SAMPLING AND ANALYSIS PLAN

For the

ALAMOSA RIVER RESTORATION PROJECT

RIO GRANDE WATERSHED
CONEJOS COUNTY, COLORADO

Prepared for:
Colorado Department of Public Health & Environment
and
U.S. Environmental Protection Agency
Region VIII

Prepared by:
San Luis Valley Resource Conservation & Development Council

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A4 Project/Task Organization

Individuals/Organizations

Management:
- EPA, Kim Larson, Project Officer, NPS Program, Colorado
- CDPHE, Kathleen Reilly, Watershed Coordinator, Ark/Rio Grande Basin
- James Mietz, Coordinator, San Luis Valley Resource Conservation & Development
- Rodger Gallegos, President, Alamosa River Watershed Restoration Foundation

Support /Technical Assistance
- Natural Resource Damages, CDPHE/Summitville Mine reparations (financial assistance)
- Agro Engineering, Inc. (past GIS coverages, technical assistance)
- Colorado Water Conservation Board (financial assistance for hydrologic modifications)
- Conejos County Soil Conservation District (data analysis, public education)
- Conejos County (Road and Bridge Dept., equipment/operators, gravel removal)
- Nature Conservancy (grazing management recommendations)
- San Luis Valley Trout Unlimited (volunteer support for planting)
- USDA Natural Resources Conservation Service (grazing management recommendations, vegetative survey, office space, supplies, phone and fax use)
- Black Creek Hydrology (stream restoration design)
- Alamosa Open High School (River Watch)

Volunteers
- Community members, landowners, other interested stakeholders
- Centauri High School Drama Club (willow planting)

Project QA Manager
- CDPHE - Kathleen Reilly

A5 Problem Definition/Background

The Alamosa River below Terrace Reservoir is highly unstable and suffers from severe erosion due to channel straightening, dewatering, inappropriate location of irrigation head gates, unsuccessful bank stabilization, over-grazing of stream bank vegetation and a high sediment load derived from upstream eroding banks. A channel straightening project in the 1970's removed the natural sinuous pattern of a portion of the stream system resulting in a locally steeper channel gradient that lowered the water table needed to support riparian vegetation.

Erosional problems were exacerbated by livestock over-grazing the woody species in the riparian areas. The grazing has been so extensive that the plants have not been able to re-establish

themselves. The result is denuded banks, a wide, braided stream unable to support a fishery, and a serious sediment loading problem, all of which further compromise the ability of the river to support wildlife.

The Alamosa River Riparian Restoration Project was established to address the severe erosion and sedimentation problems. In March 1999 project sponsors completed a concept design study. The concept plan that emerged provided a blueprint for restoration and included recommendations for instream structures, bank stabilization and revegetation. The project proponents worked with Dave Rosgen and Wildland Hydrology to define the steps to take and the cost of installing and maintaining the different measures.

Subsequent to these concept plan efforts, a project was implemented, data was collected, the river was surveyed and a restoration design was prepared. Significant bank restoration progress was made in 2004-6 by the Alamosa River Watershed Restoration Foundation through the 319 NPS Pollution Program and Colorado Water Conservation Board funding, totaling around $700,000. Extensive work was completed in 2004 on 7,000 feet of channel below Gunbarrel Road. An additional 7,000 feet of channel was treated in 2005 to County Road 8. The work included removal of excess sediment, reestablishment of natural meander patterns, channel shaping, installation of rock stabilization and enhancement structures, vegetation replanting and grazing management.

These measures have had demonstrable success and will be continued on the remainder of untreated channel from CR 8 to CR 10. In partnership with the Alamosa River Watershed Restoration Foundation, the San Luis Valley Resource Conservation & Development Council will complete the restoration of the remaining 14,800 feet of channel on the next 2.6 mile reach of river, which, when completed and meanders are constructed, will create an additional 15,000 feet of restored and stabilized river system. Additional channel shaping, stabilization and sediment removal measures will be implemented on that reach. Revegetation efforts will focus on the regrowth of woody plants in the riparian corridor along the river and cooperative grazing management plans (BMPs) will be pursued with area landowners with property along the river.

In addition to receiving assistance through the 319 program, this project will be funded through Summitville (Mine) Natural Resource Damage reparation monies for which the project is eligible as a Tier 1 Priority project as identified within the Alamosa River Watershed Master Plan (2005). This extensive plan was produced by MWH for the Summitville Natural Resource Damage Trustees, including CDPHE, CO Attorney General, CO Dept. of Natural Resources, US Bureau of Land Management, US Fish & Wildlife Service, and US Forest Service.

A6 Project/Task Description

The proposed work is a continuation of the Alamosa River Riparian Restoration Project which began in 1999 and was implemented in 2004-2006. This phase of the project continues to emphasize stabilizing severely eroded portions of the Alamosa River using, where appropriate,

rock structures, channel shaping, and vegetative controls. The key features of the continuation project are the structural changes designed to reduce the erosion of the riverbanks and bedload and alter the flow and depth of the river to improve water quality and help re-establish a fishery.

Equally important is the promotion of the regrowth of woody vegetation in the riparian area. This will be accomplished by replacing native plant species along the river to help stabilize the banks, and the cooperative efforts of river landowners who have agreed to install and maintain grazing BMPs.

The continuation phase will extend the reach of stabilized riverbed and banks. It will increase the number of rock structures in the channel that are designed to manage flow through the straightened portion of the river and to deflect flows from vulnerable stream banks and property. This continuation phase will also expand the revegetation efforts and continue a comprehensive public education effort to keep the community informed about the restoration efforts, and to enlist their support and cooperation.

Previous river assessment and monitoring efforts found that about 20% of the 2.6 mile project reach has moderate to severe bank erosion and contains approximately 12,500 sq. ft. of eroding bank surface. Monitoring of cross sections has shown that some of these banks experienced lateral erosion bank loss of eight to nine feet over the past two runoff seasons. The Bank Erosion Hazard Index (Rosgen) was used to estimate that 3,400 cubic yards of material enter the stream annually. This loss of bank will likely create more erosion on an additional 2,500 feet of stream bank if not addressed. The proposed structures have been highly effective in stabilizing the river in the restoration of the channel downstream of Gunbarrel Road.

Project goals include: I. Public Education/Information; II. Construction/ Sediment Reduction; III. Restore Riparian Health; IV. In-Field Monitoring.

Objectives include:

- Stabilize the Alamosa River, improving water quality, water accessibility, and aquatic habitat by reducing sediment load, bank erosion, and damage to irrigation head gates and adjacent land.
- Improve riparian health by replanting vegetation and assisting the natural regrowth process.
- Monitor the success of the project and develop long term BMPs, such as alternative grazing strategies, with participants so that the streams' stabilizing riparian vegetation can be maintained.
- Maintain continuous communication with area landowners as to project developments, concerns, and progress. Distribute information on the monitoring and the restoration process.

A7 Data Quality Objectives for Measurement Data

Changing the morphology of the stream channel

The original conceptual plan for restoration of the Alamosa River, developed by Dave Rosgen of Wildland Hydrology, provided for three different restoration options to return the River to its natural functioning condition. Option 2 was accepted by general consensus of the landowners and the project sponsors as the most feasible and cost-effective approach. It called for placing the stream, wherever possible, in the original channel bed and reconstructing a new type "C" stream channel in the existing type "F" and "D" channels (C, D and F refer to Rosgen's stream type classification system). A type "C" stream is defined as a single-thread channel, slightly entrenched (>2.2), with a moderate to high width/depth (>12), and high sinuosity (1.2). By comparison, a type "D" stream has multiple channels, very high width/depth (>40), and low sinuosity (<1.2). A type "F" classified stream is a single-threaded channel, entrenched (ratio: <1.4), moderate to high w/d (>12), and moderate sinuosity (>1.2).

Changing the morphology of the stream channel will require reshaping the stream to create meander bends with pools and riffles and reconnecting the stream with the adjacent floodplain. The conceptual plan recommended re-establishing the pre-existing channel (prior to 1970) wherever possible. Photo documentation, including aerial photographs where available, were used to ascertain historic conditions of the river stretch and assist in developing and evaluating options and restoration potential prior to taking action to place the channel into its original bed. In addition, landowners were consulted to discuss and determine their interest and/or willingness to have historic meanders reconnected on their properties.

Final restoration design plans were prepared and include some reconnection of the historic channel. Some land owners were not interested in those activities and some sites did not lend themselves to such work due to adjacent land use.

Photo documentation contained in the Conceptual Design Report clearly illustrates the current scope and severity of the erosion problem and the deteriorated condition of the stream. Photos taken from ground photo points will document river restoration activities and monitor the river's condition following channel reconnection and other restoration work. The success of the restoration effort will be determined by monitoring bank erosion rates across sections established following restoration activities.

Channel Structures

Site selection for the construction of in-channel structures was influenced by the conceptual plan but was largely dictated by additional stream assessment, examination for the channel cross section and profile survey data and evaluation of the geomorphological condition of the stream system. The conceptual alternatives presented in the plan were a first cut and were presented for consideration of the stakeholders and the various funding agencies. A more comprehensive and detailed draft design was then prepared and presented to the landowners and other stakeholders who provided input prior to the development of the final design.

Restoration concepts were outlined in the Conceptual Design Report referenced above and in the

design document and drawings. Stream restoration concepts presented in the design plan included sloping the banks, revegetation and installing channel structures to help stabilize both the lateral and vertical adjustments.

A 404 permit was obtained from the U.S. Army Corps of Engineers for the restoration and structural work on the first 14,000 feet of stream channel. That permit has since expired and a new permit will be obtained to complete the remaining 14,800 feet. Qualified earth movement contractors will be hired and the work will be monitored on a regular basis. Earth movement and the installation of the rock vanes and cross vane structures will be supervised and evaluated by qualified personnel. Photo documentation and cross section measurements will be used to record that the structural changes are having the intended effect.

Monitoring cross sections will be established at approximately 1000 foot intervals immediately following the completion of river restoration activities and will be monumented with rebar end pins. The exact placement of the cross sections will be determined in the field, and they will likely be located at sensitive points along the river where bank stress is high and potential for erosion greatest. These cross sections will be surveyed at that time to develop baseline post-restoration channel conditions and will be measured using either a stretched tape and laser level or a total station and stretched tag-line. The monitoring cross sections will be resurveyed annually for three years following restoration work. In addition, a channel bed profile will be surveyed immediately following construction in order to document the in-channel structure placement and pool/riffle sequencing of the restored channel and for comparison of the restored bed profile against the existing channel profile.

A "settling-in" period is expected to occur during at least the first year and through the first runoff season following construction or until a normal bankfull flow (in terms of discharge rage and duration) is experienced through the project reach. During the settling-in period some minor bank erosion and local mobilization, deposition and repositioning of disturbed bed materials is expected. Following the settling-in period, the cross section survey will be used to monitor and document the success of the stream stabilization measures and to measure any bank erosion that may occur at those sites.

Photo points will be established at each cross section where photographs will be taken looking across the channel from each side and looking upstream from downstream of the cross section and looking downstream from upstream of the cross section.

It is hoped that funding may be available in future years to resurvey the channel profile at year five following construction in order to monitor and document profile of the river bed.

Revegetation

Riparian vegetation evaluation provides detailed quantitative site information that describes the following:

a. status of the riparian vegetation prior to BMP treatment,
b. quantity of riparian vegetation to establish a goal for BMPs,
c. design criteria for BMPs to be applied at the site,
d. comparisons of before and after treatment conditions,
e. factors limiting success of the approaches used.

A conceptual restoration design plan for the Alamosa River, completed in March 1999, analyzed the factors that contribute to the instability of the riverbanks, and recommended specific steps for restoring the banks and reducing the erosion. The watershed project and the water conservancy district worked with Dave Rosgen, the author of the study, to define the scope and costs of applying the proposed remedies to additional parcels of land. During the initial phase of the project a 1300-foot reach of the Alamosa River was restored. The success of this endeavor is being monitored at two cross sections upstream of the restoration work, and one cross section downstream. Four cross sections were set up within the restored reach. Bank erosion study sites were monitored to demonstrate that steam restoration reduces accelerated bank erosion (sediment delivery to the stream from streambanks) compared to the un-restored channel.

The sites for vegetative restoration will continue to be selected using the numerous studies conducted on the area, and in consultation with area stakeholders. The condition of the selected sites will be evaluated and documented with photographs. Sampling methods to be used are adapted from the methods used by the Colorado Natural Heritage Program in their riparian inventories (Kittel et al., 1996). It is a variation of the Green line method used to inventory the current present vegetation and compare changes over time.

To document the 2004-6 riparian restoration work, nineteen vegetation transects were identified and vegetation data were taken twice at each site (once for each year) from July of 2001 through September of 2002. These data were considered baseline data because only 4 of these transects are located within areas that had already been restored (the 2 pilot sites at Ignacio Rodriguez's property and at the Quintana property above the Gunbarrel Road). One vegetation transect, Transect #2, is purely a photo monitoring site because of interest in the future of a dense stand of alders and the rapid changes occurring to the riparian area at this channel location. Vegetation is assumed to have reached full growth potential by late July. Early maturing and senescing species are measured as if they were at full cover. Vegetation monitoring is planned for this year (August 2007) according to the plan to monitor again after five years (since 2002).

Permanent vegetation transects, each 100 meters long (328 feet) were placed at each site in an area of vegetation that appeared representative of the plant community present. Permanent transects were marked with a rebar stake at each end of the transect, and these two endpoints were then recorded with a GPS reading where possible. Transect direction was generally East to West and running parallel to the stream.

Vegetation measurements were taken every 5 meters (16.4 feet) along each transect using a frame 1 meter by 0.5 meters, placed on the ground and observed from above. The frame was placed on

alternating sides of the tape that was placed along the line transect. Vegetation was assumed to have reached full growth potential by late July. Early maturing and senescing species were measured as if they were at full cover. Overhead measurements of shade cover (over story) were taken at each sampling point. Data was also collected at the ground level for the kind of substrate that the vegetation is growing in. This data includes any bare ground or rock that might be present in each frame and a percent cover of debris or litter which might cover the ground or rock. Twenty measurements were made at each transect.

In addition, permanent photo points were placed at each end of each transect (at the rebar locations), and looking along the transect. Photos of the two years of monitoring are available in the *Alamosa River Watershed Restoration Project 2000-2006 Final Report*. Photo documentation will continue to adhere to the standard operating procedures (SOPs) adopted as part of Colorado's QAPP. The photo documentation will include a record of upstream and downstream cross sections. Photo points will be used to illustrate particular problems and to document the effectiveness of the revegetative BMPs.

Vegetative profile boards will be used to illustrate the patterns and types of vegetation planted. Before and after photos will provide clear documentation of the success of the endeavor.

Grazing Management Practices

The project calls for the application of grazing management practices that will reduce the stream bank erosion in the riparian meadows. The commitment has been made to work with the landowners and the NRCS to develop individual grazing management plans that meet the landowners' needs and restore the vegetation. The preferred approach is for three years of deferred grazing followed by short-term grazing in the spring or the fall.

The effectiveness of this BMP will be evaluated on the success of the project to involve key landowners and the NRCS in the selection and application of grazing BMPs. Ten landowners who have approximately 40 acres have been included. Meadows and other land may be involved in long term grazing strategies. Once the sites are selected, photo documentation will be used to record the conditions prior to the installation of any mitigating BMPs. Once again, cross sections will be defined and photographed, and the type and location of the plant species will be recorded. The survival of the plants will be monitored and recorded and periodically re-photographed to document how well the treatment is working. The treated areas will be compared with non-treated ones. Where applied, methods used to keep the animals out of the riparian corridor will also be evaluated. Comparisons will be made between these areas and those where grazing continues.

Public Education Program

A commitment to inform the community about the restoration project and to involve them in the decision-making process is an important component of the project. The effectiveness of this effort will be evaluated by the ability of the project to fulfill the commitments indicated in the scope of work. These include field tours at the restoration sites, meetings in the community,

publication of a semi-annual newsletter, the issuance of press releases, and participation in local radio talk shows.

Standard Operating Procedures

Methods covered by this Sampling and Analysis Plan include:

Photo Documentation
Riparian Vegetation Evaluation
Establishment of channel monitoring cross sections

A9 Special Training Requirements/Certification

The NRCS and the Soil Conservation District will oversee the revegetation and will assist landowners with the implementation and oversight of the grazing practices. Both agencies have extensive experience with the installation and oversight of riparian restoration BMPs. Experienced contractors will be hired for the earth moving associated with the channel shaping and construction of the channel structures. As appropriate, local land owners and other stakeholders may be enlisted to assist with this effort to meet the inkind match requirements. Volunteer support will be under the supervision of experienced personnel.

A10 Documentation and Records

Photo documentation will be made of unstable reaches, the revegetation efforts and the channel stabilization measures as described in A7. These will be compiled into the GIS mapping and monitoring database. Progress reports will be prepared and submitted to the project management at six-month intervals. A final report documenting the outcomes will be prepared and submitted.

Measurement/Data Acquisition

B1 Sampling Design

GIS maps were prepared by AGRO Engineering to depict the historic and present channel location overlaid on current and historic aerial photographs. A cross section and longitudinal profile survey from Gunbarrel Road to C.R. 10 was performed by Black Creek Hydrology in 2002. This information was used to prepare cross section plots and CAD drawings of existing plan and profile channel geometry including thalweg, top of bank, floodplain and levee locations. This information will be used as a baseline for comparison of the pre- and post-restoration river geometry.

A morphological assessment of the stream was also undertaken in 2002 that included an in-field survey to document the conditions of in-stream structures. The 404 permit

application summarizes the detailed information available on the cross sections and the thalweg. Georeferenced plan views are available in the 2000-2006 Alamosa River Watershed Restoration Project CDPHE 319 NPS Final Report and upon request. Photographs will be used to illustrate the stream channel cross-sections for detecting changes in streambank cover, vegetative stability, and riparian vegetation recovery.

As mentioned above and in the "Channel Structures" section, the reduction in stream bank erosion, along with the decrease in sediment loading will be demonstrated by contrasting monitoring results from established cross sections upstream and downstream of the restoration work with monitoring results at cross sections in the project reach. Monitoring cross sections in the restored reach will be established at approximately 1000 foot intervals immediately following the completion of river restoration activities and will be monumented with rebar end pins. The exact placement of the cross sections will be determined in the field, and they will likely be located at sensitive points along the river where bank stress is high and potential for erosion greatest. These cross sections will be surveyed at that time to develop baseline post-restoration channel conditions and will be measured using either a stretched tape and laser level or a total station and stretched tag-line. The monitoring cross sections will be resurveyed annually for three years following restoration work. In addition, a channel bed profile will be surveyed immediately following construction in order to document the in-channel structure placement and pool/riffle sequencing of the restored channel and for comparison of the restored bed profile against the existing channel profile. Bank erosion study sites at several unrestored and restored cross sections will demonstrate that stream restoration reduces accelerated bank erosion.

To monitor vegetation, photographs will be taken upstream and downstream at the first and last cross-channel transects as described and illustrated in the standard operating procedure for photo documentation.

B2 Sampling Methods Requirements

Sites selected for riparian revegetation were documented with before, during and after photographs in the previous project to establish baseline information on the sites selected, which included sites in the current reach. Three additional transects may be added. Applicable procedures for riparian vegetation evaluation developed by the Utah Department of Environmental Quality Division of Water Quality will be used as a model from which specific procedures will be selected.

B3 Sampling Handling and Custody Requirements

Not applicable

B4 Analytical Methods Requirements

There is no analysis outside of the field

B5 Quality Control Requirements

{AARP see guidance and select appropriate measures}

B6 Method Calibration and Frequency

AARP see B6 - modify to project

B7 Data Acquisition Requirements

All data for riparian vegetation evaluation is directly measured.

Assessment/Oversight

C1 Assessment and Response Actions

Monitoring the re-growth of vegetation in treated areas by comparing treated and un-treated (and/or minimally vegetated) sites to determine the efficiency of grazing management strategies. One transect per property owner has been proposed totaling 30 transects for the eight mile section. Several transects will be located on non-restored reaches for comparison. Monitoring of these will occur annually during August.

Monitoring of the bank erosion on the restored and unrestored sites will be undertaken to evaluate the effectiveness of the erosion control strategies. This will be accomplished by setting up approximately one cross sectional profile per 1000 ft, or 5 per mile, for a total of 27 cross sections. (These stations will be installed immediately following construction activities and may be located at the same sites as those cross sections established during the design survey performed in 2002. Selected cross sections will be re-surveyed after construction and then once a year after runoff.

A longitudinal profile was performed during the design survey and will be conducted again immediately following construction. The monitoring cross sections will be resurveyed annually for three years following restoration work. In addition, a channel bed profile will be surveyed immediately following construction in order to document the in-channel structure placement and pool/riffle sequencing of the restored channel and for comparison of the restored bed profile against the existing channel profile. Pending funding monitoring vegetation will continue and grazing management will be evaluated with NRCS after five years.

C2 Reports to Management

The Riparian Vegetation Evaluation data will be included along with the photo documentation in a semi-annual and a final report to the WQCD.