years due to subsidence, erosion, urbanization and hydrologic changes. **HGD** worked with the **Galveston Bay Foundation** to restore 600 linear feet of living shoreline and tidal marsh to Mud Lake in the Houston metro area. The breakwater/marsh creation design recreated natural tidal processes and valuable fish and bird habitats at the site while also providing increased erosion protection and wave attenuation for neighboring properties.
Client: Galveston Bay Foundation

Sammamish River Tributary Restoration Design; Redmond, WA (2009-2010)

Stream Channel Design /Geomorphic Assessment/ Stream Channel Surveys/ Hydrologic, Hydraulic and Sediment Transport Analysis/Bank Stabilization Design

HGD has worked closely with Otak Inc. to provide geomorphic analysis, sediment transport analysis and channel restoration design for a tributary to the Sammamish River near Redmond, WA. This channel is currently impacted by high sediment loads emanating from an unstable upstream ravine and has numerous fish passage barriers preventing salmonid spawning. The restoration design includes; a high-flow bypass to mitigate erosion problems in the ravine area, removal of an in-line sedimentation basin, fish passage stream simulation culverts, flood plain reconnection, increased channel sinuosity as well as large woody debris (LWD) structures for added habitat and stream bed stability. Detailed hydraulic modeling, sediment transport and sediment budget analysis were conducted to confirm that the proposed design will result in improved bed load transport, channel stability and fish habitat/fish passage conditions in the reach.
Client: Otak Inc., City of Redmond, WA.

Dam Removal/ Tidal Estuary Restoration Bangor Navy Base, Kitsap Peninsula, WA (2009)

Geomorphic Assessment/ Stream Channel Surveys/ Hydrologic, Hydraulic and Sediment Transport Modeling/Stream Channel Design

As a mitigation measure the Navy is planning to re-establish two tidal estuary systems to the Hood Canal and Puget Sound, by removing existing earthen fill roadway dams at the Cattail (8.5 acres) and Devils Hole (14.3 acres) lakes. These lakes have been impounded for 70 years capturing the sediment loads from the upstream watersheds. The final project will re-establish two tidal estuaries to their original historic flow patterns and provide spawning and rearing habitat for salmon in the area. **HGD** provided a base-line geomorphic assessment of the upstream watersheds and followed that work with a hydraulic and sediment transport analysis to predict the channel evolution sequence and resulting sediment supplied to the Hood Canal when the dams are pulled. This information was utilized in the permitting and construction design phases of the project that is schedule to be implemented. *Clients: United States Navy, SAIC, Otak Inc.*

Debris Flow and Dam-Break Analysis, Cedar River Watershed; King Co., WA. (2009)

Geomorphic Assessment/ Hydrologic, Hydraulic and Sediment Transport Analysis

HGD provided a base-line geomorphic assessment, debris flow risk, and dam break analysis for a steep ravine tributary to the Cedar River. A residential development is planned for a plat at the bottom of the ravine and there is a 2 acre storm water detention basis at the upper portion of the ravine. Hydrologic, hydraulic and sediment transport analysis was conducted to quantify potential debris flow hazards under dam break conditions. Debris flow volume, velocities and depth were determined for worst case scenarios to develop mitigation and debris flow control measures necessary for the safety of the residential development. *Otak Inc.*

Geomorphic Assessment and Stable Channel Design for Culvert Replacement Projects in the Martha Creek Watershed; Snohomish Co., WA (2009)

Geomorphic Assessment/ Hydrologic, Hydraulic and Sediment Transport Analysis/Culvert Design

HGD provided a base-line geomorphic assessment, hydraulic and sediment transport analysis and design recommendation for the potential replacement of eight existing culverts along 7100 feet of channel on Martha Creek and urban watershed in the Seattle Metro Area. The analysis considers flooding, channel stability and salmon spawning habitat conditions associated with culvert replacements. The feasibility analysis and cost/benefit analysis were used to determine prioritization for the culvert replacement projects. *Client: Snohomish County, WA., Otak Inc.*

Geomorphic Assessment of Channel Stability for Storm water Flow Control Standards in the Mill Creek Watershed; Clark Co., WA. (2009)

HGD was contracted to provide expertise in the analysis and interpretation of channel stability in an urbanizing watershed in the Portland metro area. Clark County is using this data to determine threshold flow standards for storm water detention criteria on a watershed basis. HydroGeo teamed with Otak Inc. to provide hydrologic, hydraulic, sediment transport and fluvial geomorphic analysis to determine a suitable flow standard which was presented to the Washington Department of Ecology. *Client: Clark County, WA.*

Berryessa Creek Stream Restoration; Milpitas, CA. (2007)

Geomorphic Assessment/ Stream Restoration Design

HGD provided design channel dimensions, pattern, and profile including channel width, depth, slope, and meander geometry for 4500 linear foot stream restoration project proposed by the U.S. Army Corps of Engineers (USACE) and the Santa Clara Valley Water District (SCVWD) on Berryessa Creek. The purpose of this project is to restore natural channel processes in a reach impaired by urbanization subsequently reducing channel maintenance costs and improving channel stability. *Client: SCVWD and Tetra-Tech*

<u>Urban Geomorphic Assessment of Upper Penitencia Creek and Berryessa Creek; San Jose, CA.</u> (2004-2007)

Geomorphic Assessment/ Stream Channel Surveys/ Hydrologic, Hydraulic and Sediment Transport Modeling

Degradation of urbanized streams is a major concern for the Santa Clara Valley Water District (SCVWD); this project incorporated field data and numerical modeling to elucidate the primary causes of channel instability in two heavily urbanized watersheds. Project elements included historical aerial photo analysis, hydrologic analysis, detailed surveys of channel geometry for 6.5 miles of stream, monumenting over 100 permanent cross sections, bed material sampling, water discharge and sediment transport measurement, and numerical sediment transport modeling. The 100 permanent cross sections have been re-surveyed annually for four years to track channel change with time. This project also included extensive training of SCVWD engineering staff regarding field protocols and geomorphic assessment techniques via shared field work and short course workshops. *Client: Santa Clara Valley Water District*

<u>Watershed Rehabilitation Sediment Continuity Assessment Yalobusha River Basin; Northern Mississippi</u> (2002-2004)

Geomorphic Assessment/Stream Channel Surveys/ Hydrologic, Hydraulic and Sediment Transport Modeling

We developed watershed scale sediment impact assessments and sediment transport models using HEC-RAS Sediment Impact Assessment Methods (SIAM) to determine existing conditions and the effectiveness of a proposed $300 million U.S. Army Corps of Engineering watershed stabilization project to reduce watershed sediment yield and improve channel stability for the Yalobusha River basin (295 mi^2) in northwest Mississippi. This project was used to formulate the protocols and assist in the development of the SIAM module currently available in HEC-RAS 4.1. *Client: USACE (work with Colorado State Univ.)*

STEPHEN NORTON

(781) 454-7667 snorton128@gmail.com

Current Address:
401 Silver St, PO Box #412
Lake City, CO, 81235

Permanent Address:
48 George Road
Winchester, MA 01890

EDUCATION

Ithaca College, School of Humanities and Sciences, Ithaca, NY. **May 2013**
B.A., *cum laude,* Environmental Studies-Concentration in Public Health

WORK EXPERIENCE

VISTA Education & Outreach Coordinator, *Lake Fork Valley Conservancy,* **April 2014-April 2014**
Implementing educational material into Lake City Community School science curriculum
Grant research and writing to support LFVC's projects
Outreach and promotion of LFVC's events and progress
Organize volunteers, coordinate capital improvements, and track donations for Community Garden

Wilderness Skills Instructor, *Primitive Pursuits,* Ithaca, NY **May - September 2013**
Environmental Educator Intern **March - April 2010**
Taught plant and tree identification, animal tracking, primitive skills, local environmental history, naturalist skills, navigation
Lead groups with 10 children and an instructor in training

Apprentice, *Apple Pond Farm & Renewable Energy Education Center,* Catskills, NY **September - December 2013**
Operated farm equipment including tractors and electric saws in order to perform general maintenance of the farm
Greenhouse design and management; planted and harvested a variety of crops using organic methods

RESEARCH EXPERIENCE

Independent Environmental Research Project (Bobcat Tracking), *Ithaca College* **September 2013 - May 2013**
Used GIS mapping technology
Designed research methods to collect data on species occurrence of both bobcats and their prey species in various forest types
Utilized revolutionary tracking methods to collect prints, combined with wildlife motion sensor-cameras
Documented bobcat presence and presented research at Whalen Undergraduate Research Symposium

Aquaponics Research Project, *Ithaca College,* Ithaca, NY **January - May 2013**
Designed, constructed, and maintained aquaponics systems through harvest
Gained experience with NFT systems as well as barrel systems raising Tilapia and vegetables

INTERNSHIPS

Community Energy, Inc., Ithaca, NY **March - June 2012**
Tabled events and educated people on the benefits, as well as the issues with wind power
WJFF Community Radio, Jeffersonville, NY **September - December 2013**
Monitored the calling board during shows
Prepared and delivered a one-hour talk show on student debt and the underemployment of college graduates

VOLUNTEER EXPERIENCE

Country Flat Farm, Carmel, CA **January 2014-Present**
Currently working and living on an off-the-grid organic farm, maintaining the gardens and orchards
Susquehanna River Coalition, *Ithaca College,* Ithaca, NY **Spring 2011**
Managed invasive species and monitored progress of new wetlands
Collaborated with a trail crew team to build a new walking trail system in Caroline, New York

CERTIFICATIONS

Wilderness Skills Instructor Certification **June 2013**
Learned local environmental history, naturalist skills, tree and plant IDs, navigation and environmental stewardship
CPR Pro and First Aid Certification **June 2013**

SKILLS: Works well and respectfully with others, cash register operation, highly organized, manual labor and handy-man capabilities, GIS mapping and computer skills

KATHERINE DALY katherine.a.daly@gmail.com 202.262.5427

SKILLS

Microsoft Office Suite	Constant Contact	Graphic Design	Screenprinting
Adobe Creative Suite 6	MailChimp	Grant Writing	Drafting
Rhinoceros	Weebly	Water Testing	Welding
Audible	Z2 Neon, CRMS	Macro. Sampling	Sense of Humor

PROFESSIONAL EXPERIENCE

OUTREACH COORDINATOR LAKE FORK VALLEY CONSERVANCY
July 2012–July 2014, Lake City, CO
Created and implemented LFVC's first resource development plan; increased donations 19-fold in 2013.
Designed informative, inspiring outreach materials: 10-year summaries, brochures, posters, and invitations.
Created and ran an outreach program focused on environmental stewardship and preserving local history.
Recruited, trained, and directed the organization's volunteer corps.
Assisted the Executive Director in grant writing, composed press releases, and wrote copy for web and print.
Advocated for LFVC at industry events; built partnerships with businesses, NPOs, and government agencies.
Performed fieldwork for the BLM and Colorado DRMS on joint projects in the Lake Fork watershed.
Built organizational capacity by implementing LFVC's first customer relations management system, Z2 Neon.

STAFF WRITER and EDITOR GROUPON, INC.
April 2011–June 2012, Chicago, IL
Trained in editing after six months of employment; awarded a raise after 10 months.
Assigned to a team writing all Now! deals (140-word blurbs); earned responsibility for all Boston Now! copy.
Tapped by management to create website and email microcopy for the Marketing Department's campaigns.
Interviewed merchants and conducted independent research to write at least six 300-word profiles of clients such as Zagat and MOCA, Los Angeles daily; consistently asked to both write and edit my own copy.
Edited contributing writers' profiles to forge clear, compelling narratives peppered with surprising humor.

RESEARCH INTERN WRIGHT
April 2010–July 2010, Chicago, IL
Sourced citations, production dates, and materials for designed objects and art from 1900 forward.
Edited copy for auction catalogs and the web; updated lot information on First Dibs.
Responded to consignor inquiries; filled auction catalog orders; managed client and collections databases.

MANAGER and EVENT PLANNER GREEN GROCER CHICAGO
March 2009–May 2010, Chicago, IL
Enhanced community involvement by creating a calendar of food and drink tastings, classes, and parties.
Promoted events through strong personal relationships with customers, Constant Contact, and Facebook.
Initiated participation in the Illinois Supplemental Nutrition Assistance Program.
Coordinated with local producers and regional distributors to write weekly produce and beverage orders.

BOX OFFICE and MEDIA MANAGER REDMOON THEATER
September 2008–January 2009, Chicago, IL
Managed sales special promotions in conjunction with third parties such as Hot Tix.
Edited press releases, artist statements, and advertisements for print and the web.
Designed playbills and invitations; oversaw all aspects of printing and distribution.

EDUCATION

BA, VISUAL and CRITICAL STUDIES SCHOOL OF THE ART INSTITUTE OF CHICAGO, 2008
[IN]ARCH SUMMER INSTITUTE UNIVERSITY OF CALIFORNIA BERKELEY, 2014

Volunteering

HEARTS & SPADES COMMUNITY GARDEN Lake City, CO July 2012–July 2014

Served as President of the Board of Directors.
Initiated a plan to get the organization 501(c)3 non-profit status, including the creation of bylaws.
Wrote, implemented, and distributed a Hinsdale County food security assessment survey in partnership with Hinsdale County Public Health.
Initiated a $52,000 campaign in fall of 2013 to build a passive-solar, high-altitude greenhouse to complete the Hearts & Spades Community Garden master plan.

HINSDALE COUNTY EMS Lake City, CO March 2013–March 2014

Certified as a Wilderness First Responder in March 2013.
Answered emergency calls to provide efficient and immediate care to ill and injured patients in the backcountry of Hinsdale County and in the Town of Lake City.
Assisted during ambulance runs to Gunnison Valley Hospital and Montrose Memorial Hospital.

CHICAGO ARCHITECTURE FOUNDATION Chicago, IL December 2010–July 2012

Wrote and led original, two-hour architectural tours of downtown Chicago for groups of up to 15 adults.
Researched Illinois wind power infrastructure and Chicago's urban planning history for CAF exhibitions.

CHICAGO ACADEMY OF SCIENCES Chicago, IL July 2006–January 2009

Researched local ecosystems and assisted with Peggy Notebaert Nature Museum butterfly rearing program.
Lead activities highlighting local ecology and gave lectures with live animals for groups of up to 75 people.
Cataloged Chicago Academy of Sciences publications and film archives.

Lake Fork Valley Conservancy
~ Fifteen Years of Stewardship ~

Sustaining and enhancing the rural and environmental character of the Lake Fork of the Gunnison River Valley through education, restoration, and stewardship.

OUR VISION: The Lake Fork Valley Conservancy (LFVC) works to make the Lake Fork of the Gunnison River drainage a healthy watershed, defined by a balance of resource conservation, economic opportunity, recreational activities, and community values.

HISTORY: The LFVC formed in 2010, when the Lake Fork Land Trust, established in 1998, merged with the Lake Fork Watershed Stakeholders, a group dedicated to the valley's waters since 2002. The Conservancy's work continues and builds upon reclamation, conservation, restoration, and education projects begun by the founding two.

Lake Fork Valley Conservancy
LAKE CITY COLORADO

PO Box 123
Lake City, Colorado 81235
www.lfvc.org

Community Benefits

In addition to conserving and cleaning up our environment, the Conservancy aims to strengthen the community by bringing in funding, increasing tourism, building partnerships, and educating youth.

Investing Locally: **The Conservancy has brought over $2.3 million** in Federal, State, and local funds to Hinsdale County since 1998.

Educating Youth: **Reaching an average of 90 young people annually through in-school and extra-curricular programs**, the Conservancy equips future leaders for life-long achievement. Our students learn hard science, horticulture, writing, and public speaking through hands-on projects that connect them to potential employers.

Building Partnerships: **Our network of more than 30 partners** connects local and regional business owners, federal agents, directors of non-profits, elected officials, teachers, and citizens, enabling them to share resources and collaborate to improve our community.

Increasing Tourism: **We serve and protect an area whose natural beauty draws more than 300,000 visitors per year.** When we improve trout fisheries, preserve open space, protect water quality, and hold fun, public events we are supporting our community's vital tourism industry.

Improving Self-Sufficiency: **We work to make Hinsdale County more self-sufficient** by educating residents about ways to conserve water, and providing access to fresh, affordable, locally-grown food.

> ***"We have 900 feet of river and would consider opening it to the public [because of the Conservancy's river enhancement project.]"***
>
> **-- Dan Murphy, Lake City homeowner**

Measures of Success

Environmental Protection

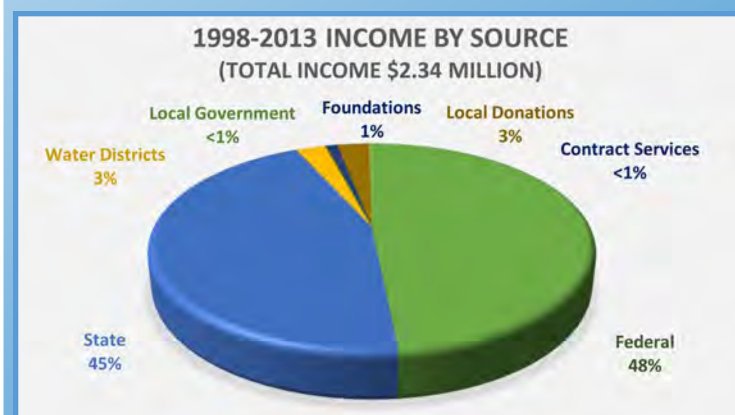
7 mines reclaimed
156 acres of land protected
3300 feet of river restored
>1000 trees and shrubs planted
Sediment controls on roads

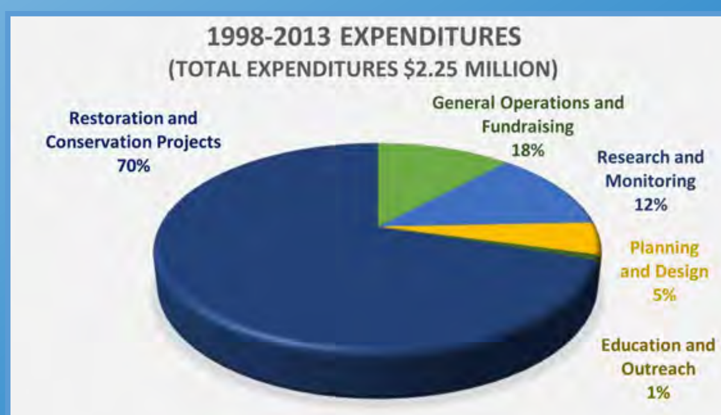
Outreach and Education

>100 youth engaged in science
Four regional workshops
Three annual outreach events
Over 500 participants in events
>5000 hours in volunteer time

Research and Monitoring

12 years of water sampling
Multi-year analysis of water data
Wetlands and seeps surveys
Henson and Palmetto TMDL's
Comprehensive database





$572,315 of State and Federal funds were managed by Hinsdale County, $800,000 by Colorado Open Lands, and $550,000 by Division of Reclamation, Mining, and Safety

Our Watershed:
Lake Fork of the Gunnison

A watershed is an area of land where all the water drains to one point. In our watershed, this point is where the Lake Fork and its tributaries feed into Blue Mesa Reservoir on the Gunnison River in western Colorado.

Our watershed spans two counties, Hinsdale and Gunnison, and can be easily subdivided into three sub-watersheds (see map below). Fun fact: the distinctive shape of the Henson Creek and upper Lake Fork watersheds, which follow the margins of the prominent Lake City Caldera, can be seen from space.

The Conservancy is based in Lake City, at the confluence of the Lake Fork and Henson Creek.

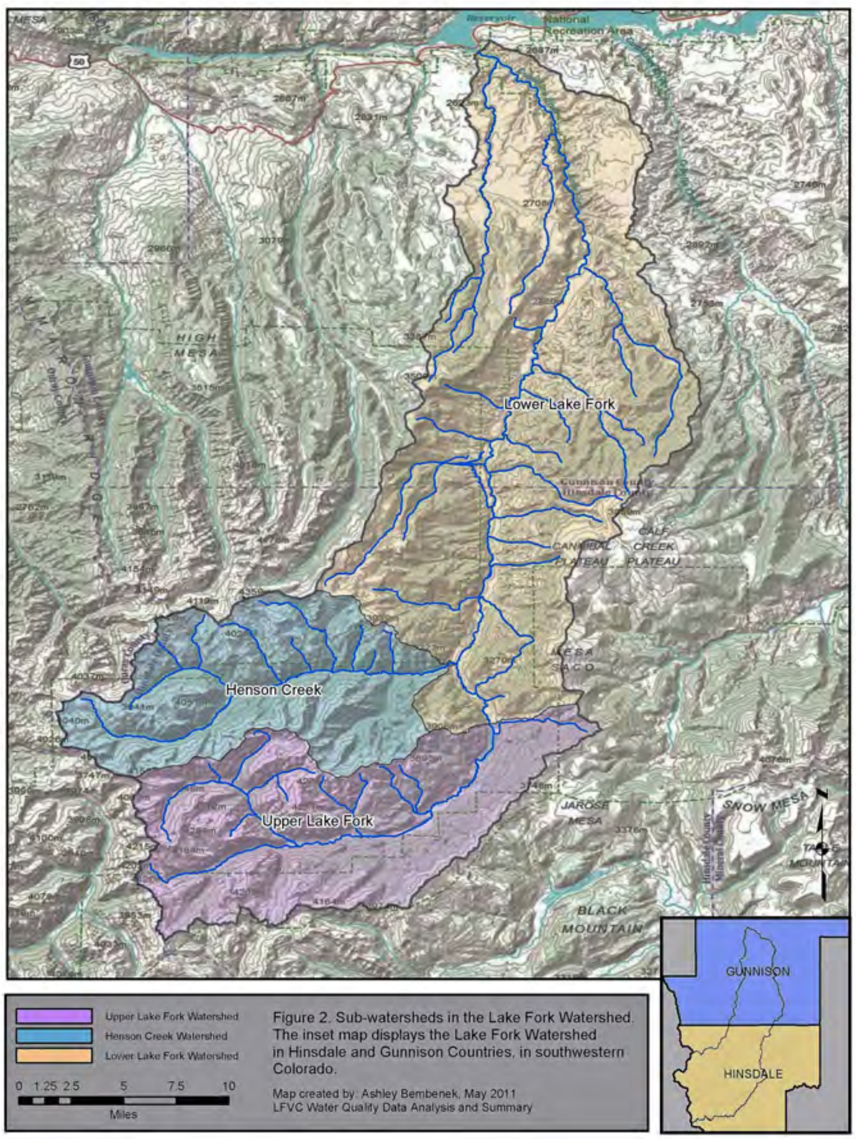


Figure 2. Sub-watersheds in the Lake Fork Watershed. The inset map displays the Lake Fork Watershed in Hinsdale and Gunnison Countries, in southwestern Colorado.

Map created by: Ashley Bembenek, May 2011
LFVC Water Quality Data Analysis and Summary

Why Watershed

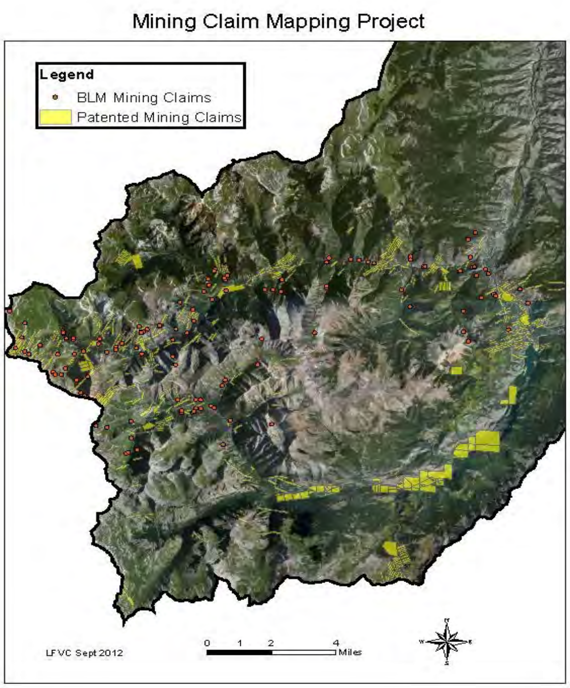
A watershed is the ideal unit for management, intertwining all the elements of culture and landscape. As so aptly stated by John Wesley Powell, "[a watershed is] *that area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demand that they become part of a community.*"

The Conservancy believes that a healthy watershed provides a sustainable economic base, protects community and cultural values, and sustains ecological integrity.

Mined Land Reclamation

Historic mining contributes to the cultural heritage of Hinsdale County, and is part of the unique character and tourism draw of the watershed. Acid mine drainage and leaching from waste piles from abandoned mines cause heavy metals and sedimentation problems in streams, impacting water quality and severely depressing biological productivity. The Conservancy has partnered with the Bureau of Land Management and the Colorado Division of Reclamation, Mining and Safety to characterize and cleanup seven area mines since 2002, work that earned us an EPA Achievement Award in 2008.

Roy Pray prior to remediation. Photo: Barbara Hite



Clean-up at the Hough mine in July, 2013. Photo: Tara Tafi.

Camille Richard and son Silas planting trees at the Ute Ulay Repository in 2010. Photo: Carol Robinson

The map illustrates that Hinsdale County is disproportionately impacted by the legacy of mining. Most impacted is Henson Creek, which was listed as water quality impaired on the Colorado 303 (d) List in 2008.

Hough

2013 Mine Reclamation Begins. The Hough Mine is the largest man-made contributor of cadmium and zinc to Henson Creek. Of 66 mine waste sites sampled in Henson Creek drainage in 2005, the Hough contributed 95 percent of metal loading from this type of source. The site also contributes substantial copper, lead, aluminum, and arsenic.

Golden Fleece

2010-2012 Drainage Rerouted. Acid mine drainage from the Golden Fleece was contaminating Lake San Cristobal, potentially affecting the recreational tourism economy (fishing was a concern).

Ute-Ulay

2009-2011 Paste Repository Created. The Bureau of Land Management in partnership with the Division of Reclamation, Mining and Safety, initiated a $1.2 million clean-up of the tailings piles above Henson Creek. This state of the art repository includes tailings from the Ute-Ulay and three other sites: the ore pile at Hanna Mill, the Risorgimento Mine, and the Hidden Treasure Mine.

Hanna Mill

2008 Mill Cleanup. The Hanna Mill is located in the Capitol City area. It contained two areas of concern, 900 cubic yards of mine waste at the terminus of an aerial tramway that transported ore from the mines above, and a tailings pile along Henson Creek

Risorgimento

2007 Mine Reclaimed. The Risorgimento Mine is located about three miles west of Lake City on Henson Creek. Prior to cleanup it consisted of an adit and a mine dump. It contained high levels of lead, copper, zinc, and arsenic.

Hidden Treasure

2007 Tailings Secured. The Hidden Treasure tailings sat at the mouth of Alpine Gulch on the banks of Henson Creek. The tailings contained very high levels of lead and zinc.

Roy Pray

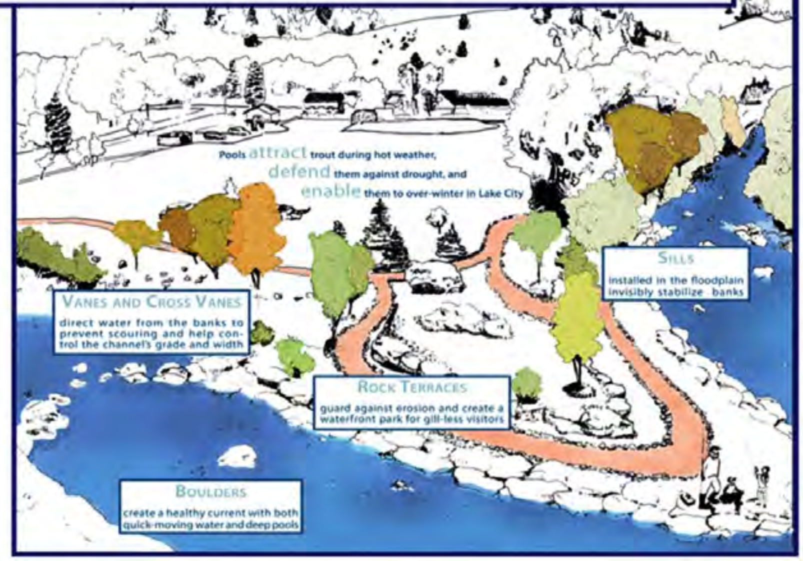
2003 Mine Portal Bulkhead and Site Cleanup The acidic portal discharge from this abandoned silver mine was one of the largest contributors of metals to Palmetto Gulch, at the upper end of Henson Creek watershed, seriously impacting macro-invertebrates in the Gulch. The bulkhead has significantly reduced metal loading in the creek.

RIVER RESTORATION

The Lake Fork Valley Conservancy has spent the past five years coordinating a planning effort for river enhancement work along a two-mile stretch of the Lake Fork of the Gunnison River and its main tributary, Henson Creek, in and near the Town of Lake City.

This stretch has been heavily impacted by legacy mining and channelization over the past century and is considered high priority in the LFVC's long term watershed stewardship plan for the Lake Fork.

IMPROVEMENTS AT THE CONFLUENCE OF HENSON AND THE LAKE FORK

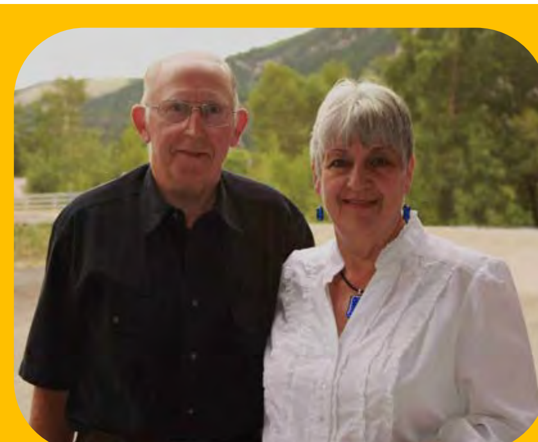


Community planning for the river project 2010. Photo: Camille Richard

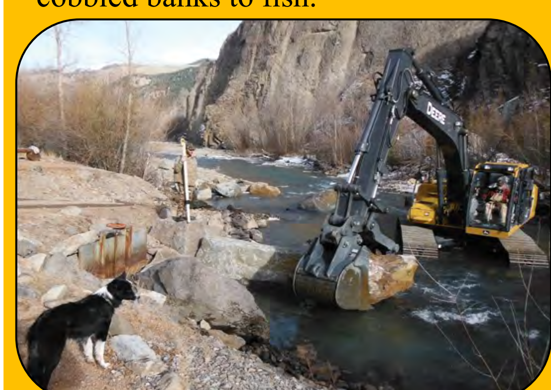
Our goal is to enhance and protect the ecological health and recreational quality of these rivers. Our strategies to achieve this include:

1) Construction of in-channel structures that stabilize banks— thereby protecting public and private lands— and improve fish habitat;
2) Revegetation that enhances the natural structure and function of the riparian corridor;
3) Acquisition of river front properties to protect flood zones and riparian areas and increase public access (approximately 8 acres);
4) Construction of low-impact trails and recreational facilities to improve quality of life for residents and visitors alike;
5) Development of a fun interpretive trail system to educate the public about river function/ecology and history.

Introducing
Joe and Judy Hoover



Henson Creek has been Joe and Judy's delight since 1979, the year they discovered Henson Creek RV Park as guests, and then part of their livelihood since 2004, when they became the park's summer managers. Visitors drive from all corners of the United States to fall asleep to the river's soothing babble, and carry their morning coffee down its cobbled banks to fish.



Construction at the head gate on Henson. Photo: Camille Richard

By the time Joe and Judy had moved to the other side of the welcome desk, however, they had become increasingly concerned about the declining trout habitat of lower Henson Creek due to impacts of historic mining upstream and man-made modifications in town.

The Lake Fork Valley Conservancy shares their interest in healthy rivers, and started river construction along lower Henson Creek in 2013. Construction will continue downstream to just beyond the north boundary of Lake City once funding is secured.

Land Conservation

Photo: Mary Carkin, Lake City Switchbacks

Hinsdale County residents live in an area that consists of over 95 percent public land. Despite this fact, many private lands occupy valuable valley bottom wetlands and river corridors, which serve as critical habitat for a number of Species of Special Concern. The Conservancy facilitates the protection of these areas by linking private land owners with conservation organizations who can protect these areas in perpetuity. A high priority area has been the wetlands at the inlet of Lake San Cristobal. The Conservancy has been working with the owner of this property, Emma Lillian Plauche, since 1998 to protect this valuable resource.

A conservation easement was completed at the end of 2013, along with a deed restriction on an adjacent 40 acre parcel, thanks to the due diligence of our partner, Colorado Open Lands (COL). COL also holds a conservation easement on the Peninsula, a highly visible island in the midst of the lake.

The 156 acre Plauche property boasts grasslands and forests rising from a tapestry of wetlands, historic channels, and beaver dams that comprise the inlet's delta. The delta is haven not only for wildlife such as the rare Northern Leopard Frog and the American Bald Eagle, but also for anglers. Fly fishing has historically been allowed on the property through a handshake agreement with the landowner. The project partners and the family have collaborated with Colorado Division of Parks and Wildlife to formalize permanent public access for fishing along 0.62 miles of the Lake Fork that flows through the property.

Education

National Civilian Community Corps members teaching local youngsters about water. Photo: Katherine Daly

The Lake Fork Valley's education program deepens understanding of and appreciation for our watershed through citizen science, special events, and journalism. LFVC has sponsored four regional workshops covering a wide range of topics.

Our partnership with **Colorado River Watch** gives students the opportunity to become water scientists who learn about river habitat, health, and chemistry by collecting samples from Henson Creek and the Lake Fork and testing them in the lab. The data our team collects is used for policy-making in Denver.

LFVC staff teach monthly science classes at Lake City Community School, partnering with various agency staff and other professionals to take students into the field.

Hearing Hinsdale is a multi-media education program with the school in which our youth preserve and share local history while learning radio production skills, evolving as writers, and developing soft skills such as tactful interviewing. Their resulting audio presentations are aired on KVNF Community Radio, shared at local events, and made available online.

Local student Gracie Hearn interviews Linda Pavich about local mining history. Photo: Katherine Daly

Research and Monitoring

Geologists, mining reclamation specialists, and hydrologists, along with dedicated local volunteers, have lent their time and expertise to sampling efforts over the years to assess environmental conditions in the Lake Fork Watershed, particularly those areas that are most impacted by historic mining. A major sampling effort of water and mine waste chemistry in Henson Creek led to the publication of a reclamation feasibility report, which outlined and ranked the most important mine sites for follow-up remediation.

Hydrologist, Andrew Breibart and OSM/VISTA, Katherine Daly, sort macroinvertebrate samples. Photo: Camille Richard

Craig Palmer sampling for dissolved metals at Cooper Creek. Photo: Katherine Daly

The LFVC has also worked to develop Total Maximum Daily Loads (TMDL) guidelines for Palmetto Gulch, a Henson Creek tributary that was listed as "water quality impaired" on Colorado's 303(d) list in 2002. A TMDL was also completed for the main stem of Henson Creek, which was listed as impaired in 2008. The purpose of the TMDL assessments was to identify reductions in zinc and cadmium concentrations from mining sources that would enable the river segments to support aquatic life and to meet water quality standards, in compliance with the Federal Clean Water Act.

Additional research efforts included the first ever chemical characterization of Lake San Cristobal, a bibliography of watershed research, mapping of patented mine claims, and comprehensive habitat surveys of critical wetland and riverine habitats.

Sustainable Living

The Hearts & Spades Community Garden formed in 2011 to help our small, high altitude, rural community become more sustainable. The mission of the Garden is to improve local access to affordable, healthy and locally produced food, educate the public on sustainable growing practices, and increase our community's self sufficiency by supporting a resilient local food system. The Town of Lake City generously provided land and a water tap. Dedicated locals donated materials and constructed the garden fence, shed, and raised beds in 2012. Residents rented plots and finally planted vegetables in 2013.

Funding for the construction of a high altitude four-season passive solar greenhouse is nearly complete. Hearts & Spades will use the space to supply fresh produce to local grocery stores and restaurants, Hinsdale County Food Bank, and the Lake City Community School year round.

The LFVC has served as the Garden's sponsor from the start, but Hearts & Spades is applying for non-profit 501c(3) status this year to become an independent organization, thanks to LFVC's help.

The planting crew! Photo: Katherine Daly

Annual Events


3rd Annual San Juan Mining Conference

Moseley Art Center - 300 N Silver Street - Lake City, CO

April 18-19, 2013

Featuring speakers from all over the San Juan Mountains and topics relevant to mining in the past, present and future.

Visit mountainstudies.org and click on "Education Programs" then "Conferences and Meetings"

Lake Fork Valley Conservancy

Mountain Studies Ins

Save The Date!

A Word from the Executive Director on Top of the Watershed!

I am the luckiest person to have been part of this organization for so many years. I have watched it grow from a small band of dedicated conservationists who formed the initial land trust into the thriving organization it is today. Local citizens have given countless hours of volunteer time and many local, state and federal organizations have collaborated in our work. We are an amazing team striving to protect and enhance the beautiful place we call home. Thanks to all of you who have supported our mission through the years. We could not have done it without you!

Camille Richard,
Executive Director

The Lake Fork Valley Conservancy is a 501(c)3 non-profit organization in Lake City, Colorado.

Lake Fork Valley Conservancy
LAKE CITY COLORADO

Lake Fork Valley Conservancy
LAKE CITY COLORADO

Watershed Stewardship Plan
Executive Summary

The LFVC has completed the first draft of our Watershed Stewardship Plan and we are seeking input from the community and interested parties to guide our efforts for the next ten years. The purpose of this executive summary is to provide an overview of this draft Plan in order to generate feedback which will be incorporated into the final Plan. This document will be revisited on an annual basis, ensuring that our goals are in line with the needs of the community and environment.

Newsletter Contents:

Our Vision:
The Lake Fork of the Gunnison River drainage is to be a healthy watershed that is defined by a balance of resource conservation, economic opportunity, recreational activities and community values. The health of the watershed will be sustained, protected and improved by a broad-based partnership of an educated citizenry, nonprofit groups and governmental entities.

Our Mission:
The Lake Fork Valley Conservancy seeks to sustain and enhance the environmental and rural character of the Lake Fork of the Gunnison River valley through education, restoration and stewardship.

Background of the Watershed Stewardship Plan

What is a Watershed?
A watershed is an area of land where all the water drains to one point. In our watershed, this point is where the Lake Fork drains into Blue Mesa Reservoir on the Gunnison River in western Colorado, and is fed by numerous tributaries, most notably Henson Creek.

Why a Watershed Approach?
A watershed is the ideal unit for management, intertwining all the elements of culture and landscape. As so aptly stated by John Wesley Powell, "[a watershed is] that area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demand that they become part of a community." A healthy watershed provides a sustainable economic base, protects community and cultural values, and sustains ecological integrity. The LFVC's planning process provides the opportunity for citizens and stakeholder groups to create a common vision for our watershed's future. The development of partnerships and collaboration among the various levels of government, community organizations, interested public, and other stakeholders is vital to the success of protecting the watershed.

Purpose and Use of the Watershed Stewardship Plan
The Lake Fork Watershed Stewardship Plan is a dynamic, strategic document with the purpose of guiding decision making by stakeholders living within and managing the resources of the Lake Fork of the Gunnison River watershed over a ten year time frame. The Plan provides an overview of the watershed's natural resources and ecological zones, demographics and cultural and historic resources, identifies and describes threats to the resources in the watershed, contains time-based objectives to address resource issues, and provides programmatic and organizational strategies for attaining our proposed outcomes through a collaborative process. It is not intended to be a regulatory document.

© Barbara Hite

Key Issue: Mining Impacts and Water Quality

Historic mining contributes to the cultural heritage of the area, and is part of the unique character and tourism draw of the watershed. Acid mine drainage and leaching from waste piles from abandoned mines cause heavy metals and sedimentation problems in streams, impacting water quality and severely depressing biological productivity.

Water quality standards set by the Colorado Department of Public Health and Environment help to support aquatic life, recreation, and drinking water uses (where feasible). These standards are exceeded in both Henson Creek and the upper Lake Fork, due to a mix of both mining impacts and natural mineralization.

Watershed Plan Objectives:

- Improve water quality and prevent further degradation.
- Protect areas high in natural, cultural and historic values that would be sensitive to mining impacts.

Key Issue: Development Impacts

The term "development" incorporates residential and commercial, as well as supporting infrastructure, such as roads, water and sewer systems, fences, and utility access. Development is vital to the local economy in that it generates jobs, property tax revenues and consumers for local businesses.

With the Lake Fork drainage comprising predominantly public land, the characteristics of the Lake Fork valley presents a unique and positive opportunity to develop the river corridor in an aesthetically and ecologically sound manner. The majority of current development is along the Lake Fork, impacting riparian areas through the conversion of native riparian forests and wetlands into homes, infrastructure, pastures and lawns. Potentially, development may place constraints on water usage, fragment and decrease key wildlife and fish habitat, increase erosion, disrupt the ecological fire regime of the forests, and increase the spread of invasive weeds. Potential pollutants from development may include septic leachates, pesticides, sediments, and organics.

Watershed Plan Objectives:

- Advocate and encourage land use planning and zoning regulations promoting aesthetic development that maintains the cultural and natural values of the Lake Fork watershed.
- Promote restoration of key reaches of the Lake Fork to enhance and protect riparian habitat, while respecting private property rights and uses.
- Advocate and facilitate the conservation of private lands.

Key Issue: Altered Hydrologic Regime

The Colorado River Basin is experiencing the impacts of global climate change and there is growing concern that there could be an increase in demand for Upper Gunnison basin water, including the Lake Fork. Consequently, the Town of Lake City and Hinsdale County plan to put a water release control structure at the outlet of Lake San Cristobal and claim the water rights to the upper 1000 acre-feet of water. This water would then be held in reserve for use in times when the lower Colorado Basis states would make an upstream call on water, forcing water users in the Lake Fork to shut down their wells and irrigation ditches.

Fluctuation of water storage in the lake could have potential impact on fish and riparian habitat below the lake, as well as wetlands at the lake's inlet, depending on how the lake level is managed after construction.

Watershed Plan Objectives:

- Raise awareness of the need for water conservation in the valley.
- Advocate for effective land use planning to maintain in-stream flows in rivers that protect the wetlands, riparian areas, fisheries, aesthetics, and economic and cultural values.
- Provide recommendations so that Lake San Cristobal water levels are managed to protect or enhance fisheries and riparian habitat.

Key Issue: Recreation

Recreation-based tourism is the lifeblood of the local economy, especially in Hinsdale County where traditional mining, forestry, hunting and agriculture-based employment has significantly declined. The tax dollars and income generated are critical for local government budgets and services. Tourism directly creates jobs, primarily in the construction service and retail sectors.

Recreational use of the watershed has been steadily increasing and shifting away from traditional hiking, fishing, hunting and camping to more high impact motorized tourism, including ATVs, off-road motorcycles and SUVs. Increasing motorized recreation, especially if improperly managed, potentially causes erosion, disturbances of stream-flow and sedimentation, excessive dust , and transport of non-native weeds into the backcountry.

Another concern with increasing recreation is the loss of solitude, an important cultural value for backcountry users, especially for year-round residents who live here because of the area's remoteness and isolation. There is a limit to the number of users that can be sustained without threatening both the health of the watershed and the recreational experience of the users themselves.

Watershed Plan Objectives:

- Increase awareness of residents, business owners, and tourists of recreation impacts and benefits of sustainable tourism.
- Advocate effective tourism planning to maintain the cultural and natural integrity of the watershed.

Key Issue: Invasive Plants

Invasive plants can pose a threat to native plant communities, wildlife, land and recreation values, soil stability and water quality, and the productivity and integrity of agricultural lands and adjacent public lands. They typically are aggressive invaders, they can be poisonous to livestock, they can be carriers of detrimental insects, diseases, or parasites, and their presence negatively affects environmentally sound management of natural or agricultural ecosystems.

There are four invasive plant species that have become a major concern in the Lake Fork watershed and have been identified as "noxious weeds" by the Colorado Noxious Weed Act; Yellow toadflax (butter and eggs), Canada thistle, Oxeye daisy and Downy brome (cheatgrass).

Watershed Plan Objectives:

- Raise awareness about noxious weeds and integrated pest management practices including prevention and control.
- Encourage proper management of noxious weeds in order to protect and enhance residential and agricultural properties, native plant communities, wildlife habitat, and watersheds thus preventing adverse economic and ecological impacts species both locally and downstream.

Key Issue: Non-Native Aquatic Species

Some non-native aquatic species, especially brook, rainbow and brown trout, provide fishing opportunities in waters where native trout do not exist. These species may also fill an important role where native cutthroat trout once survived but are now absent. There is a risk however to introducing new species to our watershed. Introduced species of trout may displace native species, compromising ecosystem diversity. Parasites such as *Myxobolus cerebralis* (which causes whirling disease) and aquatic nuisance species (ANS) such as zebra mussels, and New Zealand Mudsnails have no apparent benefit to the watershed. Non-native species may have no natural controls and prove devastating to trout reproduction and survival, ultimately degrading the quality of the fishery and negatively impacting the recreational economy.

Watershed Plan Objectives:

- Where practical, encourage reintroduction of native cutthroat trout to appropriate habitat within their historic range.
- Raise awareness of prevention and control measures of aquatic nuisance species and parasites.
- Improve water quality to a standard that is favorable to native invertebrate and trout species.

Key Issue: Altered Fire Regime

The natural fire regime is a description of the role fire would play across a landscape in the absence of modern human intervention. A natural fire regime contributes to a healthy forest by maintaining a proper diversity of age classes, rather than being overcrowded with younger trees. Without a fire regime that approximates the natural cycle, the forest ecosystem can be lost to large-scale fire, insects or disease. The threat of fires having an unnaturally high intensity has been increased by human intervention through fire suppression.

Watershed Plan Objectives:

- Raise awareness of the need for a healthy fire regime.
- Advocate proper planning for local fire control and controlled burns that is appropriate to improve ecosystem health and to protect developed areas.

Key Issue: Domestic Livestock Grazing

Livestock grazing has been an important component of the economy for generations in the Gunnison Basin. Working ranches maintain open space and properly managed grazing can enhance wildlife habitat and native plant communities. Excessive or poorly managed livestock grazing can decrease plant cover, change native plant composition, facilitate weed invasion and reduce forage for livestock and wildlife. Additionally, significant weed invasion is prevalent in the lower watershed and deserves extra educational outreach to livestock producers.

Disease transfer between domestic sheep and native bighorn sheep is a concern where the two species overlap in our watershed's alpine zone.

Watershed Plan Objectives:

- Raise awareness of the need for diverse native plant communities that provide sustainable forage for livestock and quality habitat for wildlife.
- Advocate for sustainable livestock and wildlife numbers that are appropriate for the carrying capacity of the available habitat while considering other land uses.

Key Issue: Deer and Elk Population Growth

The Lake Fork watershed is within a limited hunting management zone. The Division of Wildlife and sportsmen have played a vital role in reducing the historically overpopulated elk herds and discrepancy in bull to cow ratios within our herds. A better part of the Gunnison Valley has exceeded population goals for post-season elk herds. The limited hunting has greatly benefited deer and elk populations and their habitat within the Lake Fork valley. Although this control has helped it does not eliminate the possibility of high elk numbers as seen in the past on critical winter ranges. Continued population control will help maintain critical winter ranges in the future.

Watershed Plan Objectives:

- Monitor big game numbers working with the Division of Wildlife.
- Advocate for continuation of limited hunting to promote healthy habitat and sustainable numbers of big game animals.

PLEASE SEND US YOUR FEEDBACK

The full draft plan will be available on the Lake Fork Valley Conservancy's website at www.lfvc.org. Comments can be sent to LFVC staff at the contact below. We welcome any questions or concerns!

P.O. Box 123, Lake City, CO 81235
Phone: (970) 944-2406
Email: info@lfvc.org

Ten Year Strategic Milestones

Year:	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Management Issue: Mining and Water Quality										
Inventory and prioritization of patented mine sites for clean-up, historical preservation and open space designation			■	■	■					
Design and implement water quality monitoring plan for watershed (in tandem with triennial water quality data calls for Gunnison Basin)	■		■			■		■		
Incorporate water quality data into a watershed wide Geographical Information System (for upload into Data Sharing Network/STORET)	■	■	■			■			■	
Outreach program on mining impacts and clean-up options					■	■				
Public input on clean-up projects					■	■	■			
Assessment and clean-up of high priority sites in Palmetto Gulch	■	■	■	■	■					
Clean-up of other sites identified through assessments							■	■	■	■
Facilitation the conservation of mining claims with historic or open space values					■	■	■	■	■	
Management Issue: Development										
Mapping of existing development infrastructure in the watershed				■	■	■				
Identify and prioritize both public and private lands for restoration and protection	■	■	■	■	■	■	■			
Water quality sampling in areas adjacent to heavy development pressures, especially near Lake City and upstream to Sherman	■		■			■		■		
Raise awareness about impacts of development and about environmentally appropriate and sustainable development approaches					■	■	■	■	■	■
Bring critical tracts under conservation easement, or to negotiate land exchanges for permanent federal or state protection	■	■	■	■	■	■	■	■	■	■
Promote improved land-use planning, zoning, enforcement, and proper maintenance of roads				■	■	■	■	■	■	■
Planning/Restoration of two miles of the Lake Fork and lower Henson Creek in vicinity of Lake City	■	■	■	■	■	■	■			
Management Issue: Altered Hydrologic Regime										
Map riparian and wetland communities				■	■	■				
Public education on natural conditions and functions of rivers, lakes and wetlands	■	■	■	■	■	■	■	■	■	■
Promote effective water management planning to maintain in-stream flows and lake levels for Lake San Cristobal				■	■	■	■	■	■	■
Management Issue: Recreation TO BE DISCUSSED FURTHER										
Compile and summarize existing data on recreational use and impacts			■		■	■				
Public education on recreational impacts on the watershed						■	■	■	■	■
Collaborate with Town of Lake City and County Master Recreation planning					■	■				
Develop public access points and recreation infrastructure along restored sections of the Lake Fork, where appropriate				■	■	■	■	■		
Facilitate the formation of an Alpine Triangle stakeholder group for discussion of future area designation and management					■	■	■			
Management Issue: Invasive Plants										
Identify and monitor invasive species and populations	■	■				■	■			
Public education on impacts of invasive plants and methods of control	■	■	■	■	■	■	■	■	■	■
Develop and implement watershed-wide weed management program						■	■	■	■	■

Management Issue: Invasive Aquatic Species
Monitoring of fish and macro-invertebrate populations
Promote interagency reintroduction plan for cutthroat trout, including habitat improvements
Public education on the important of native aquatic populations, and the control and prevention of aquatic invasive species.
Management Issue: Forest Health
Participate in County Hazards Mitigation Planning
Cooperate in interagency fire awareness and beetle kill outreach
Explore options for use of beetle kill timber in local construction industry
Management Issue: Domestic Livestock Grazing
Public education on the positive and negative impacts of livestock grazing
Participate in the development of land use plans that facilitate proper grazing in the watershed, coordinating with federal planning efforts

Robert Hudgeons
Silver River, Inc.
PO Box 905
Lake City, CO, 81235

September 29, 2014

Chris Sturm
Colorado Water Conservation Board
1313 Sherman St., Room 718
Denver, CO 80203
Phone: 303-866-3441

Dear Chris,

I am writing as a community member, river-front landowner, and supporter of the Lake Fork Valley Conservancy. As a river-front property owner along the stretch of river proposed for Phase II, I strongly support the Conservancy's work to proceed with the Henson Creek and Lake Fork River Restoration Project.

The portion of river that runs past my property is the stretch that has changed and degraded the most over the past 10 years. The high flows of recent years have taken more than 30 feet of our bank. This will continue with succeeding high flows.

This River Enhancement project is crucial to re-channelizing the river to improve bank stability, reduce bank erosion, and mitigate flooding; not only for the river along our land but for the town of Lake City as a whole. At the town irrigation ditch head gate, where the River Enhancement Project kicked off last fall on Henson Creek, the design has diverted more water into the town ditch, to help maximize the town's water rights and significantly improved bank stability and fisheries.

My partners and I will be contributing $3,000 toward the survey and design work. We are also considering donating a portion of our property to the LFVC so that they can protect this important flood zone, depending on outcome of their fundraising efforts to purchase neighboring river bottom land.

Sincerely,

Robert Hudgeons
Silver River, Inc.

Upper Gunnison River Water Conservancy District

210 West Spencer Avenue, Suite B • Gunnison, Colorado 81230
Telephone (970) 641-6065 • Facsimile (970) 641-1162 • www.ugrwcd.org

September 25, 2014

Chris Sturm
Colorado Water Conservation Board
1313 Sherman St., Room 718
Denver, CO 80203
Phone: 303-866-3441

Dear Chris,

The Upper Gunnison River Water Conservancy District (UGRWCD) strongly supports the Lake Fork Valley Conservancy's (LFVC) continuation of the Henson Creek and Lake Fork River Enhancement project, which started construction in fall 2013 after several years of community planning.

The UGRWCD provided funding for the completion of Phase I, at the confluence of Henson Creek and the Lake Fork. The benefits of Phase I can already be seen with improved public fishing access, floodplain areas revegetation, and improved trout habitat. With a high run-off this spring, the scouring, and narrowing effects of the rock boulder structures were visible as the river contoured in a new way. Due to the success we have seen in Phase I, we are confident that Phase II is a worthy investment.

River enhancement projects such as this are not only important to the immediate community, but also to the larger watershed. The LFVC maintains consistent partnerships at the local, state, and federal level which contribute greatly to their projects' success, and highlight the regional effort necessary to deal with water quantity and quality issues in Colorado.

We encourage CWCB to continue its support for the LFVC as it enters into Phase II of the project and support final design work required for ensuing construction.

Sincerely,

Frank Kugel