Telluride Valley Floor

Integrated Monitoring Plan

December 1, 2013

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Prepared on behalf of Telluride Open Space Commission

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Acknowledgements

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Cover Photo Credit: Rory Cowie, 2013

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1.0 INTRODUCTION

The Town of Telluride (Town) through its Telluride Open Space Commission (Commission) have developed the Integrated Monitoring Plan (IMP) for the town-owned Telluride Valley Floor property (Valley Floor) as an adaptive management tool and living document to guide conservation and stewardship of the Valley Floor. The 560-acre Valley Floor is an important ecological resource, recreational amenity, and scenic landscape of the Town of Telluride, containing diverse vegetation communities, wildlife habitat, and cultural and historic resources along a three-mile section of the San Miguel River. In 2009, the Town placed a Deed of Conservation Easement on the property ensuring its protection as open space in perpetuity. The Telluride Valley Floor Open Space Management Plan was completed in 2009 (Management Plan, Telluride, 2009). The Management Plan establishes and articulates the Town's policies and guidelines for management of the property, emphasizing protection of the property's conservation and ecological values consistent with the allowed and prohibited uses set forth in the Conservation Easement. The policies and priorities outlined in the plan are derived, in large part, from the findings and recommendations of the Valley Floor Environmental Report. The Commission selected an interdisciplinary team of Mountain Studies Institute, Rhea Environmental Consulting, and Terra Firm, Inc. develop the IMP.

Conservation Values and Management Plan Direction

The purpose of the Deed of Conservation Easement (Conservation Easement) is to preserve and protect in perpetuity and, in the event of their degradation or destruction, to enhance and restore, the open space and natural features and values of the property. The easement defines the open space and conservation values of the property as natural, ecological, educational, riparian, environmentally sensitive areas, significant relatively natural habitat for native plants and wildlife, and scenic vistas of great importance to the Grantor and its citizens, guests, and invitees (C.R.S. Sections 38-30.5-101—111, Recitals B. Page 2). It is further the specific purpose of the Conservation Easement to conserve important habitat for wildlife; to protect rare or unique native plants currently known or later identified; and to conserve the diverse meadow, and riparian communities and the wildlife inhabiting these communities. Further the specific purpose of this Easement is to ensure the recreational and educational uses, such as nature walks, trails and areas for hiking, bicycling, running, cross country skiing, and other public park purposes not requiring the improvement of the land or placement of permanent structures, and that such uses are accessible to the public and do not significantly impair or interfere with the Conservation Values.

Development of the Integrated Monitoring Plan

A priority of the Management Plan is to develop a monitoring plan to document baseline conditions, track long-term trends on the property, and assess the efficacy of management actions in maintaining the values of the property. Through its implementation, valuable information and data will be collected to be used for a variety of activities, such as future restoration work and wildlife-human management decisions. The intent is to develop practical and efficient monitoring strategies, protocols, practices and standards; short- and long-range capital and operational/maintenance cost estimates; budgetary priorities; and identify potential funding partners for implementation. The information gathered through the IMP will assist the Commission and the Town in the development of adaptive management policies associated with the Valley Floor and will help to provide an understanding of the benefits and consequences of various management actions.

The IMP monitoring strategies and methods are based upon guiding documents for the property, including: Deed of Conservation Easement, Environmental Report and Appendices, Management Plan, and Telluride Valley Floor Trails and Conceptual Stream Restoration Plan. In addition to the resources named in these plans, the IMP combined input from the Commission, community, field reconnaissance and experience to identify additional elements for inclusion in the plan, such as establishing a climate station to understand climate inputs and drivers into the system.

Adaptive Management Philosophy

The Management Plan is ultimately tasked with balancing use and enjoyment of the property with protecting its conservation values in perpetuity. Through the Management Plan, the Valley Floor has embraced a practice of adaptive management that will require the Town to periodically plan, monitor, assess, refine management approaches and polices, and adapt resource management actions based upon a growing understanding of the resources being managed, and how those resources respond to changes on the property, by:

1. Establishing a clear set of management policies and objectives
2. Implementing management actions to address specific policies
3. Monitoring to ensure the effectiveness/consequences of management actions; and
4. Incorporating knowledge gained from monitoring and revising management policies and actions accordingly.
5. Adaptively managing the Valley Floor property to protect the open spaces, natural features and conservation values of the property.

The mission of this project was to establish a monitoring plan that would support the adaptive management process.

Structure of the Integrated Monitoring Plan (IMP)

This report includes an introduction to the monitoring objectives and protocols for the Valley Floor. This monitoring plan provides an overarching framework integrating monitoring strategies and objectives to support the long-term management and stewardship of the property. It is meant to be a living document for the Town and Commission to adaptively manage the property; however, it does not commit the Town to specific monitoring activities or funding obligations. These monitoring strategies are primarily offered in three formats: 1) a tabular summary of the key activities and characteristics of the monitoring strategy listed by resource (Appendix A); 2) a narrative description of the considerations, drivers, and monitoring approach; and 3) an interactive table of cost estimates by resource and monitoring objective.

The IMP is a comprehensive monitoring strategy that integrates individual protocols and objectives into a holistic understanding of the systems and processes on the Valley Floor. Where practical, it incorporates opportunities for integrating methods and improving cost effectiveness of the monitoring design. Additionally, it provides basic directions on spatial and temporal resolution, sampling design, and analysis. For some resources, this plan will be sufficient to guide the Town to prioritize monitoring efforts, budget resources, and initiate field monitoring. In areas where major changes in management or restoration actions are planned, a detailed monitoring plan would be developed in concert with the development of those actions, such as the phased river restoration project.

Why Monitor?

Monitoring is the systematic and periodic measurement of indicators of resource and social conditions. There are many reasons to monitor, which range from regulatory requirements to pure interest in a process or phenomenon. A critical first step in developing a monitoring plan is to clearly define the goals (i.e. purposes) of the project and the specific objectives needed to achieve those goals. To that end, most monitoring plans have at their core one or more of these five elemental goals:

1. Describe the status and trends of valued resources
2. Describe and rank existing and emerging problems
3. Design and evaluate management and regulatory programs
4. Respond to emergencies and/or catastrophic change
5. Protect valued resources from harm

For the majority of the resources on the Valley Floor property, little to no background information exists. Therefore, in general, the monitoring needed for the Valley Floor would initiate a process to describe the resources present, determine their current status, and provide a baseline for trend and viability analysis over time. ***Status and trend monitoring*** attempts to estimate the status of a resource, and to track over time indicators of important factors to that resource. Once the initial baseline has been established more complex and in-depth studies will be able to evaluate problems, determine the effects of management actions and ultimately determine if values and resources are being preserved over time.

Monitoring strategies enable a holistic and comprehensive understanding of the systems and controls on those systems, so management can focus on cost-efficient strategies which maintain and enhance the values associated with a specific landscape or site. These strategies drive where, when, and how you will collect information, and how you will analyze and organize the data to meet your goals.

Monitoring objectives articulate the outcome necessary to attain a goal or to answer a question about a resource's status or state. A good objective should be results oriented, quantifiable, time limited, specific and practical.

Monitoring protocols detail standard operating procedures and field methods that explain how the data are to be collected, managed and reported. Protocols are essential to quality assurance for monitoring programs to ensure that data meet defined standards consistently over time and comparisons of results are meaningful.

Indicators are the values resulting from reduction of the data, or measurement, collected in the field. The information gained from processing data from the field enables us to understand the status condition or trend of a resource or ecological process. The indicator should answer the question posed by the objectives of the protocol.

Highly effective monitoring systems will do a number of things simultaneously, including: (1) actively integrate multiple disciplines and perspectives so as to minimize systematic biases apparent in most single discipline or approach; (2) take measurements and evaluate data at or at slightly finer than the scale of the physical/biological process of interest; and (3) focus on the connections of processes functioning at different scales, dependencies on prior conditions, and the fluxes of energy and material through the area of interest. It is equally important that there is a systematic, repeatable process and reasoning that structure the monitoring design and protocols to provide meaning over time.

Foundations of a Successful Monitoring Program

Two of the most important foundations of a successful and effective monitoring program are preparation and adaptation. *Preparation* refers to the wide range of activities that will include the development of a system for ingest, analysis and dissemination; *adaptation* refers to the regular re-visiting of monitoring activities as they support (potentially changing) management objectives and extant conditions. Here is a list of sequential activities for developing a monitoring program:

1. *Identify management goals and conservation objectives* to guide the monitoring program.
2. *Design monitoring program to address specific questions and testable hypotheses* - which the monitoring serves to answer (*e.g., Water quality conditions in a reach meets standards developed by the Town*).
3. *Plan for data collection and storage* - including identification of a data steward and data archive options.
4. *Collect and archive all existing background information* (*e.g., archives, articles and reports*).
5. *Acquire and archive all current and historic web-based data* (may include data from USGS, EPA, US Forest Service, NOAA, etc.) – this is essentially a web-mining exercise.
6. *Develop plans for data analysis, reporting and distribution* – what are the main questions to be answered by monitoring and how will you communicate the answers to your public(s).
7. *Implement, test, and refine protocols* used for monitoring – specific protocols or methods should be tested to confirm that they meet the needs and serve the objectives of the monitoring effort, and that they can be completed consistently by field crews.
8. *Adaptively manage resources* through evaluating monitoring information and process for meeting the monitoring objectives—iteratively review management practices and policies and adjust accordingly.

Design of a Monitoring Program

Identify Goals & Objectives

- Articulate management goals and conservation objectives
- Develop specific information needs for long-term and short-term management of the resources and values of the property

Design Monitoring Program

- Develop specific questions and testable hypotheses to direct monitoring effort
- Design monitoring strategies and monitoring networks
- Select monitoring protocols to monitor and develop indicators

Collect & Manage Information

- Plan for data management, collection, and long-term storage
- Initiate database for managing data
- Acquire and archive all current and historic data (internal, web, etc)

Develop Analysis & Report Plan

- Develop process for analysis and interpretation to answer questions and to identify interactions and relationships
- Define quality control and quality assurance measures
- Articulate a plan to communicate answers, share data, and translate information with the Commission, public, and partners

Implement, Test & Refine Protocols

- Implement, test and refine protocols to be used for monitoring
- Evaluate and confirm that methods serve the objectives of the monitoring effort and are consistent over time

Adaptively Manage: Review & Revise

- Evaluate monitoring information and data in light of management questions and activities
- Iteratively review protocols, monitoring design, management practices, and adjust

2.0 INTEGRATED MONITORING PLAN STRATEGY

In this document, the IMP describes monitoring approaches and protocols to support adaptive management for 24 resource values (Figure 1). To fully support the strategies in the IMP, it is essential that the full six-step 'Design of a Monitoring Plan' process be considered and implemented. The process is consistent with state-of-the-art practices utilized by national and regional leaders in monitoring and data management, such as the Colorado Data Sharing Network, United States Geological Society, and National Park Service. The IMP provides detailed resource sections to establish a monitoring program. In addition, the following steps are equally important for structuring the monitoring plan to be successful. The full process ensures that the finite resources available for monitoring are efficient, effective, and targeted. It confirms that changes detected by monitoring are actually occurring in nature, and not simply a result of differences in practice or measurements taken by different people in slightly different ways. It creates a system to record and steward the data beyond changes in technology and staffing. Together, the IMP Strategy section includes protocols for a holistic monitoring plan to support the iterative adaptive management approach for managing the Valley Floor.

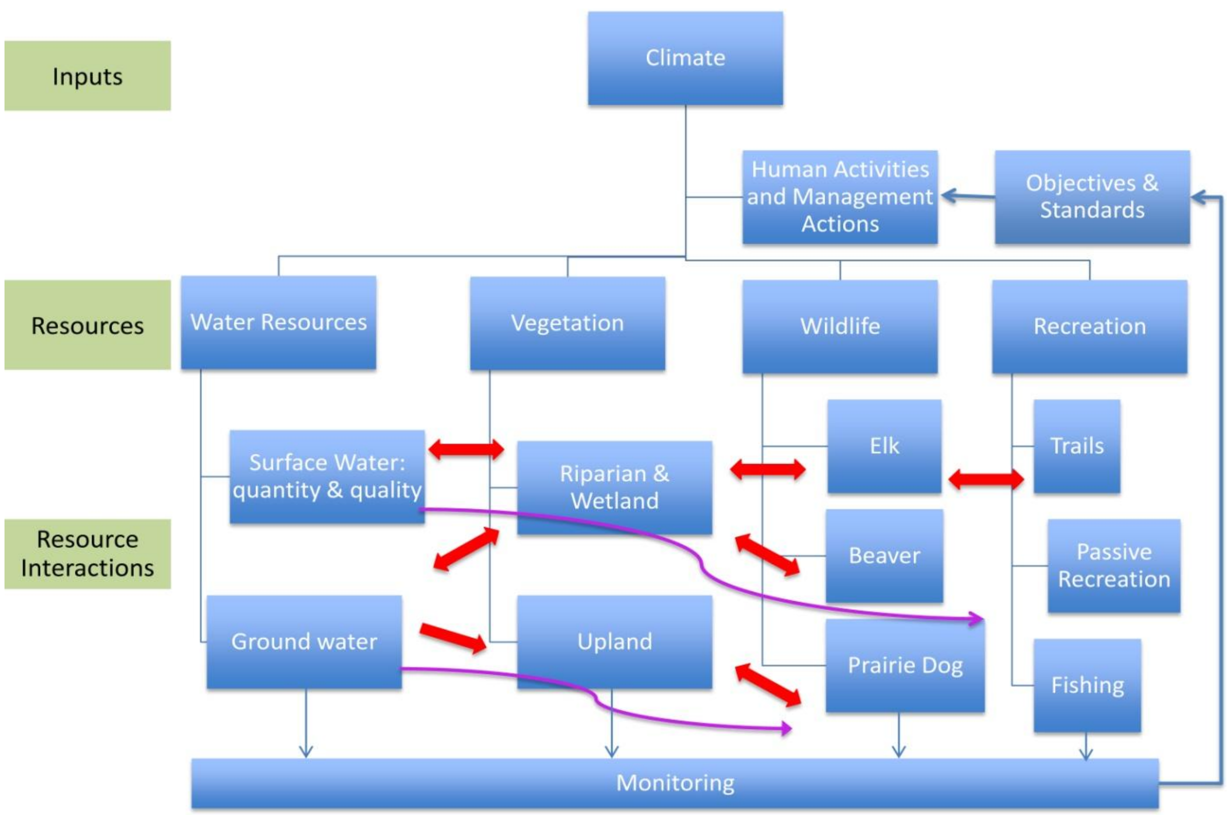

Figure 1: Conceptual diagram of connections between adaptive management, monitoring, and resources. The diagram is divided into the *inputs*, or drivers, of the system, the *resources* to be monitored, and some of the specific *elements* and *interactions* within the resources. The arrows begin to demonstrate the interconnections between different components.

Management Goals and Objectives for Monitoring

The management of the Valley Floor is guided through the Management Plan, which details management approaches and policies for key resources and activities. Further, it defines Zone Designations for management emphasis and allowable uses in certain areas for Low Impact Recreation, Conservation, and Habitat Protection, as Zones 1-3, respectively (Town of Telluride 2009). The IMP is designed to support the zone system in its goal to ensure the preservation and protection of conservation values of the property. The IMP supports the Management Plan by incorporating the Zone Approach through locating activities according to these priorities. Additionally, the Management Plan recommends that the Town and San Miguel Conservation Foundation commit to update the Management Plan every four years, or sooner if it is in the best interest of the conservation values of the property (Management Plan, pg. 51; Deed of Conservation Easement, Section I.3, pg. 7). This cycle would include reviewing the design of the IMP.

Initiating a monitoring plan is a long-term commitment. Knowing that the Town is operating in a world of limited resources, the IMP was structured to consider where to start and with which resources, so that the effort can be sustained over time and best support the Valley Floor management and resource decisions in perpetuity. *The Commission should prioritize aspects of this plan for the first five years using a systematic, reproducible approach, to be chosen by the Commission and to be revisited over time.* The system should be documented and reviewed as part of the annual work plan review and as part of a larger Management Plan update.

The prioritization process should weigh the following considerations:

- Areas where conditions are changing rapidly or are anticipated to change in the future
- Areas where specific and important values exist, such as Zone 3 Habitat Protection
- Areas where conditions are at or in violation of a standard
- Number of monitoring goals that a project or element addresses
- Relative density of sensitive or unique resources in the area
- Relative concentration of activities occurring or proposed in an area
- Level of anticipated impacts or if there are questions regarding the impacts of an activity
- Return on investment measured by the confidence that the activity will produce good information
- Ability to leverage, augment or extend existing data or efforts by partners

Design the Monitoring Program- Introducing the Integrated Monitoring Plan

In order to develop a monitoring program that includes the Valley Floor resource values, incorporates the three management zones, and integrates opportunities for co-locating monitoring efforts, the IMP describes an integrated, multiple phase monitoring program that combines a series of permanent plots and transects with resource-specific locations where change is occurring, or proposed to occur such as river restoration. The first phase of the program is to spatially distribute sampling locations in a systematic, randomized design designed to monitor general resource values (Figure 2). This can be accomplished by establishing the appropriate number of transects to dissect the property, which will be further defined in the vegetation monitoring sections. The second phase of developing the program is to distribute sampling points along the transects so that each of the three management zones are adequately sampled for the most important resources within those zones.

The third phase of the program is to further develop the conceptual model and scientific understanding of which resources being measured have direct and indirect influences on each other. The idea is that the monitoring for one resource can complement the understanding of changes in other resources. For example, monitoring local climate variables is important because they will have a direct impact on some resources like surface water, which in turn will indirectly impact additional resource components such as wetlands (see Figure 1). Development of a conceptual understanding then helps to show the equal importance of monitoring multiple resources concurrently, and in a compatible manner, so that long-term monitoring efforts can present feedback loops that will ultimately assist with making management decisions.

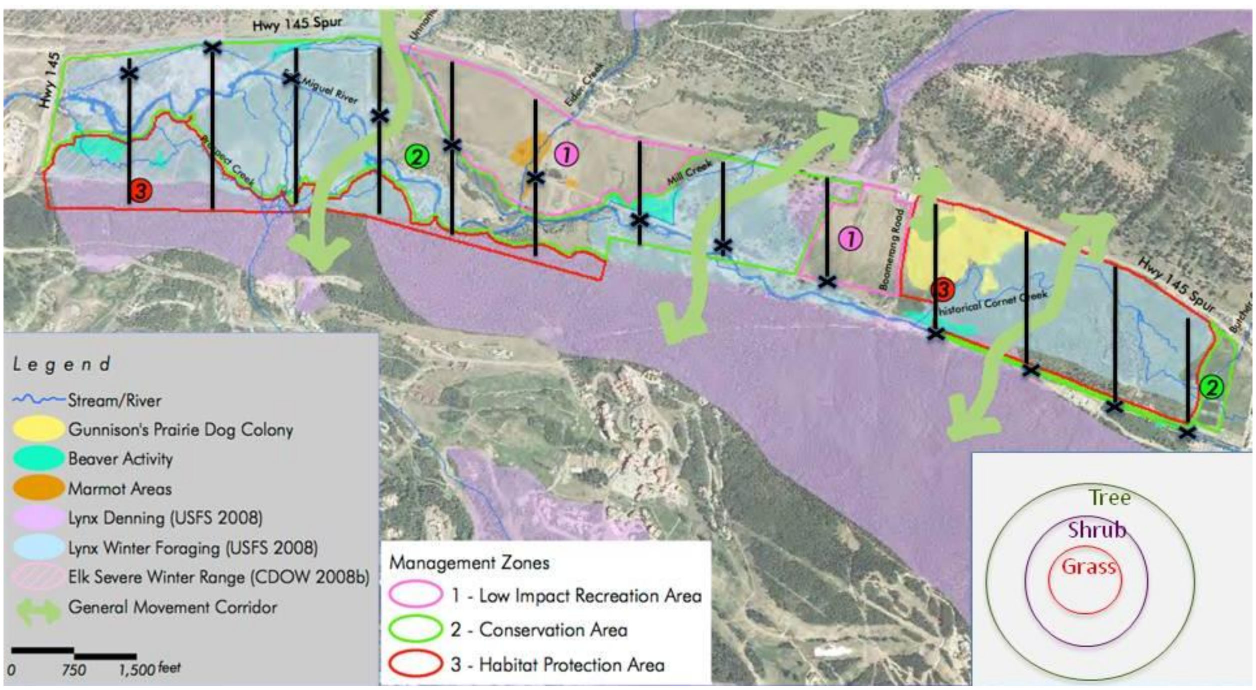

Figure 2: Integrated Monitoring Plan transect concept. The program concept is based upon establishing multiple transects (black lines), that are accessed from existing trails (x where crosses the railroad grade), and cross each of the management zones and distinct vegetation communities. Multiple plots would be spaced randomly across each transect to capture the important resource values and transitions.

Based on the current understanding of Valley Floor ecosystem as a whole, the initial priorities for monitoring and capital investment are:

- **surface water** and **groundwater** to support river restoration planning;
- **climate and weather** to understand the water balance and important climatic fluxes that are changing in the basin;
- **invasive and noxious weeds** to continue to contain and control undesirable species; and
- **photo point records**, to establish a baseline of current resource documentation.

Collect and Manage Data

The collection and management of data includes many activities beyond the careful and accurate recording of field measurements. In this phase, it is important to establish mechanisms for data quality assurance and quality control (QA/QC) to ensure that the data will produce reliable information. It is essential that the Town execute a standardized system for collecting and entering data and for assessing and maintaining data quality.

- **Develop a computer database for data entry**. The computer database that will be used to store and manage data should be developed concurrently with the monitoring manual and field data forms. Automated procedures and programs for entering and analyzing data can assist with quality assurance. As one example, the National Park Service (NPS) Inventory and Monitoring (I&M) Program's Natural Resource Database template (NRDT) is a good example of a free, relational database template that can be adapted to capture and organize monitoring data (see Natural Resource Database Template, NPS I&M 2013). Additionally, the NPS offers an application template for the user-interface for entering and managing data through their portal. *A field computer should be purchased where data can be directly entered or downloaded from electronic sensors, gauging stations, and cameras can streamline the process.*

- **Define quality assurance measures for data handling and analysis.** The data steward should define: Metadata procedures; Overview of data base design; Data entry, verification, and editing; Routine summaries and statistical analyses to detect change; Reporting schedule; Report format with examples of tables and figures; Methods for long-term trend analysis; and Data archival procedures. *A qualified professional or scientist should be involved at the beginning of the monitoring program to assist with the design and execution.*

- **Data storage.** Monitoring activities generate an immense amount of data that will need to be stored for decades and beyond. *A steward should be identified to care for the data which should be saved to a secure server, such as a GIS department, with an automated backup function.*

Develop Analysis, Data Sharing, and Report Plan

Data analysis and reporting procedures should be developed to ensure a close connection between management objectives and the intended uses of information. The key steps in that the process would be: (1) invite scientists with diverse backgrounds to advise the Town and Commission with a periodic review of the data for emerging trends; (2) establish the analysis approach and level of detail for consistent implementation over time; (3) develop a communication plan for reporting and data sharing; and (4) design a public engagement plan for where, when and how the public will be included in scientific monitoring, where appropriate.

- **Invite expert review.** In order to ensure continuity and scientific rigor, the Town may invite scientists with diverse and relevant backgrounds to periodically review the data collection program, monitoring plans, and monitoring protocols. The Town would receive input to critique the program and to perform periodic reviews. The primary role would be to assess if the protocols and data collection are sufficient to provide information, data quality assurance measures are incorporated, and that the monitoring program is scientifically defensible.

- **Detail a plan for analysis.** Analysis is a creative process, with many options. The most important piece is that the results be reproducible. In order to do so, the process should be documented, including the techniques, assumptions, and software used. Adequate training is important in this phase, and the Commission may want to work with a statistician or resource expert(s).

- **Articulate a plan for science communication, data sharing, and public engagement.** The Town will want to determine how much of the information that will be collected can reasonably be shared and select appropriate vehicles for dissemination, including raw data, GIS layers, analyses, and reports, including analyses developed by other agencies or scientists such as regional air quality trends that are identified by the Commission as relevant. Scientists may be interested in collaborating with the Commission and staff to bring their research interest to the Valley Floor, once there is an established data record. This could benefit the overall objectives of bringing more expertise and leveraging resources for answering the questions posed by the IMP and managers. Partner agencies, stakeholders and citizens may provide insights and observations that further the information.

- **Design a public engagement plan for where, when and how the public will be included in scientific monitoring**. Involving citizens as "citizen scientists" in scientific research often enlists the public in collecting large quantities of data across habitats, locations and spans of time and are particularly effective in sciences where basic skills in observation can be more important than expensive equipment. Citizen scientists can be anyone who is interested in science, has basic to advanced observation skills, and will volunteer as part of a research project or experience (e.g. high school students, retirees, families, volunteers). Typically, citizen scientists work with professional counterparts on projects that have been specifically designed or adapted to give amateurs a role, either for the benefit of the project, the benefit of the volunteers themselves, or ideally both. Citizen science projects have been successful in advancing scientific knowledge, and contributions from citizen scientists now provide a vast quantity of data about species occurrence and distribution (i.e. PikaNet, Project BudBurst, USA National Phenology Network). Most projects also strive to help participants learn about the organisms they are observing and to experience the process by which scientific investigations are conducted. However, these programs still have associated costs, as recruiting, training and maintaining a volunteer base can require extensive time and management. The trade off is that it accomplishes multiple goals of involving people from different perspectives directly in the process, and often leads to a higher level of support for a management activity or concern. The IMP monitoring activities include opportunities where citizen science may be appropriate technique to employ, however the costs associated with these programs are often equally or more expensive than professional services.

Protocol Implementation- Test and Review Methods

Developing and documenting the standard operating procedures (SOP) of the monitoring protocols are critical, and often neglected steps in implementing monitoring programs. Many types of resource conditions are difficult to objectively and consistently measure, and differences between assessments of individual evaluators are likely to be large in the absence of carefully defined and documented procedures. Without defining SOPs, changes in personnel could potentially create a situation where managers are unable to continue consistent monitoring or interpret previous monitoring data.

- **Develop a monitoring manual and update every four-five years.** This is a critical step that is often neglected in establishing a monitoring program. The manual should expand upon the information presented in this plan to document: specific field procedures, field data forms, personnel and budget requirements, training requirements, frequency and spatial distribution, data analysis procedures, and reporting requirements. Additionally, the manual should include professional standards of practice, such as appropriate ways to travel to minimize the monitor's impacts.

- **Define, test and refine monitoring procedures.** The monitoring manual should fully describe through narrative, diagrams, illustrations, and photographs the protocols and illustrate distinctions between resource conditions. Monitoring protocols will typically require at least some modification over time to ensure that they adequately capture the desired information and that they are comprehensive, concise, and repeatable over time.

Adaptively Manage- Revise and Review

The implementation and development of the IMP should provide Town and the Commission with useful information for describing the status of the Valley Floor ecological resources for the purpose of adaptive management. Data collected would ultimately help to identify potential changes in the resources in terms of amount, distribution and quality. Certain management actions or interventions may be indicated if changes in a monitoring indicator are detected and the condition deviates from the stated objectives. It is suggested that resource thresholds be determined beforehand by the Town and that the thresholds be based upon defined objectives and desired conditions that are specific and measurable.

The IMP monitoring procedures and data would be reviewed as an integral part of the periodic assessment of the Management Plan. This review would involve quantitative analyses to evaluate the efficiency and efficacy of the program, monitoring design, resulting information, and ability of the results to meet the Town and Commission's goals and objectives for adaptive management. A major outcome of the review would be to recommend revisions to management and to the monitoring program. *The Commission should pursue a program review to evaluate the monitoring program at least every five years.*

3.0 CLIMATE, SURFACE WATER, AND GROUNDWATER RESOURCES

The protection of natural water systems requires a detailed understanding of how natural and human activities affect such systems, and how the structure and function of aquatic ecosystems changes in response to those effects. Although water is neither created nor destroyed, it is in a constant state of flux as it transitions through the many stages of the hydrologic cycle. As a result, monitoring water quality and quantity at any point in space or time requires a full understanding of the hydrologic system. Appropriate monitoring of water resources also requires the acknowledgement that water is never in a state of stationarity nor does it recognize human defined boundaries. Therefore the best approach to monitoring water resources for a defined physical setting is to maximize and define the spatial and temporal footprint of the monitoring campaign.

The hydrology of the western United States, like many semi-arid regions of the world, is dominated by snowmelt runoff (Serreze et al., 1999). Mean annual temperatures in Southwestern Colorado have risen almost 2° Celsius (C) in the past three decades (Rangwala and Miller, 2010), a rate of warming greater than the western U.S., or any other region of the U.S. except Alaska (Ray et al., 2008). The timing of snowmelt has shifted two weeks earlier in Western Colorado in the last 30 years (Clow, 2010). In general, increased air temperatures, more frequent and prolonged droughts, and more intense storms are predicted for this region (Doherty et al., 2009). More specifically, climate models suggest that 21st century air temperatures will increase 2.0 – 3.5°C in the Rocky Mountain region relative to the last years of the 20th century (Baldwin et al., 2003). The combination of these factors is also likely to result in decreased annual snow pack, earlier onset of snowmelt, and increased evapotranspiration (ET; Stewart et al., 2005; Clow, 2010; Pielke et al., 2005). Predicted climate warming may also affect the ratio of rain versus snow in the western United States (Knowles et al., 2006), which could alter the spatial distribution of snow accumulation and the timing of melt in mountain catchments (Nayak et al., 2010), with ramifications for discharge, evapotranspiration, and groundwater storage fluxes. Knowing that these changes are probable we must recognize that the monitoring of fluctuations in hydrological resources is a vital component to monitoring the Valley Floor ecosystem function as a whole.

Local Climate

In mountainous areas the local climate can change dramatically over short distances, due to physical parameters like high topographic relief and variable slope and aspect. Therefore, climate should be monitored as close to the study area as possible. Currently, the nearest operational weather station to the Town of Telluride is at the airport which is outside of the valley on a south facing slope at an elevation 350 feet higher than the Valley Floor. Additionally, changes in local climate must be documented and understood in order to assess what is driving any changes to the local ecosystem identified by monitoring efforts. Without knowledge of inputs to the system it is difficult to identify causes, and nearly impossible to separate natural drivers such as climate and human- induced changes (i.e. water diversions or restoration).

Objective
The objective is to directly measure the meteorological fluxes occurring at the land surface. The meteorological fluxes should be measured on-site at consistent and continuous intervals to allow for appropriate correlation between environmental conditions and observed variations in resources being monitored across the Valley Floor.

Monitoring Approach
The climate monitoring approach is to install a climate station in a location that is most representative of Valley Floor, since the nearest existing weather station is located at the Telluride airport. It may also be useful to co-locate the station with other long-term monitoring points such as groundwater levels and vegetation plots.

The ideal station is a small tower (2-3 m height is sufficient if it is not located in a forested setting) containing a number of instruments to measure some combination of the following parameters: air temperature, wind speed, precipitation (rain and snow), relative humidity, solar radiation, soil temperature and moisture levels, and heat flux between the ground and atmosphere.

Climate stations often include co-located measurements of subsurface conditions like soil temperature and moisture levels. Instruments can be added independently at different times; however, it may be best to purchase a complete weather station set up as the installation will require a specialist. Current technology enables all of the mentioned parameters to be measured at high temporal resolution (i.e. every 10 minutes) and data stored on high capacity loggers. The data can then be transferred wirelessly from the weather station to a computer via cellular telephone connection. The weather station can also be fully powered via solar panels and therefore does not require line power or fiber optic cables. Consultation on solar panel options with the local power company is advised.

It is important to recognize that the value in collecting this data is through comparing the data with other potential partners to extend the network for comparison with other data sets. Once installed, the data can be translated into user friendly and easily accessible formats for download by the public and other interested parties. Significant potential for use and support could be obtained from both local and remote academic and research initiatives. The station will require substantial effort in preparing the data through a rigorous quality assurance and quality control process (QA/QC). The station will create large volumes of data and a plan for storing the data will need to consider these factors.

Surface Water Quantity and Quality
Surface waters of interest to the Valley Floor ecosystem include the main stem of the San Miguel River and the major tributaries. The major tributaries from East to West are Butcher Creek, Mill Creek, Eider Creek, and Prospect Creek. There is also an “unnamed” creek entering the property from the north, just west of Eider Creek, which should be initially monitored to determine if it is a measureable contributor of surface water flow to the Valley Floor.

The San Miguel River is a snowmelt-dominated system, with peak flows coinciding with spring and summer snow melt at the high elevations, followed by relatively steady base flow conditions through the fall and winter months. Similarly, the tributaries will have highest flows during the spring snowmelt. Therefore, the monitoring frequency should be built around this with greatest emphasis on capturing the rise and recession of the hydrograph, when the greatest changes will occur in short periods of time relative to the base flow period when hydrologic conditions are generally more stable. Sampling should be conducted weekly in the spring and summer and monthly during low flow.

Objective

The objective is to detect changes and trends in water quality and quantity entering and exiting the property. Monitoring of surface water flows will identify changes in the timing and magnitude of surface waters entering the Valley Floor property, which has important correlations to changes in other valuable resources including groundwater recharge and vegetation community structure. Monitoring for changes in water quality is an important tool for identifying the location, timing, and magnitude of external forcing (such as nutrients loading from land use change or metals loading from legacy mining activities).

Monitoring Approach

<u>Stream Discharge (quantity):</u> The approach to monitor surface waters is to quantify the volume of water from each of the sources at the point near where they enter (or leave) the property. For the San Miguel River this entails establishing monitoring locations where the river enters (upstream or East) and exits (downstream or West). Measuring stream discharge requires permanent (non-changing dimensions) channel constraints. Given the inherent variability in measuring discharge in mountain streams, reliable and consistent data will require a measurement point that offers uniform channel dimensions that do not change with time or forces of erosion. Therefore, the most logical locations are the Mahoney Street Bridge and the culverts under Highway 145 at Society Turn. Although the locations are not on the Valley Floor property, both locations have considerable historic data that should be considered for inclusion into the long-term database. No considerable surface flows are entering the river between the gauging station and property boundary at either location, thus changes in streamflow in those reaches are anticipated to be negligible.

For the tributaries, installing channel constraints, such as flumes or a permanent diversion structure, will help ensure the total surface waters entering the property are properly monitored. This monitoring approach includes the purchase and installation of four flumes to be installed in locations where no flume exists. Uniform installation of flumes at all locations will minimize monitoring costs by streamlining the data collection and processing into one standard format. One flume is to be installed at Butcher Creek, and the others are to be used at locations where Mill Creek and Prospect Creek (and/or their associated diversions) enter the Valley Floor Property. Prospect Creek would ideally be measured at a point above all diversions and braiding but this location is not on the Valley Floor property, so ownership would need to be addressed. An alternative plan for Prospect creek would be to install a series of smaller flumes on each diversion or braid as it enters the property and sum the flows to insure that all surface waters from Prospect Creek are accounted for upon entering the Valley Floor. Therefore, the number of flumes to install may be adjusted as needed. Eider Creek has an existing flume that needs to be properly located at the property boundary to follow the design to monitor the surface flows at the point at which they enter the property. The unnamed creek to the west of Eider Creek needs to be named and initially monitored to determine the amount of flows and then to install the appropriate size flume that will capture flows with minimal disturbance to the landscape.

In all stream flow monitoring locations a stilling well should be installed at each monitoring location and a continuously recording pressure transducer be placed inside the well. The flume and stilling well will remain in place indefinitely to insure that the depth of water in the well will be correlated to a uniform channel dimension. The pressure transducer will be installed in the spring and removed in the fall and will continuously measure the stage height of water at that location throughout the summer season. At locations where flumes are used the stage height of water in the flume can be directly converted to a discharge (cfs) using manufacturer conversions. For larger flows such as those on the main stem of the San Miguel where flumes are not feasible, the velocity-area method would enable the manual calculation of the discharge over the full range of stage heights and would support the generation of stage-discharge curves. This will require collecting manual measurements of velocity using an in-stream flow device (i.e. pygmy meter) and calculating the cross sectional area of the stream. Manual measurements should be collected weekly during the runoff season and monthly during baseflow conditions. This will generate data sufficient to establish a rating curve. The pressure transducers should be downloaded monthly and may need to be removed in winter due to avoid freezing in the stilling wells.

<u>Water Quality:</u> Equally important to the quantity of water moving through the Valley Floor is the quality of water, especially when monitoring for overall ecosystem health. The most common way to measure water quality is to take routine measurements of common water parameters including hardness, alkalinity, dissolved oxygen, pH and temperature. These parameters can be measured on site with field instruments. These measurements could be taken at the same time and place as flow measurements. Given that Telluride is located in a highly mineralized geologic setting, with significant past mining activity, it is also important to monitor for total and dissolved metals that are naturally occurring or generated by human activity. The most common metals that are tested for included aluminum, arsenic, cadmium, copper, iron, lead and zinc. Additional metals analysis can be performed if specific pollutants are identified in synoptic (baseline) samples. Metals analysis requires samples to be collected and sent to a proper laboratory. It is ideal to collaborate with local and state municipalities to analyze samples at the same laboratories to endure consistency in processing. The Colorado Water Quality Control Division of the Colorado Department of Health and Environment in conjunction with the Colorado River Watch Program have collected water quality data at locations on the San Miguel within and adjacent to the Valley Floor. However, the frequency and consistency of the sampling is sporadic and thus, warrants a more detailed sampling plan to specifically monitor surface water resources on the Valley Floor. Communication with the local San Miguel Watershed Coalition Group would assist in determining were existing sampling programs can complement the sampling efforts directly associated with the Valley Floor monitoring plan

In addition to metals pollution, it is important to monitor for changes in nutrient loading and analyze the water for compounds such as ammonia, chloride, sulfate, phosphorous, nitrate, and nitrite. Proper amounts of nutrients are good for aquatic systems, but excess amounts can have negative ecological impacts to flora and fauna disrupting naturally occurring biogeochemical cycles. The nutrient and compound analysis provides information primarily on local human impacts, including, but not limited to, land use changes, fertilizer applications, and de-ice salt applications (A complete discussion of Colorado Department of Public Health and Environment standards for water quality is included in Appendix B).

Initial monitoring should include the collection of a full set of the metals and nutrient data at quarterly intervals for 2-3 years and the analysis to establish a baseline of existing conditions. The baseline data will provide preliminary insight on which elements of concern are most appropriate to include in the long term monitoring program. Future monitoring could then be designed to monitor for changes relative to the baseline and to assess impacts of management decisions such as river restoration.

Groundwater

Understanding the spatial and temporal distribution of groundwater is important to the overall health of the Valley Floor ecosystem as the physical landscape is such that significant portions of the property have groundwater at or near the surface. Shallow groundwater tables mean that there will be significant interactions between the groundwater and aboveground activities such as surface water flows, vegetation communities, wildlife habitat, and recreational opportunities. The spatial extent of the groundwater and surface water interactions will therefore be influenced by, but not limited to, both natural and human activities. The natural activities are primarily related to changing climate, which will influence the input functions including factors such as timing and magnitude of precipitation that drive both groundwater recharge and surface water flows. The human activities that influence groundwater include irrigation and/or other flow manipulation activities, such as relocation of stream channels during restoration efforts.

Objective

The objective of water resource monitoring is to establish groundwater dynamics (level, movement, extent) in relation to hydrologic drivers such as climate (i.e. runoff), irrigation, and re-channelization via restoration. Understanding groundwater dynamics will ultimately assist in better understanding changes in other resources being monitored (such as vegetation community structure or wildlife habitat), and therefore assist in making future Valley Floor management decisions.

Monitoring Approach

The approach for groundwater monitoring is to refer to the three management zones defined in the Management Plan (see Figure 2), when determining density of groundwater monitoring. To effectively monitor groundwater across the entire Valley Floor, it will be necessary to install a number of piezometers, or monitoring wells. The spatial distribution and density of the wells will be defined by the Management Zones, and the sensitivity of habitat to groundwater interactions in different zones.

Some practical limitations exist regarding number of wells that can be adequately installed and maintained. The well installation plan will require assessment of environmental impact at each location to first determine what type of installation will be appropriate. At locations with high sensitivity and/or shallow (< 2m) water tables wells may be installed by hand augers. At locations with deep (> 2m) water tables and low impact access a drill rig could be deployed to install the wells. Mechanized drilling options include; hand carried backpacks, remote controlled rolling carts, 4-wheel ATV mounted drills, and track mounted systems. The exact cost for well installation will depend on access to drill locations, the depth necessary for each well, and drilling speed. The completion of well installation requires a combination of both manual and mechanical techniques, and will likely occur in several phases to best utilize resources like labor. To provide the best data for future management decisions well installation should also be prioritized to first cover locations where changes are likely to occur first (i.e. following the East to West progression of the proposed river restoration).

Depending on resources the best practice may be to install continuously-recording, mechanical water level loggers in a small set (i.e. +/- 20% total) of wells and perform manual measurements for remainder of the wells. To insure appropriate spatial coverage, and maintain the 20% mechanized monitoring ratio, the minimum installation would be water level loggers in 10 monitoring wells. The monitoring frequency of the non-mechanized wells should be weekly in the summer and monthly in winter, with level logger data being downloaded approximately quarterly. Monitoring well placement and density would be set by Management Zone and management goals, as follows.

Zone 1 refers to *low impact recreation areas* that also tend to have the lowest sensitivity value from the Environmental Report. These areas are to have the lowest density of wells with the well locations randomly distributed across the Zone 1 areas. The objective of these wells will be to add to the overall ability to map groundwater on the property and to monitor the impacts of changes in surface flow or management activities in these areas.

Zone 2 refers to the *conservation areas* that have medium environmental sensitivity and also contain a large portion of areas that could undergo improvements if restoration management objectives followed out. For this zone, the goal would be to install a sufficient number of wells to enable monitoring of current conditions while also being able to monitor future changes that are likely to result from restoration efforts. Zone 2 wells will require the most strategic planning for installation because thought should be given to their placement in relation to what data will be most useful for different stages of restoration efforts. It is fair to assume that additional groundwater monitoring methods and detail may be added in the future to address specific management issues or restoration design requirements.

Zone 3 refers to *habitat protection areas* with predominantly high environmental sensitivity and also represents areas of the Valley Floor that are the most natural and ecologically intact under current conditions. In Zone 3 the goal is to establish an appropriate number of wells to establish baseline conditions with the goal of these wells serving as reference sites or “control” data for a restored system on the property. For example, the information obtained from Zone 3 wells would be controls to compare to data being collected in the Zone 2 when/if restoration activities occur.

The existing wells on the property provide a useful relevant subset of groundwater information. This is primarily a reference to the +/- 80 wells residing on the Prospect alluvial fan from previous restoration efforts. The appropriate method would be to choose +/- 10 of these wells and re-initiate sampling. This will enable the long-term data set from these efforts to link with the new proposed monitoring efforts, therefore extending the record for the Valley Floor.

4.0 VEGETATION AND PLANT COMMUNITIES

Vegetation monitoring, coupled with hydrologic monitoring, is the core indicator used for determining the status and trends of the Valley Floor ecosystems. The resulting analysis of vegetation monitoring data allows managers to make better informed decisions under the Adaptive Management strategy, and more effectively communicate with the public and elected government officials. Vegetation monitoring should include multiple spatial and temporal scales, and include species that are both important from a conservation perspective (rare plants) as well as dominant species. The most effective strategy would combine elements of plot-based sampling along transects, interpretation of photo and satellite imagery, and detailed structural monitoring where additional detail is desired.

There are two primary vegetation community groupings occurring on the Valley Floor: upland plant communities and wetland communities. While many of the objectives and approaches for monitoring will be similar between these two community types, there will be some differences. For example, objectives of upland vegetation monitoring may include determining the effects of irrigation or impacts of prairie dogs on upland grassland communities, while objectives for monitoring in wetland communities would include tracking vegetation changes shifts in the riverine system related to such factors as altered stream flows, river restoration projects or beaver activity.

Vegetation monitoring should simultaneously: 1) support a large enough sample size where the number and location of plots and transects are able to statistically represent the vegetation on the Valley Floor, and 2) are practical to the costs and time commitments; these two characteristics may be at odds with one another, yet are important to balance. Through the use of previously collected information, including habitat delineations, a stratified, scalable, random design should be developed to comprehensively address the vegetation monitoring goals for the site.

The overall objective of an effective vegetation monitoring strategy would be to better comprehend the dynamic nature and condition of the Valley Floor landscape, provide reference points for comparisons along a gradient of natural to altered environments, and provide a means of evaluating the effects of restoration, reclamation, and management activities over time. Additionally, monitoring can provide an early warning of abnormal conditions of selected resources allowing for the development and timely implementation of effective mitigation measures, potentially reducing the overall costs of management. Resource considerations in this section include upland and wetland plant communities, species of conservation concern, forest fuels and fire risk, and noxious and invasive weeds.

Upland Plant Communities

The primary vegetation monitoring categories on the Valley Floor include native terrestrial plant species and communities and non-native terrestrial plants. As identified in the Management Plan, terrestrial plant species and communities require the identification of trends and status over time (Town of Telluride 2009a, p. 45). Specifically, to understand changes in vegetation, monitoring should establish: 1) long-term trends in species composition and community of selected focal plant communities, 2) long-term trends in the distribution and abundance of plant species of special interest, and 3) annual variation in recruitment and mortality for selected populations of long-lived perennial plant species of management interest. The terms “selected” and “special interest” refer to plant species, or species requiring special management designation or attention, that can broadly be defined as plants with unique, desirable functions or values, or undesirable plants that potentially threaten native plants or plant communities. Mushrooms and fungal communities are an example of a special interest community of plants that has been identified by the Commission for monitoring. Other plants and communities may be identified by Valley Floor management team for monitoring.

Documenting the presence of and changes in invasive and noxious weeds occurring on the Valley Floor will also be important. The study of non-native invasive terrestrial plants addresses the goals of early warning for potential wide-spread infestations and their status and trends on the landscape. In order to effectively identify early warning indicators, monitoring protocols should include a list of target species that do not exist on the Valley Floor, or are extremely rare, but that would cause significant ecological or economic problems if they were to become established. Invasive plants, their status, and trends are identified by determining the areal extent, distribution and abundance of selected non-native invasive plants. Additionally, identification of populations of invasive plants will aid in predicting potential spread.

Objective

The objective for monitoring upland plant communities is to identify changes in extent, conditions, and trends of specific plant communities across the Valley Floor. The approach would determine baseline conditions of diversity and density of plant species and plant communities, and then measure changes over time.

Monitoring Approach

The methodology for vegetation data collection relies on transects and plots. Because the vegetation gradients on the Valley Floor are clear, transects are appropriate. However, because the surveys are to be completed on an ongoing, regular basis, the monitoring requires the establishment of a fixed point for replicable data sampling, so that it is easy to return to these locations over many decades.

As shown in Figure 2 (Integrated Monitoring Plan Strategy, page 8) an approximate east-west latitudinal transect would be established along the railroad grade and river trail. Equally-spaced north-south longitudinal transects would be established that bisect the latitudinal line. The longitudinal lines would serve as a backbone or framework upon which to establish vegetation survey plots or line-intersect transect surveys. The exact quantity, spatial distribution, and design of the transects and plots would be planned to balance the necessary standards for statistical reliability and representation, and to meet budget limitations. The number of north-south transects should pass through the range of habitat /Management Zones identified in the Environmental Report so that all are adequately represented in the vegetation sampling. The location of plots and transects can be coordinated with other IMP activities (e.g. wildlife), as well as other with other relevant regional studies.

Randomized plot locations will be established along the north-south transects in a quantity sufficient to ensure that the vegetation conditions in all habitat zones occurring within the Valley Floor are adequately represented in the monitoring data.. As some vegetation communities are highly prevalent, such as upland grasslands, and others are less common, the number of plots will vary for each habitat. Other monitoring indicators, such as groundwater wells and photo points, should be co-located with the established vegetation plots for data correlation.

The goal of developing a plot structure that is stratified, scalable, and random can be met through the use of nested-circular plots defined by radii from a single plot origin, as shown in the Figure 2 inset (page 8). The conceptual approach would include:

- herbaceous community data collection in small diameter plots (1' radius,) representing approximately 1/3000th of an acre to establish cover estimates and species abundance for plant communities that are representative of community structure at the larger landscape scale
- shrubs and forest regeneration metrics in medium diameter plots, extending with a 6' radius from the same origin, representing an area of approximately 1/300th of an acre, and
- Tree/forest surveys in large diameter plot surrounding the sub-plots would encompass 1/10th of an acre.

The data collected from within all of the plots should focus on a range of species and growth indicators. For tree plots, data collected should include information concerning species present, diameter, height, condition (e.g. rot, dead top, disease), and percent of over-story canopy cover. Shrub plots should include species, diameter, number of stems and stem growth data, height, canopy percentage, and the shrub community condition including browse or other indicators of stress or vigor. Herbaceous community plots should identify species presence/absence assessments, relative percent cover by species, total estimated cover, average height of herbaceous layer, percent of bare ground, and specialized data such as sedge shoot densities, as required. The monitoring protocol should utilize visual estimates at a minimum, and more robust methods, such as point-cover and line intercepts, should be considered if funding allows to increase the replicability and accuracy of the surveys. The suggested methodology for vegetation monitoring addresses both the scientific requirements of a defensible monitoring approach and the practicalities of continued monitoring by an assembly of scientists and non-technical people into the future.

Wetland Communities

Unique hydrologic, vegetative and soil characteristics combine to create wetland communities, the dominant landscape feature on the Valley Floor property. Riparian corridors, willow-herb communities, and sedge-dominated fens are examples of wetland types where collected data will prove to be of high value for future Valley Floor land management decisions, especially restoration.

Objective

The objective for monitoring wetland communities is to monitor changes in character and extent of wetland habitat, functions and values.

Monitoring Approach

Data collection in wetlands is accurately achieved through the establishment of monitoring plots and associated photo-points through the same methods as recommended for the upland plant communities and described for Visual Resources (Section 8). Understanding the relationship between wetlands and the localized groundwater regime is critical. It requires that vegetation monitoring plots and groundwater monitoring wells be spatially aligned as related metrics and indicators. All wetland types on the Valley Floor contain some combination of tree, shrub and herbaceous plant communities, which can all utilize the nested-circular plot convention to collect representative data.

An archive of available historic data should be developed and maintained for reference purposes. Special circumstance sites where tailings are known to exist may require a modified monitoring approach to incorporate historic data, to address the unique site conditions, and to incorporate the previous monitoring variables.

Annual vegetation surveys should be completed across all monitoring sites for the first three years following establishment, and then on a 5 year cycle where 20% of the plots are surveyed annually. Annual vegetation monitoring activities will capture the required wetland plant data, and seasonal groundwater and surface water monitoring will provide hydrologic data to further develop an understanding of the Valley Floor wetland, their functions, and values. Through observation of the site over a period of years, baseline conditions for individual wetland areas may be recognized, and used to define restoration/mitigation goals and contribute to the fulfillment of long-term planning goals.

Wetland areas modified or established as a part of any restoration activity may require the creation of supplementary monitoring plots to collect relevant data pertaining to the manipulated portions of the landscape. Pre- and post- construction monitoring at established plots allows for annualized review of project success criteria, and will provide meaningful information used in the Adaptive Management strategy. Formal wetland delineations resulting in Jurisdictional Determinations from the Army Corps should be completed on 5 year cycles to maintain validity if Nationwide Permits are required for management actions.

Plants of Conservation Concern

One of our biggest conservation issues for Colorado native plants is the lack of awareness of the existence and status of rare plant species. The term refers to species that have been identified as currently considered to be vulnerable with the potential to become threatened. Increasing this awareness on the Valley Floor property will enable the Town of Telluride and Commission to increase the potential to protect and conserve these species. Thus far, one species, slender cotton grass, has potential to be found on the Valley Floor (ERC 2009, p.69).

Objective

The objective for this resource is to determine what is the baseline for diversity and density of sensitive and protected plant species on the Valley Floor and to monitor over time how they change in response to restoration activities, management practices, or shifts in natural dynamics, such as climate.

Monitoring Approach

The monitoring approach for plants of conservation concern is to work in concert with the Colorado Natural Heritage Program (CNHP), as the central steward of rare and sensitive species conservation. The initial step would be to meet with CNHP to determine documented and potential species that would be expected on the property, and existing site records would be collected from their archives and local resources. From this step, a species specific monitoring plan would be developed following CNHP methods to measure for changes in extent and distribution of conservation targets. Surveys should be completed with guidance of a trained botanist on a two-year cycle. Volunteers have been a valuable resource in rare plant monitoring in many areas, and citizen science programs may be worthy of consideration for this resource.

Fuels and Fire Risks

Forest health is increasingly a topic of public and private concerns, with the recent spread of several bark beetles gaining more attention. Several issues and influences act on forests simultaneously to create the complex mosaic of forest types and habitat structure on the property. Current agents of change include changes in forest age and structure, insect and disease cycles, suppression of wildfire and natural disturbance, and changes in water cycle and climatic forces. Declining forest health and extended wildfire seasons linked to a changing climate are pressing issues throughout the Rocky Mountains. Changes in forest health are both driven by large landscape-scale dynamics beyond the Valley Floor and very small, site specific interactions that are internal to its boundaries. Therefore, monitoring for forest health and fuels requires a process that encourages collaboration, works with neighboring parties and managers, and is simple and site-scale responsive, all at the same time. The U.S. Forest Service (USFS) and Colorado State Forest Service are two partners who could bring significant resources and a wealth of information to the process of managing forest resources for the Valley Floor to manage the connected forest landscape beyond the Valley Floor, collectively.

Objective

The objective of monitoring for forest health, fuel loading and fire risks is to determine what the current distribution of forest health issues is and what is the level of fuels that relate to potential wildfire risks. A second objective is to understand how forest health and fuels change in response to management practices or climate.

Monitoring Approach

To complement the monitoring plot data that will be collected on the ground, a duel/complimentary approach for fuels and forest health is to utilize combining aerial photographs and field surveys to document the conditions from multiple perspectives. As very little of the Valley Floor is actually occupied by forests, the monitoring here should be performed in concert with regional property owners, specifically the USFS and Mountain Village, with collaboration on forest management occurring biennially (at a minimum). A trained specialist in remote sensing and forest ecology can use recent aerial photographs (or satellite imagery) of the property, and utilize GIS, to interpolate polygons of different types of forest cover, densities, and status (live, dead). From these polygons, a random stratified set of sample points will be identified as long-term monitoring plots. Once the points are selected, the specialist will visit the field to confirm that the forest imagery classification is consistent with the on-the-ground conditions.

In the second phase, a field survey crew will visit the sites and collect data including: diameter, height, damage, and grade; counts of tree regeneration; forest type, canopy, age class, and disturbance history; lichens, pests and diseases; and down woody debris. This information will be useful in determining forest health, fire fuel potential, and vegetation structure, which is also useful in wildlife habitat monitoring. These metrics would be incorporated into the appropriate vegetation plots listed under general upland plant community monitoring and repeated on a three-year cycle. Monitoring protocols practiced by the Forest Inventory and Analysis Program (www.fia.fs.fed.us) are a useful guide (although the full practice is too detailed for direct application). Linking the Valley Floor monitoring to this existing protocol would enable comparisons with a regional and national programs and trends.

Noxious Weeds

Noxious weeds occur in a number of locations across the Valley Floor. Some of the weed species found here can spread aggressively and have the potential to substantially alter the native plant communities associated with the Valley Floor. The Town is currently managing weeds on the property; however, due to the wide-spread occurrence of weeds across the Valley Floor and on adjacent public and private lands, weed management will likely require persistent efforts to maintain control of weeds over time.

Objective

The objective of the weed monitoring program would be to identify and document the location of Colorado-designated Class 1 and 2 weed species occurring across the Valley Floor and use this information to inform and evaluate weed management priorities and practices. The efficacy of weed management efforts would be monitored to identify where re-treatment of weeds may be necessary or to indicate the need for alternate control strategies.

Monitoring Approach

Thorough walk-through surveys of the Valley Floor should be conducted to identify areas in which weeds are present. The surveyor(s) would identify the species of weed and define the extent of the species' presence. A GPS coordinate of the center of small infestations (<¼-acre) should be recorded. For large infestations, the perimeter of the affected area should be recorded using the GPS. A qualitative description of the density of weeds occurring in the infested area would assist with control strategies. However, the weed density could be quantified using the sampling procedure for herbaceous vegetation monitoring by counting the individual plants within 1/2000th-acre sample plots. The information would be entered into a GIS data base and used to develop a control strategy. Treated areas should be re-examined the following year before seed heads form to determine the effectiveness of the past treatments and the need for scheduling re-treatments. These areas should be examined in successive years since seed can remain viable in the soil for a number of years after the weed treatments. Surveys across the Valley Floor should be conducted annually, or at least biennially, until populations are controlled, to ensure that new infestations do not become established problems requiring significant control efforts.

5.0 WILDLIFE

Wildlife are an integral component of the Valley Floor and has been recognized through the Conservation Easement, Environmental Report, and Management Plan as a valuable resource to community. The large number of species associated with the Valley Floor is a reflection of the health and diversity of the habitats provided by this area. Wildlife species, in general, are sensitive to changing conditions within their habitats and typically respond to these changes through shifts in population numbers or alteration of habitat utilization patterns. Monitoring local wildlife populations or habitat usage can provide land managers a tool through which they can detect undesirable shifts in conditions that may occur on the Valley Floor address them in a timely and appropriate manner.

Resident Elk Herd

Since acquisition of the property by the Town, an elk herd has taken up seasonal residence on the Valley Floor during the summer and fall to take advantage of its favorable foraging and calve-rearing habitat. This herd adds to the overall diversity of wildlife found here and has become a popular feature for both local residents and visitors. However, an increase in herd size from its current levels could lead to undesirable effects to grassland areas and other plant communities, such as the willow riparian habitat, through over-utilization of the foraging resource.

Objective

The objective for monitoring the resident seasonal elk population would be to develop a baseline estimate of the size of the current elk herd and to track changes in its population numbers over time. In addition, the vegetation would be monitored in elk concentration areas to detect any over-utilization of the vegetation resources that might be occurring. This information would provide managers a basis on which to determine the carrying capacity for elk on the Valley Floor and help the Town in developing future decisions regarding elk management.

Monitoring Approach

Population Size: Estimating herd size would be based on a “maximum head count” of animals when they form concentrated herds in the openings. Counts would be conducted in late summer and early fall when individuals begin congregating after the calving season. This approach will be somewhat opportunistic, since the counts can only be done with reasonable accuracy when elk have moved in mass to more open areas. This most commonly occurs in the late afternoon and early evening. It may be best to perform the census when animals are highly visible from the highway, which would allow the surveyor to “blend” with the roadway disturbance regime to which the elk appear to have developed a tolerance. The surveyor may need to make counts from an elevated station, such as the back of truck or a stable step ladder. Several counts of the herd should be made until the surveyor feels an accurate count has been achieved. After the total herd size has been determined a count of only the calves should be made to provide an estimate of the calving activity that is occurring on the Valley Floor. At least three counts should be made during the summer and fall season, with the maximum count representing the best estimate of the current year's herd size. Scheduling of the counts may require some "pre-census" observations to ensure that they are conducted after the herd appears to have fully occupied the area and before they have begun to disperse in the fall. This will likely result in surveys being conducted between July and September. This census approach will likely be biased low, since some elk will likely not be with the main herd during counts. However, counts should provide a good relative annual estimate on which to base population trends of the elk herd over time. Counts should initially be done annually and results compared with the previous years' results to identify potentially significant shifts in herd size. If the herd size appears to be reaching stability, as evidenced by comparisons to previous years' counts, surveys can be done on a biennial schedule.

Vegetation Monitoring: The carrying capacity or desirable population size of the elk herd on the Valley Floor will ultimately be determined by the level of impact they are having on the plant communities they inhabit. Basic monitoring of the vegetation within elk utilization areas would be accomplished through periodically surveying plots using the general vegetation survey protocol (See Vegetation Monitoring Section 4, pg 18). In addition, walk-through surveys should be conducted in concentrated-use areas (as evidenced by direct visual observations of the animals and high density pellet piles) to detect high levels of vegetation utilization in both the herbaceous and shrub layers. Signs of over-utilization by elk include high levels of bare soil in areas that would be expected to have more complete herbaceous plant coverage, declining shrub cover with existing shrubs exhibiting heavy defoliation, and heavy browsing of the woody tips of shrub branches. If over-utilization is suspected, additional vegetation sampling plots can be established to monitor these areas over time. Additionally, exclosures can be constructed to allow a comparison between foraged and non-foraged areas. For upland areas, 5'x5' exclosures can be used; a similar technique is proposed for prairie dogs. For shrubby habitats, such as the willow riparian community, exclosures would have to be larger and more substantially constructed. The fenced area should be a minimum of 10'x10' square and at least 7 feet high. Corners would be treated posts placed at least 2 feet in the ground with center supports of either wood or tall "t" posts. The actual fence material should be grid ("sheep") fencing capable of excluding all large herbivores, including beavers. Comparisons of the vegetation inside and outside of the exclosures would be documented through a photo record comparing the areas. Vegetation monitoring following the vegetation monitoring protocols outlined in the Vegetation Monitoring, Section 4 (pg. 18) could also be employed to compare differences between the grazed and protected areas. Exclosures should be placed away from trails and other high human-use areas to reduce visual impacts of the structures. The exclosures should remain in place until the Town is confident that elk are not having a substantial negative impact on the riparian vegetation.

Avian Populations

The Valley Floor supports a rich avian community comprised a large number of upland and riparian/wetland bird species. Birds serve as an important element in the total biological matrix of almost all Colorado ecosystems. Changes in populations (numbers within a species and number of species) often reflect changes in the environmental conditions in which these populations occur. This can be a significant indicator of overall ecosystem health and stability, when observed over time. The breeding season is probably the most important period of the year for observation in terms of avian population dynamics. Since many of the species utilizing the Valley Floor are seasonal migrants, the monitoring of populations during the breeding season provides the most reliable measure of population status.

Objective

The primary objective of avian monitoring would be to initially establish a reliable baseline measure of current bird populations within the area including both species richness (number of species) and the relative number of individuals within each species using the area during the breeding season. After baseline counts have been established, a comparison with future survey results would determine if any notable shifts in species richness and intra-specific populations that might indicate ecological changes occurring on the Valley Floor. A secondary objective would identify breeding areas or concentrated-use areas of avian species of high conservation concern, such as raptors, whose utilization of the Valley Floor could be affected by activities within the area. Identification of these areas could allow for adjustments in management, such as seasonal closures, to accommodate this use.

Monitoring Approach

The monitoring approach for this element follows the Rocky Mountain Bird Observatory's (RMBO) protocol for its *Monitoring Colorado Birds* program[1] (RMBO 2009). One major benefit to this approach is the data collected on the Valley Floor would be directly comparable to other data collected for this program both regionally and across the state.

The RMBO's point-transect approach would involve the establishment of permanent monitoring points evenly distributed across the Valley Floor, generally 250 meters apart and at least 125 meters from the area boundaries. Surveys are conducted in the late spring to coincide with the peak breeding period for this elevation and life zone. Surveys are begun early in the morning and should generally be completed by 10:30 to 11:00 AM. At each point a number of parameters of the vegetation characteristics are recorded to accurately identify the life zone and stage of development in which the point occurs. The surveyor then performs a strictly timed, 5-minute census of all birds that are detected from the point either aurally or visually. A rangefinder is used to determine the distance of each bird from the survey point, information that ultimately is used to estimate overall species density. After the point is completed the surveyor walks to the next point and repeats the process. All data is recorded on standard data sheets with a format provided by RMBO. The data is entered into a special program that generates summaries relating to overall species richness and intra-species densities, as well as statistical data. This approach would provide a reliable measure of both species richness and individual species' populations that can be statistically compared with previous years' surveys to detect changes in populations over time and directly compared with regional data for similar habitats being monitored through the Monitor Colorado Birds program. This approach requires technically-skilled surveyors to conduct the monitoring. Data management is somewhat involved, making this a more expensive approach than less scientifically-rigorous avian survey methodologies.

[1] The complete guide is online at: http://www.rmbo.org/public/monitoring/protocols/PT_Protocol_final_2009.pdf

An Alternative Approach to the RMBO Protocol:

Under this alternative approach, surveyors would walk a set, predetermined route recording every bird that is detected either by sight or bird call. Routes should be surveyed at roughly the same time each year during the breeding season (mid-May through the 1st week in June), preferably conducted twice during this period and, ideally, by the same individual(s). Routes would be established that pass through all of the varying habitats within the Valley Floor. A suggested route would be the primary loop trail that runs along the perimeter of the Valley Floor and the railroad grade. This could be broken up into an eastern and western route that could be surveyed by one person in two days or by two individuals in one day. The outings would begin in the early morning hours, beginning at 6:00-6:30 AM and completed by 10:30-11:00 AM. In addition to recording bird detections, the location of species of special conservation interest, such as raptors, should be recorded (preferably with GPS coordinates) to help identify potential sensitive breeding areas.

This methodology would still require surveyors technically competent in identifying birds both visually or aurally. This could include professional wildlife technicians or local skilled volunteers (e.g. skilled Audubon's Society members). Benefits to this approach would be lower costs, less complicated data management, and the potential to involve the local birding citizenry. Drawbacks would include less control of the quality of the information gathered (highly dependent on the skill of the surveyor), a high level of management in organizing the time-sensitive volunteer effort, and a difficulty in segregating survey results by habitat. The data derived from this approach would not be as suitable for statistical analysis and would not be statistically comparable to other monitoring efforts occurring regionally using more scientifically based surveying methodology.

Christmas Bird Counts:

The Christmas Bird Count (CBC) is a census of birds in the Western Hemisphere, performed annually in the early Northern-hemisphere in winter by volunteer birdwatchers. The purpose is to provide population data for use in science, especially conservation biology, though many people participate for recreation. Past local CBC surveys have included the Valley Floor and should be continued, with the portion of the data collected for the Valley Floor used to track winter bird populations over time.

Fish

According to the Environmental Report, the only fish species likely occurring in the San Miguel River through the Valley Floor is brook trout. Brook trout is a non-native fish, which now fills the niches formerly occupied by the native fish populations. This introduced fish species still plays an ecological role in the aquatic environment, as well as offering fishermen an angling opportunity in a pleasant setting close to town. While brook trout are not the only component of aquatic habitat in this section of the San Miguel, they should serve as a good indicator of overall aquatic habitat quality, and if the components of favorable trout habitat are well-represented, the overall aquatic habitat can generally be considered of higher quality.

The preferred methods for monitoring fish species on the Valley Floor are those that are non-invasive, based upon observation, and will not adversely injure or effect fish. Therefore, the Habitat Suitability

Index is the preferred method on the Valley Floor. Other methods, such as electro-shocking which may injure fish, are discouraged in favor of other methods to the extent possible.

Objective

The objective of monitoring the fishery in the San Miguel would be to measure aquatic health and to track changes in the aquatic ecosystem as reflected by fish populations and fish habitat conditions. This will be particularly important during river restoration phases. Monitoring this element of the Valley Floor will also help to manage and potentially improve the recreational values offered by the fishery resource.

Monitoring Approach

<u>Habitat Suitability Index (HSI) Methodology:</u> Monitoring the fishery would follow the approach used in development of the Environmental Report (2009, pg. 40). This approach measures a suite of stream physical characteristics, as well as water quality and flow parameters and compares them to favorable ranges of these characteristics or habitat suitability indices (HSI) for the brook trout. These stream parameters are recorded by reach. The fourteen physical characteristics of the stream, which include substrate consistency and size, bank characteristics, streamside vegetation, pool availability, and shading, are made primarily through ocular estimates, while the seven water quality characteristics (pH, temperature, stream velocity, and flow patterns) are derived from water sampling and past flow data.

The HSI methodology determines habitat quality for brook trout based on various life stages (adult, juvenile, fry and embryo) and other physical, hydrological and water quality parameters that span multiple life-cycles. Each variable represents species' habitat requirements/ preferences and each variable is scaled in the model to produce a numeric index between 0 (unsuitable) and 1 (optimal). The different physical habitat, water quality and flow regime variables are quantified for each reach. A summary of these scores provides a numeric estimate of habitat quality for the various life stages of the brook trout. Successive surveys can allow a comparison of these conditions overtime.

This approach to monitoring the fishery would have no direct impact on fish population, as opposed to other methods, such as electro-shocking. Sampling can be conducted and data compiled by a trained technician; and much of the data could be collected when other stream sampling procedures are being undertaken. Sampling should occur on an annual basis during the restoration phases of the San Miguel River restoration plan and afterwards every 2-3 years. While this approach will provide information regarding the overall habitat conditions, it will not provide any population data or fish condition data.

Alternative (Optional) Approaches

"Krill counts" could be conducted through which an interviewer would periodically query fishermen on-site regarding the number, size and species of the fish that they are catching. A variation on this approach would be to solicit volunteer fishermen that use this stretch of the San Miguel on a regular basis, who would record information regarding their fishing success and the character of the fish caught during their outings. The volunteers would be provided an electronic form on which their data could be recorded and sent via email back to the data processor for recording. Either of these approaches would provide information about the condition of sport fishery, as well as the angler success and overall experience.

Electro-shock Sampling: While electro-shocking is discouraged as a monitoring technique on the Valley Floor, there may be occasions in the future where additional information on fish species, community composition, and presence of juveniles may justify its occasional use. For this approach an electro-fishing backpack is used to collect fish from sample sections of each reach (such as the Seber-LeCren two-pass method). Shocked fish are collected in a net and placed temporarily in bucket before being transferred to a portable holding tank. A second pass of the same stretch is made to collect any remaining fish. Information regarding the reach, its habitat character, and length are recorded along with the species, weight and length of each fish collected during the capture process. After the fish data the fish are returned to the stream. This approach would likely be done in partnership with wildlife personnel from the Colorado Department of Parks and Wildlife (CPW) and the actual protocol used and data record would follow their standard procedures. Frequency of the surveys would be somewhat dependent on the availability of agency personnel and potentially budgetary constraints. Generally, these surveys should be conducted no more frequently than every three years. The benefits of this approach include its ability to identify all fish species present and their relative abundance, the proportion of adults to juveniles, and the range of sizes and conditions of the fish. However, there is some evidence that this approach can be injurious to fish, which could be a consideration for this approach as a regular monitoring technique.

Benthic Macro-invertebrates

The Environmental Report (pg. 50) identifies a variety of benthic macro-invertebrates (BMI) occurring in the San Miguel River. BMI form the base of the aquatic food chain and play a crucial role in stream nutrient cycling. Due to their sensitivity to changes in stream conditions, species-specific tolerances to pollution, and their relatively short life cycles, BMI populations provide an excellent indicator of overall stream health. Sampling procedures are well-established and relatively straight forward, offering a good opportunity for educational and citizen-based participation under the supervision of an experienced investigator.

Objective

The objective of BMI monitoring would be to establish baseline population data and track population changes in the various BMI species found in the San Miguel River and its tributaries over time. A quantitative measure of aquatic health of the stream system would be of particularly importance in evaluating the effects of, and potential benefits from, future restoration activities. It might also assist the Town in identifying potential effects of off-site, upstream influences.

Monitoring Approach

Field sampling for BMI is the multi-habitat approach described in the Rapid Bio-assessment Protocols for Use in Streams and Wadeable Rivers methodology. This is the method used in the development of the Environmental Report, and data from these initial surveys could be used as baseline data for the overall monitoring program. For the Environmental Report, the river was divided into six reaches with samples being taken from three of the reaches and one in the side channel to the river downstream of Eider Creek in the northwest portion of the Valley Floor (Environmental Report, pg. 49). For the IMP, these sampling areas would be established as permanent sample points. Additional points would be established in areas immediately downstream of proposed restoration areas to more effective segregate effects to BMI from those activities and to measure their recovery over time.

The field approach involves disturbing the substrate on the stream bottom 0.5 m upstream of a sieve net either by "kicking" the substrate or jabbing substrate with the net a set number of times (20)/reach. The number of jabs or kicks in each habitat should be roughly proportional to the amount of that habitat in the reach (an alternate method used by DP&W disturbs the substrate upstream of the net for a specific period of time [e.g., 60 seconds]). The substrate is collected in the net and transferred to a collection container, covered with ethanol and the container is labeled. Samples should be collected when the stream flow is generally stable (July-October), and at roughly the same time each year to add to annual comparability. It will require several people (3-4) to collect the samples and transport equipment and materials. While the procedure would lend itself to citizen participation or educational groups, collections need to done carefully and should be done under the supervision of qualified individual.

The lab procedure involves pouring the individual sample substrate into a sieve and sorting the individual specimens taxonomically under a dissecting microscope. This will have to be done carefully by individuals trained in the identification of species likely to occur in the area, as well as the specific laboratory methodology. Summaries of the data could be compiled similarly to the approach taken in the Environmental Report to provide measures of abundance, richness, evenness, Hilsenhoff Biotic Index (HBI), and Shannon Diversity Index and analyzed by a BMI specialist. This approach is fairly standard in the research community and the data would allow for comparisons of conditions over time on the Valley Floor, as well as comparisons with studies on other reaches in the San Miguel or other regional streams.

Beaver

Several separate colonies of beaver currently inhabit the Valley Floor along the river. These colonies play important roles in the overall ecology of the riverine community, creating extensive wetlands and open-water situations that contribute to the diverse fauna and flora of the area. Beaver can also create undesirable ecological shifts through over-utilization of the riparian vegetation, the killing of trees, and flooding in areas with other resource values.

Objective

The objective of monitoring the beaver population would be to track beaver activity along the riverine corridors to identify colony centers and to record the location and extent of structural features (i.e., dams, ponds) associated with these colonies. This information would provide general information about the overall health and possible expansions (or declines) in the beaver population as an indicator of ecosystem health. Information would also show how beavers respond to any changing conditions resulting from restoration activities. An on-going knowledge of the nature of the beaver activity would provide managers an opportunity to employ curative measures, as necessary, to minimize substantial undesirable outcomes, such as flooding and over-utilization of riparian vegetation.

Monitoring Approach

Walk-through surveys of the riverine corridors would be conducted to identify activity centers of the different beaver colonies. Generally, stretches of the corridor with little or no activity between areas of high activity would define the separated colony territories. The coordinate locations of dams, lodges, impoundments and areas of intensive vegetation would be recorded with a GPS, which would be entered into a GIS system. Corresponding photos of these features would also be taken and made part of a photographic record of activity. The initial walk-through survey would serve as the baseline measure of the beaver populations. Subsequent surveys would be done biennially to document any notable changes in the existing colonies and to identify any new colonies. The proposed vegetation monitoring program (see Vegetation Monitoring, Section 4, Wetland Communities, pg. 20) should capture some of the influences to the riparian corridor associated with beaver activity. However, establishment of additional vegetation monitoring plots may be desired to effectively quantify the effects of beaver in concentrated use areas. The results of the vegetation monitoring on individual plots can be compared overtime and contemporarily with plots of similar vegetative structure to measure the effects being exerted by beaver activity. Exclosures may also be considered as means to compare the level of influence resulting from beaver activity. Exclosures would probably need to be at least 10'x10' to capture a meaningful amount of the shrub component. However, they would not have be as substantially constructed as those for elk. The supporting post could be metal "t" post with rectangular 5' wide grid fencing material.

It may be possible to coordinate activities associated with the beaver monitoring program with other monitoring efforts occurring in the riparian corridor. Surveys should generally be done biennially. However, annual surveys may be desired during the proposed restoration phases, since these activities could have a substantial direct effect on the beaver populations on the Valley Floor.

Prairie Dogs

The Valley Floor hosts several colonies of Gunnison's prairie dogs ranging in size from a few burrows to many burrows occupying over 30 acres. Prairie dogs play important ecological roles in nutrient cycling and soil restoration, as well as symbiotic and predator/prey-based relationships. However, their presence in large numbers can substantially alter the local biological communities in which they occur. Much discussion has occurred in the community regarding the management of the prairie dogs on the Valley Floor. Future discussions and decisions related to this resource would benefit from knowledge of population trends, dispersal patterns, and ecological effects associated with the prairie dog communities.

Objective

The initial objective of the prairie dog monitoring program would be to build on existing baseline information identifying the location and extent of colonies occurring within the Valley Floor and to develop baseline population estimates of the individuals occupying those colonies. This information, gathered over time, will provide trend data for the overall population of prairie dogs inhabiting the property, as well as tracking those areas on the Valley Floor that are being directly influenced by prairie dogs. Vegetation data collected within and immediately adjacent to the colonies will provide a measure of the influence that prairie dogs are exerting on the plant communities in proximity to their colonies.

Monitoring Approach

Colony ID: The locations of all colonies occurring within the Valley Floor will be identified by thorough "walk-thru" surveys of open upland habitats and the immediately adjacent wetland habitats. A colony will be defined as having at least three or more mounds clustered in a roughly 33-foot diameter space. Each colony will be given a discrete identifying name or number with a qualitative description of site. The surveyor(s) will walk the perimeter of the colony, placing pin flags around the outlying burrow holes to define the approximate boundaries of the colony. The surveyor will then follow the flagged perimeter recording GPS coordinates around the boundary of the colony to a point of beginning. The GPS coordinates will be downloaded into a GIS mapping system. Burrow holes greater than 100 feet from the primary burrow grouping will not be considered part of the colony complex. If these out-lying burrows do not meet the "3-burrow cluster" parameter described above, they can be recorded in the GPS individually and entered into the GIS system without a discrete identifying number.

Population Estimates: Population counts at each colony would be conducted at least 2-3 times during the summer season. The census of all colonies should occur within a 1-2 week period so that factors, such as seasonal mortality and dispersal, do not overly influence density estimate comparisons between colonies. Surveys should generally be conducted in mid to late summer (late July to the end of August) since the young will have weaned and will be foraging above ground, and females will not be spending time below ground nursing. This period of time also allows for the natural high mortality rate of prairie dogs to express itself. Surveys should also be conducted at a time of day when prairie dogs are most active. Typically, this is in the early morning and late afternoon. However, because diurnal activity varies greatly by site and elevation, it may be best to establish the time through casual pre-survey observations. Surveys should be conducted during clear weather, since rain and clouds can affect activity levels. The surveyor(s) will locate a spot where, if possible the entire colony can be observed. Use of a portable elevated platform (e.g., deer stand) may be desirable from which to make counts. The platform can be camouflaged with cloth camouflage material to help obscure the surveyor's presence and movements. In large colonies (e.g., Boomerang Road) it may be necessary to divide the colony into two separate areas to view the entire occupied habitat.

The surveyor should wait a period of approximately 15-20 minutes after set-up before beginning counting to allow prairie dogs to acclimate to the observer and resume above ground activities. Counting should be done with the aid of 7x or 8x binoculars with a wide field of vision. If discernible, tallies should separate adults from juveniles in the count. Two counts of the area should be conducted during each site visit, separated by a period of 5-10 minutes between counts. While both counts should be recorded, the highest number will be taken as the best estimate of the population that day. Similarly, the highest population number recorded over the 2-3 census visits will also constitute the best estimate of the population for the year. It is important to recognize that this approach will likely under-estimate the true population size since some prairie dogs will remain in their burrows during the counting procedure. Some researchers suggest that this approach consistently underestimates the colony population size by roughly 30%. However, the resulting counts should provide a useful relative estimate of colony population size overtime, if surveying the methodology remains consistent and timing of the surveys are roughly equivalent.

Burrow Entrance Density: Research has shown that the density of the burrow entrances has a poor correlation with population size, especially in older colonies. There may be more than one hole per burrow and some burrows may be abandoned within the active colony. However, to provide continuity to past survey efforts for prairie dogs, it may prove useful to continue sampling for this parameter of the colonies. During this procedure surveyors could identify the density of active vs. inactive burrows and could also make other observations, such as the level of badger activity.

To characterize and quantify the burrow density, burrow entrances can be counted within fix-area 1/300-acre circular plots distributed uniformly across the colony within the previously marked boundaries. The plot centers would be roughly evenly spaced along parallel transects running from one edge of the colony to the other, which would have been defined by the Colony ID procedure. The beginning and ending points of the transects can be laid out on a mapping program prior to field counts and the coordinates entered into a GPS. Plots along the transect could be located by pacing distances between points using a compass or GPS to follow the transect line. Alternatively, all of the sampling points could be entered into the mapping program and all points located in the field using a GPS. When the edge of the colony is reached the surveyor will move in a perpendicular direction and then run another parallel transect at the established spacing. A 1/300-acre plot (radius= 6.8 feet) is a manageable plot size for one person; however, a larger plot could be used if more than one person would conduct the survey. With the 1/300-acre plot the surveyor could use a 6.8-foot pole to define the circular plot, while larger plots would require a center pin and measuring tape. At each plot the number of holes occurring within the plot would be counted before moving to the next plot. Active burrow entrances could also be separated from inactive burrow entrances. Once the entire area has been surveyed, an average number of holes on the individual plots can be multiplied by 300 (for the 1/300th–acre plot) to calculate average acreage density and that figure multiplied by the total acres in the colony to provide an estimated total burrow density. Sampling intensity (number of plots/acre or colony) will be dependent on the statistical reliability desired from the procedure. Generally, the spacing between plots will be greater as colony size increases, to achieve similar statistical accuracy between larger and smaller colonies.

Vegetation Evaluation: After the boundary of the colony has been defined by the Colony-ID procedure, a second boundary approximating the limits of the primary foraging (clip) zone is defined by pin flags and a second perimeter around the colony is recorded with a GPS to define the area of high ecological influence of the colony. This information will also be downloaded into the GIS system. Vegetation plots should be established in and around the colonies and surveyed periodically using the standard upland vegetation survey protocol (see Vegetation Monitoring-Section 4, Upland Plant Communities, pg. 18), to further characterize vegetation composition and condition. Comparisons between prairie dog influenced and non-influenced plots will provide a measure of the level of effect prairie dogs may be having on the neighboring vegetation community. These surveys should be conducted biennially.

Small exclosures (5’x5’) constructed of “t” post and 4-5’ tall grid fencing with chicken wire on the lower 2-3’ may also be useful in comparing browsed areas and clip zones to non-browsed areas. Photos of the comparisons of the vegetation in and adjacent to the exclosures should be taken biennially later in the growing season (August) to document the differences. These photos would be made part of the overall photo record.

Multiple Species- Winter Snow Tracking

A variety of ground-based wildlife species use the Valley Floor during the winter months, including species of high conservation concern (i.e., Canada lynx, American marten). Winter snow tracking offers an opportunity to develop a better understanding of what species are using the area, especially for species that avoid human contact making other monitoring methods difficult. The Valley Floor likely serves as important winter range and habitat for several species, providing for forage and shelter when deep snow and severe weather may limit their options and resources for survival (Fahey and Wardle 1998, Olliff et al. 1999). Winter sports activities could potentially influence the activity patterns of these species. Because winter survival adds a basic level of stress for wildlife, interactions with humans may have a higher impact during the winter than other seasons of the year. The wildlife species using the Valley Floor and the level of that use has not been systematically examined. Additionally, it is unknown if wildlife-human contacts are occurring, and if that contact is having an impact on wildlife.

Objective

The objective of monitoring the winter wildlife activity would be to initially identify those species using the area and at what frequency. Ultimately, this information would be useful to identify winter wildlife activities, determine winter ranges and use areas, and determine if potential conflicts may occur between wildlife use and winter recreational activities occurring on the Valley Floor.

Monitoring Approach

Snow track surveys would be conducted along “to-be-determined” routes across the Valley Floor. Surveys would occur 48 hours after new snow events to allow adequate time for wildlife to utilize the area. Each set of tracks would be identified by species. Tracks that are not identifiable by the surveyor(s) should be photographed to allow for further attempts at identification. Tracks suspected to be those of lynx should be photographed to document the presence of this federally-listed species. Surveys should be conducted several times a year with a minimum of four surveys during the winter months. These surveys can be done by a trained technician and may also be suitable for educational or citizen volunteer participation under the guidance of a knowledgeable team leader.

6.0 RECREATION

The Management Plan calls for providing low-impact recreational opportunities while minimizing environmental disturbances (Town of Telluride 2009a, p.26). Key elements of the Management Plan and the Telluride Valley Floor Trails and Conceptual Stream Restoration Plan are to "develop and implement a Trails Plan that provides quality recreational access and opportunities in a manner that is compatible with the conservation values of the property and long-term restoration plans" and "permit compatible winter recreational activities and uses while minimizing impacts to wildlife, sensitive vegetation, and wildlife movement corridors." To achieve these goals, the Management Plan established three zones to manage the character, use and sensitivity of the property's resources: Zone 1- Low Impact Recreation; Zone 2: Conservation Area; and Zone 3: Habitat Protection Area. Additionally, the Trails Plan defined trail design elements, which established general trail types with associated design and implementation guidelines. The monitoring approach is designed to utilize this framework as the basis for monitoring.

Telluride Valley Floor provides for a variety of public uses and recreation throughout the year. Hiking, mountain biking, nature viewing, Nordic skiing, and snowshoeing use the 3.6 miles of existing trails. The Telluride Valley Floor Conceptual River Restoration and Trail Plan envisions an additional 3.6 miles, of which 2 have already been constructed and the rest may be added over time. The San Miguel River is popular for fishing, tubing, boating and stand up paddle boarding, a new and increasingly popular activity on the Valley Floor. Trends indicate that visitation and use will likely increase, particularly where new access or amenities are added such as river access and the recent addition of winter grooming (Town of Telluride, 2009a, p.132). Over time, potential increases in the levels of use could impact the trail system, and the quality of the visitor experience in any season of use. In addition, these levels of use could increase impacts on soils, vegetation, and wildlife in environmentally sensitive areas and seasons when plants and animals may be more sensitive to disturbance. Conversely, trails can also protect environmental resources through concentrating use and directing people away from sensitive areas. Monitoring recreation use and trail conditions can provide important information to support adaptive management as patterns and trends develop.

Recreation is a prime resource of the Valley Floor. However, it is a difficult resource to measure, as it entails an understanding of the natural setting and environmental sensitivity of resources, as well as the aesthetic and experiential qualities that characterize open space for people. These qualities are both a true physical resource and a perceived one, which is much more difficult to define and measure. Some impacts associated with recreation are inevitable or difficult to avoid. Even thoughtful visitors can have impacts through leaving footprints and unintentionally disturbing wildlife. As recreation is a legitimate use on the Valley Floor, the issue for managers is to determine at what level resource impacts become unacceptable based on other management goals. Impacts often include wildlife disturbance, trail braiding, soil compaction, erosion and bank destabilization, and changes in water quality (see Town of Telluride, 2009a 3.2.6 and Appendix L for a full discussion).

Trails and Trail Use for Summer and Winter Activities

Approaches to recreation monitoring have developed over time to provide managers with useful information for determining appropriate levels of use and for determining at which level of use unacceptable impacts begin.[2] The challenge for managers is that in some environmentally sensitive areas even low levels of use can produce substantial impacts to vegetation and soils. By the time impacts are visible or noticed, damage has already occurred and recreation use of an area has been established. In other areas, no clear relationship between use and impact has been established, which has hampered the wholesale application of any one approach. As different approaches, methods based upon predetermined standards or classes have been incorporated into management by agencies and local governments. Examples of these types of systems include the Limits of Acceptable Change (LAC) by USFS, Visitor Experience and Resource Protection (VERP) framework (NPS), and Trail Condition Assessment and Survey (USFS 2009). These methods all involve a method for monitoring a resource or setting in order to prevent more than a predetermined level of change from occurring. The basic premise of recreation monitoring is that while recreation use effects both the physical and social setting overtime, these changes can be managed. However, concepts such as *acceptable change* focus monitoring to the practice of maintaining a particular setting or trail type and identifying the level at which recreation impacts can be detected *before* an action is needed to balance resource and recreation needs.

Objective

The objective for recreational use would be to monitor trails and recreational trail use, and potential changes in trail and site conditions, relevant to the values established within the Conservation Easement, Telluride Valley Floor Conceptual Trails Plan, and Management Plan. Additionally, the monitoring objective would be to provide information to make trail maintenance more effective and efficient, and ultimately to determine if the management objectives are being met.

Monitoring Approach

The Telluride Valley Floor Trails and Conceptual Stream Restoration Plan established criteria for four summer trail types and three winter trail types with associated trail widths, surfaces, and uses. The approach for monitoring trail conditions and recreational use is based upon an assessment of use, trail conditions, vegetation, erosion, and user-created trails or sites, such as river access. Conditions would be observed through walk-through surveys and notations would be made in a GPS where undesirable conditions exist for a 30-foot length of trail or longer. Monitoring would identify specific locations where the conditions result in changes to the physical and/or social setting that exceed the standard or use defined in the Management Plan and Trails Plan types. The monitoring information would identify areas where mitigation could be implemented once a standard is reached to return the trail or facility to the desired condition. In some cases, mitigation actions are set in the Trails Plan; in others, the desired outcome is set in the Trails Plan. Actual mitigation would be site-specific, and may depend on the social and environmental direction at the time.

[2] The research synthesis “Recreation Impacts and Management: a State-of-Knowledge Review” by Rocky Mountain Research Station (2000) provides a good, holistic review of recreation monitoring and approaches.

Monitoring summer and winter activities would use the same tools listed below for understanding trail condition, zone of influence surrounding trails, and trail use. Key metrics to use include monitoring social trails, vegetation openings, trampling and erosion. As winter use often involves accessing the site when soils are wet, erosion and soil compaction are more of a concern in the winter.

Trail Condition: To balance the amount of time monitoring with the benefits of improvements in trail conditions, the monitoring approach combines point sampling methodology with a problem assessment approach to trail condition monitoring, where the "point sample" equals a 30-foot or larger section of trail that would deserve mitigation. The benefit of knowing the nature, location and extent of specific trail issues is of greater value than a precise set of trail measurements and statistics of trail use. For this reason, the approach includes the following steps: (1) assign the trail type design standards from the Trails Plan for summer and winter trail types with allowable tolerances for vegetation disturbance and erosion conditions (ERC 2009, p.31); (2) assess trail conditions for trail surface, tread width, presence of erosion, and vegetation trampling along trail edges; and (3) document the status of constructed trail features, such as water bars and stream crossings, where erosion and change are more likely to occur. [3] The surveyor should also note what actions, if any, should be taken.

Trail Use & Compatibility: Trail counters to could be installed semi-annually to monitor both summer and winter use at approximately 6 locations on the property, at entry points and intersections. Photo points should be established in areas where high use is occurring and where actions have been taken to manage use, such as closed social trails, restored stream banks, and trail relocations.

While the majority of trail users will enjoy the Valley Floor without experiencing conflicts, occasional conflicts or accidents do occur. Discussion during the public processes to develop the Management Plan and Trails Plan identified trail conflicts in congested areas, such as the east end near Boomerang Road, and between users who travel at different speeds (Town of Telluride 2009a, p. 134). The Town should record information when conflicts are reported that would be helpful in understanding the patterns of the use or design that may contribute to the conflict, such as the location, context, and types of users involved. Encounters between different types of trail users to which one or both users simply object to each other's presence or activity should be counted as a different type of conflict. Monitoring indicators should include: 1) the number and location of user accidents and user type directly related to trail use, and 2) the number, user type and location of reported incidents of trail user conflicts. Incidents could be recorded at trail heads or a monitoring mobile app could be developed to assist with data collection.

Social Trails: Generally, social trails on the Valley Floor are managed closely and closed as they are noticed. However, social trails that reoccur over time are often in response to trail users avoiding wet areas or attempting to access specific areas or activities, such as river access for fishing. Monitoring where social trails occur over time can help inform management mitigation or education efforts. The basic elements of documenting social trials include recording the location, length, and condition of social trails in a GPS. Monitoring activities should be based upon the same practices as the trail condition

[3] Examples of condition surveys are available at several trail impact monitoring sites, such as www.wilderness.net/trail. The City of Boulder Open Space and Mountain Parks Visitor Master Plan provides an excellent example of applying the system to a local park (www.bouldercolorado.gov).

monitoring referenced above in this section. It is important to document where social trails occur in an effort to support management direction in the area.

Grooming Impacts to Trail-side Vegetation: Impacts from recreation may include inadvertent impacts associated with the maintenance of trails and recreation access by the winter grooming machine. Years with warmer temperatures and low snow levels may be of particular concern, when plants and soils are less protected by a blanket of snow and stable, frozen temperatures. Monitoring activities should establish indicators for potential changes in vegetation, stream banks and wet areas along groomed routes over time. Changes in vegetation may not be immediately evident and long-term trends may become visible through the photographic record (Visual Resources, Section 8, pg 45). Sensitive vegetation resources near stream crossings and low canopies should be measured using trails survey methods for vegetation (Trail Conditions, pg 37, listed above) and repeat photographic stations. Monitoring would capture changes in vegetation composition, bank erosion, and the establishment of social trails.

Water-based Recreation Uses

Popular water-based recreation includes traditional fishing, wildlife viewing, boating, and tubing. In the Management Plan, river use is permitted as long as it "minimize[es] wildlife disturbance, social trails, trampling and aquatic habitat impacts" (Town of Telluride, 2009a p.31). The Management Plan anticipated that improved access to the San Miguel River and improved health of the fishery would likely result in increased use and, by association, increased impacts along access points and stream banks.

Objective

The objective for water-based uses would be to monitor river and stream conditions that are sensitive to disturbance by recreation use. The focus of monitoring efforts would provide information to managers for determining appropriate levels of use.

Monitoring Approach

Monitoring for water-based recreation impacts would monitor river use, access patterns, and social trail development along stream banks. For this use, the monitoring plan would follow the same protocols for trail conditions at access points and the protocols for social trails and undeveloped areas for stream banks. Water quality stations mentioned in previous sections could be co-located with recreation access points and/or high use areas. Monitoring would identify changes in canopy openings, vegetation cover, soil compaction, and trampling. Sensitive wildlife and plant species that are associated with riparian corridors may be found on stream banks. Plant surveys should identify areas where early signs of expanding informal use are found along stream banks and other potential areas of concern.

Recreation/Wildlife Interactions

While there are many benefits that may be gained by people interacting with the natural world and enjoying an occasional encounter with wildlife, these interactions may also have direct and indirect detrimental effects on wildlife. Wildlife responses vary by location, species, season, and individual animal. In particular, research has shown large mammals, birds, and carnivores can be affected by repeated disturbance. The Environmental Report Appendix L addresses this topic in detail (Town of Telluride, 2009a).

Objective

Initially, the objective of monitoring recreation-wildlife interactions would be to provide baseline information to inform managers of patterns of interactions and reactions by people and wildlife. Ultimately, the objective would shift to determining if the management objectives of providing for the conservation and/or preservation balance detailed in each Management Zone are being met.

Monitoring Approach

The monitoring for human and wildlife interactions should be focused along wildlife corridors, corridors through upland vegetation, riparian corridors, and (eventually) new trails, especially where new trails are proposed in Zone 3 Habitat Protection Areas with high environmental sensitivity. These corridors and human concentration areas would be identified in concert with staff and wildlife managers, and in partnership with information developed by the wildlife monitoring program.

In the Management Plan, Management Zones 2 and 3 recreation impacts are to be balanced with conservation and preservation goals respectively. In these areas measuring the zone of influence of recreation on habitat and sensitive areas should include establishing field observation stations in areas where 1) high levels of recreation use is occurring and 2) sensitive resources are in close proximity of trails and informal use areas. These locations would be selected by management and may include wetlands, water crossings, wet meadows, and wildlife corridors. Indicators would include measuring trail treads, vegetation trampling zones, vegetation clearing height and width, frequency and extent of social trails.

The Trail Use and Compatibility protocol described above could be used for safety concerns and conflicts associated with wildlife-recreactor interactions. Monitoring should be done in winter and non-winter seasons, and coordinated with tracking surveys described under the winter snow tracking section. The monitoring staff should record any observed conflicts and interactions with wildlife. The Commission should establish a volunteer monitoring system that would enable users to report observations, location and time of incident via a registry at trailheads. A simple system for comment submittal might include a special email or text number where mobile devises could take and send pictures with GPS coordinates attached. As off-leash dogs and wildlife interactions were a concern expressed during the Management Plan process, staff could maintain a database of off-leash offenders.

In conclusion, monitoring for this entire recreation and trailssection would require a technician to conduct the trail monitoring, who has an understanding of trail management objectives, is able to identify in detail where the trail meets standards and what it would take to remedy issues, and is able to define a reasonable prescription for trail maintenance. Ideally personnel would attend a training specific to the monitoring method to be utilized. Minimal equipment is required for initial set up, however investments in automated trail counters would be beneficial to understanding current and future levels of trail use.

7.0 RECLAMATION AND RESTORATION

Restoration ecology is the process of renewing a degraded, damaged, or destroyed ecosystem through human intervention. Some of the past uses of the property, including transportation development of railroads and roads, municipal waste water facilities, agricultural use, and mining, have left a legacy of degraded or altered habitat conditions in certain areas. The Environmental Report identifies several areas where reclamation or restoration opportunities can improve the ecological value and function of the property. New emerging techniques for bioremediation, the process of using either natural occurring or deliberately introduced microorganisms to consume contaminants, may provide an opportunity for treatment of tailings on the Valley Floor, such as mycelium. Some of these restoration projects are relatively small in scope, are isolated from other resources or restoration efforts, are not constrained by timing or phasing, and could be completed on a case-by-case basis. Other projects are large and complex efforts that could influence a variety of uses, habitats, and ecological functions, and require a significant level of planning, technical data collection, and coordination for successful completion.

The Management Plan emphasizes the planning and implementation of the San Miguel River and associated tributary Restoration, and Society Turn Tailings Pile #1 Remediation, as the top priorities for large-scale restoration projects. The Conceptual Trails and River Restoration Plan provides conceptual plans on restoration activities that have been approved by the Town and provide a reach-by-reach conceptual guide. In support of these plans for river restoration and site reclamation, the objective of the IMP is to first collect baseline information on the current condition of resources including vegetation, soils, water resources, and wildlife that will support restoration and reclamation planning. This information will be collected following the protocols (i.e distribution and frequency of measurements) listed in previous sections and will occur during the planning and implementation of restoration activities. Information collected on individual resources will then be used to make river restoration management decisions, which may include increasing the number, type, and frequency of monitoring measurements in targeted areas deemed to be influenced by management actions, such as areas currently identified in the Management Plan.

Previous monitoring efforts on the Valley Floor have collected samples of tailings, stream sediment and water quality from the San Miguel River and project area (summarized in the Environmental Report, pgs 78-83, Figures 29-2.10, and Table 2.9). Collectively, these results document elevated levels for lead, cadmium, copper, aluminum, and zinc at various locations, as the chemicals of concerns (COCs). Additionally, the water quality samples showed that some changes in water quality levels could not be explained by the known tailing piles alone, indicating that there may be other factors yet to be discovered on the site. As such, this section proposes targeted sampling in those areas. Additionally changes in the river course, due to restoration activities, may expose sediments that are currently buried on the Valley Floor. Therefore the recommendations here also apply to the discovery of materials, should they be exposed or discovered in the future.

Water Monitoring

In concert with sampling proposed in the Water Quality and Vegetation sections (Water Quality Section 3, pg 13; Vegetation Section 4, pg. 18) this may include adding surface water and groundwater sampling points that are directly downstream of the restoration and reclamation areas. Given the highly mineralized geologic setting and significant mining activity both on the property and upstream, it is important to monitor for total and dissolved metals in waters that are associated with disturbed sites.

Objective

The objective for water monitoring in relation to restoration and reclamation activities is to identify changes in hydrologic parameters (water quality and quantity) specifically related to reclamation and restoration efforts.

Monitoring Approach

Previous sections have detailed monitoring protocols for monitoring water quality and quantity, and the same methods should be used for understanding how these resources may influence the plans for restoration/reclamation and how these resources may change as a result of these same activities (please refer to the appropriate sections for detail). Monitoring for total and dissolved metals would be useful at these locations. When the conceptual plans for restoration or reclamation are developed, a detailed spatial and temporal monitoring plan could be developed in concert with those activities. The monitoring described in this document would provide baseline information prior to changes in management or other activities.

Revegetation Monitoring

Revegetation monitoring plots would utilize the Vegetation Section strategy, with sites strategically located to measure success of associated re-vegetation practices. One of the key differences between revegetation and other vegetation monitoring would be the importance of establishing pre-construction data which will serve to establish baseline conditions prior to restoration and remediation activities, with changes as a primary analytical tool. The second difference is need to closely monitor for weed establishment in these plots, at a higher level of sensitivity than other areas of the property. Disturbance to soils that are already poor to begin with would enable weeds to establish quickly and with vigor.

Objective

The objective for revegetation monitoring is to measure changes in vegetation in reclaimed, remediated, and degraded areas.

Monitoring Approach

Monitoring for revegetation would utilize the same methods as listed within the Vegetation Section 4 (pg 18). Specifically, sites would be established to represent degraded vegetation and bare areas associated with reclamation projects. In particular, the key concerns would be to establish the baseline and trends of plant establishment, community composition, and weeds (if any) in reclamation areas. Plot or transect based plant surveys would identify species and growth rates of plants used for re-vegetation, and other species that may/may not be considered invasive. Indicators would include changes in stem density, percent cover, and plant community composition. Additionally, reference plots should be identified where no improvements or actions are taken to enable a comparative assessment of the effectiveness of the treatment actions.

Soil Conditions

In addition to water and vegetation monitoring the monitoring program should include a synoptic soil survey across both the Society Turn Tailings pile # 1 area, other miscellaneous tailing areas, and other locations where soil disturbances, surface alterations, and erosion processes are a likely to change as a result of management activities. The eight sites identified in the Environmental Report would be prime candidates to initiate soil survey, however multiple sites in the property would be worth exploring before restoration activities are initiated.

Objective

The objective for soil conditions specifically identified for restoration and reclamation activities is to identify the location and extent of contaminated/introduced materials, and to improve restoration/reclamation success through understanding the relationship between contaminants that may be present, vegetative health and soil quality.

Monitoring Approach

The monitoring approach would be to inventory the soils conditions, chemical composition (i.e. heavy metals concentrations) along existing riparian corridors and planned restoration/reclamation areas. The method would physically extract soil cores across the target land area to develop a three dimensional soil profile that would identify the presence/absence and concentration of contaminants of concern. Soil samples would be tested in a laboratory for the presence of the suite of heavy metals that may be of concern on the site. Additionally, if contamination or heavy metals are identified, those soils should be tested to see if the contaminants are likely to leach into the water table, are available for uptake by plants or animals, or are inert in their current form, as these characteristics would affect the potential risk to people and species that are exposed to these materials. The data obtained would ultimately aid management actions such as final locations of restored river channels, appropriate erosion control plans, and necessary stream bank armoring to minimize ecological degradation and mobilization of contaminates.

Tailings Remediation

The Environmental Report classified tailings into three categories: Idarado Consent Decree tailings, miscellaneous tailings, and other potential tailings. The first two types are tailings piles where the locations are known and some of the hazardous materials, such as heavy metals, have been identified. The third type, other potential tailings, represent areas where discernible piles and other non-native surface soils appear to be intermixed with native soils (Town of Telluride, 2009b, p.79). Minimal information currently exists regarding these piles, their extent, and their contents. Further, sampling in 2000 indicated that water quality concerns (zinc) were higher upstream of Pile #1 than at or downstream of the pile, and further investigations were recommended to identify the cause.

For the Idarado Consent Decree remediation, the Town could work with the State of Colorado and other relevant parties to develop and implement a tailings remediation plan that meets existing legal requirements while also protecting and enhancing the wildlife, habitat, recreational, and aesthetic values of the property (Town of Telluride 2009a, p.43). Information from ongoing monitoring of vegetation and water resources (following previously mentioned protocols) will provide baseline information prior to remediation work and should be used to develop additional monitoring programs at specific locations as identified in the final remediation plan. Tailing remediation may offer opportunities to innovative techniques for remediation, and the monitoring program should include comparative studies of different treatments, such as mycoremediation using fungi or phytoremediation using microorganisms to treat tailings in their current location.

Objective

The primary objective for monitoring tailings piles would be to confirm the location and extent of contaminated materials and understand any potential influence that the potential tailing piles may have on water quality or other valued Valley Floor resource. Further, monitoring should provide information regarding the effectiveness of remediation treatments for improving water quality, soil health, and vegetative cover.

Monitoring Approach

Future restoration activities are proposed that may alter the course of the river and, by association, the river's potential for erosion and ability to transport materials from the stream banks. The tailings may be downstream of the future restoration projects, and downstream of the reclamation areas changes in the water table may enable COCs (such as heavy metals) to leach into the water in new areas. These mechanisms would determine the spatial distribution of where monitoring stations would be established.

Monitoring for tailings remediation would determine if the tailings contain dissolved metals and potential contaminants that have the potential to leach into surface waters and groundwater. Additionally, the monitoring would identify signs of mobilization through monitoring transport (erosion and dispersion) or leaching (dissolving into the water column) to identify and monitor the potential pathways for the distribution of the tailings. The method would install and monitor groundwater wells for water quality. The stream banks would be analyzed to quantify changes in stream morphology and erosion trends. The samples would be analyzed for the presence/absence and concentration of Chemicals COCs. Monitoring activities would be completed monthly during the runoff period (April-August). Monitoring methods used for miscellaneous tailing piles and future discoveries would be similar to those listed under water quality and soil conditions.

Monitoring for remediation of tailings in the area would develop a detailed monitoring plan at the time that the treatments are designed. This would include water quality, vegetation, and soil monitoring methods in the previous sections.

8.0 VISUAL RESOURCES

Visual Resources are the visible physical features on a landscape (e.g. land, water, vegetation, animals, cultural modifications, and structures) that characterize the landscape. Visual resources are included as a conservation value in the Conservation Easement as scenic vistas of importance to the Valley Floor (C.R.S. Sections 38-30.5-101—111, Recitals B. Page 2) and as the scenic gateway to the Town of Telluride (Town of Telluride, 2009a). In addition to monitoring the scenic resources for the sake of scenic vistas on the Valley Floor, a visual record of changes that may be occurring across the area over time would provide a useful element to the overall monitoring program. This comprehensive photographic record would provide managers and the public with a non-technical measure of these changes, indicating both the positive outcomes of management activities, as well as areas of management or resource concern. The general photographic record provides a broad overview of the Valley Floor that would not be captured by the resource-specific photographs taken in other phases of the monitoring plan.

Over time, human activities and dynamic natural processes have the potential to modify the character and scenic quality of the landscape. These changes can affect the experience of visitors to the Valley Floor. These changes can also be indicators of change to the natural systems that collectively are easier to identify through a visual record than through other monitoring methods.

Objective

The objective is to establish permanent photo-point locations across the Valley Floor and develop and maintain a broad photo-record of conditions on the Valley Floor, including general landscape and vegetation, riparian habitat, recreational features, restoration areas, visual corridors, and other features of social and biological importance.

Monitoring Approach

A number of photo-points would be established across the Valley Floor in a manner that would ultimately provide as complete a visual record as possible of all the varying landscapes and areas of special interest. While some pre-planning using maps and aerial imagery may help in development of a photo-point layout strategy, much of actual layout should occur in the field to ensure the optimal location for capturing the most visual information from each point. Generally, areas with open views would be selected for photo-points. Elevated features, such as the railroad grade can also be used, where available, to offer more unobstructed views.

Each photo-point would be given an identifying number and its location will be documented using a GPS. Its coordinates will be entered into the GIS system to allow for its exact future relocation. At each photo-point a series of photographs will be taken to record the general condition of the area from that perspective. Photographs should be taken with a quality digital camera at a relatively high level of resolution to allow for a clear enlargement of distant features that may occur in the field of view of the cameral shot. The number of photos taken at each point location will vary depending on the areas of interest. In an open area a full panoramic suite of photos may be desirable, while in areas more closed in by vegetation only a few photos may appropriate. At some locations only items of specific interest, such as structures, roads, or other features may photographed. The intent is to capture the character of the landscape or focal point of interest at that location and the number of photographs taken would be determined by the photographer. Each photograph will be given an identifying number that ties it to photo-point.[4] The azimuth orientation of each photo will be recorded using a hand-held compass with a declination compensation setting and the declination setting used should be recorded. For consistency the photographer should start with the most northerly orientation and take subsequent photos at that photo-point in a clockwise direction. A digital map should be created showing each photo-point with an arrow indicating the orientation of photos taken from that point. This will allow for an efficient determination of which photos might capture an area of interest within its photo field. The general photo record could be merged with the individual resource monitoring photo-record to provide a complete photographic record of Valley Floor. However, also keeping separate resource photo records would be wise to allow for more efficient access to specific resource-related situations.

Photos at each location should be retaken every three years with care taken to assure that the photo is taken using the exact photo-point location and orientation as the previous years' photos. All photos will be stored digitally in a manner that will allow a viewer to look at a series of individual photos over time.

[4] A suggested indexing system could be GPP1-1, where "G" represents the general photographic series, "PP1" represents the first photo-point in the general photographic series, and "-1" represents the first photo at that photo-point. For other resources a different identifying letter could be used. For example "B" could be used to identify photos associated with the beaver resources.

9.0 REFERENCES

Baldwin, C., F. Wagner & U. Lall. 2003. Rocky Mountain/Great Basin regional climate-change assessment report for the U.S. global change research program. In: Wagner, F. (Ed.), Water Resources. Utah State University Press, Logan, UT, pp. 79-112.

Clow, D. W. 2010. Changes in the timing of snowmelt and streamflow in Colorado: A response to recent warming, Journal of Climate, 23(9), 2293-2306.

Doherty, S. J., S. Bojinski, A. Henderson-Sellers, K. Noone, D. Goodrich, N. L. Bindoff, J. A. Church, K. A. Hibbard, T. R. Karl, L. Kajefez-Bogataj, A. H. Lynch, D. E. Parker, I. C. Prentice, V. Ramaswamy, R. W. Knowles, N., M. D. Dettinger, and D. R. Cayan . 2006. Trends in Snowfall versus Rainfall in the Western United States. Journal of Climate, 4545-4559.

Ecological Resource Consultants (ERC) and ERO Resources Corporation (ERO). 2009. “Telluride Valley Floor Environmental Report.” Prepared for the Town of Telluride, May 2009, Telluride, CO, pp. 111.

ERC and ERO. 2011. “Telluride Valley Floor Trails and Conceptual Stream Restoration Plan. Report prepared for the Town of Telluride, February 2011, Telluride, CO. pp. 43.

Leung, Y. and J. Marion. 2000. “Recreation Impacts and Management in Wilderness: A State of Knowledge Review.” In Cole, D. et al. 2000. Wilderness science in a time of change conferece. Volume 5: Wilderness ecosystems, threats and management; 1999 May 22-23. Missoula, MT Proceedings: RMRS-P-15-VOL-5. Ogden UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

National Park Service Inventory and Monitoring Program. 2013. Natural Resource Database Template. Available online at http://science.nature.nps.gov/im/datamgmt/applications/template/index.cfm.

Nayak, A., D. Marks, C. G. Chandler & M. Seyfried. 2010. Long-term snow, climate, and steamflow trends at the Reynolds Creek Experimental Watershed, Owyhee Mountains, Idaho, United States. Water Resources Research, 46, W06519, doi:10.1029/2008WR007525.

Pielke, R. A., N. Doesken, O. Bliss, T. Green, C. Chaffin, J. D. Salas, C. A. Woodhouse, J. J. Lukas & K. Wolter. 2005. Drought 2002 in Colorado: An unprecedented drought or a routine drought? Pure and Applied Geophysics, 162, 1455-1479.

Rangwala, I. and Miller J. 2010. Twentieth Century Temperature Trends in Colorado’s San Juan Mountains. *Arctic, Antarctic, and Alpine Research,* Vol. 42, No. 1, 2010, pp. 89-97.

Ray, A.J.; Barsugli, J.J.; Averyt, K.B. 2008. Climate Change in Colorado—A Synthesis to Support Water Resources Management and Adaptation. Cooperative Institute for Research in Environmental Sciences, Western Water Assessment, for the Colorado Water Conservation Board. Available at: http://www.pawsd.org/CWCB-ex-summary.html.

Rocky Mountain Bird Observatory, authors: Hanni, D. J., C. M. White, J. A. Blakesley, G. J. Levandoski, and J. J. Birek. 2009. Point Transect Protocol. Unpublished report. Rocky Mountain Bird Observatory, Brighton, CO. 37 pp. Accessed online: http://www.rmbo.org/public /monitoring/protocols/PT_Protocol_final_2009.pdf.

Saunders, M. S. Smith, K. Steffen, T. F. Stocker, P. W. Thorne, K. E. Trenberth, M. M. Verstraete & F. W. Zwiers. 2009. LESSONS LEARNED FROM IPCC AR4 Scientific Developments Needed To Understand, Predict, And Respond To Climate Change. Bulletin of the American Meteorological Society, 90, 497-+

Serreze, M. C., M. P. Clark, R. L. Armstrong, D. A. McGinnis & R. S. Pulwarty. 1999. Characteristics of the western United States snowpack from snowpack telemetry (SNOTEL) data. Water Resources Research, 35, 2145-2160.

Stewart, I. T., D. R. Cayan & M. D. Dettinger. 2005. Changes toward earlier streamflow timing across western North America. Journal of Climate, 18, 1136-1155.

Town of Telluride. 2009a. "Telluride Valley Floor Open Space Management Plan." Prepared by ERO Resources Corporation on behalf of the Telluride Open Space Commission. Telluride, CO. pp 99.

Town of Telluride. 2009b. Deed of Conservation Easement for Telluride Valley Floor Property. Document 408200, San Miguel County, CO. 25pp.

United States Forest Service (USFS). 2009. TRACS: Trail Assessment and Condition Surveys 2009 User Guide. Available online: www.wilderness.net/toolboxes/documents/trail/tracs_user_guide_2009.pdf.

Monitoring Action	Monitoring Protocol	Ecologic Priority	Indicator	Monitoring Frequency	Expertise Level Required	Analysis/Validation	Potential Partnerships with Town	Initial Capital Investment	Estimated Annual Costs (order of magnitude)
CLIMATE, SURFACE WATER AND GROUNDWATER RESOURCES							**Type: nonprofit, agency, volunteers, etc**	**Cost for initial installation** *See cost categories at bottom of document*	**Cost for annual monitoring, data collection, analysis**
Local Climate Monitoring Objective: To directly measure the meteorological fluxes occurring at the land surface.									
• Establish local climate through direct measurement of meteorological fluxes (esp. precipitation and temperature) occurring on the property.	Install and maintain a weather station in appropriate location to track precipitation and temperature (at minimum)	High	Changes in precipitation, temperature, growing degree days, etc.	Continuous, plan on weekly to monthly data QAQC	T2-T3, C2	Correlate with existing weather stations maintained by NOAA, NRCS (i.e. SNOTEL)	Local nonprofits, researchers/agencies with similar interests, such as NRCS SNOTEL	F	D
Stream Water Quality Monitoring Objective: To detect changes and trends in water quality entering and exiting the property.									
• Document the water quality of the San Miguel River and tributaries that confluence with the river within the Valley Floor.	Standard WQ parameters of temp, pH, DO, conductivity, turbidity and selected analytical parameters to address issues like metals from tailings	High	Changes in water quality parameters	Standard parameters: summer-weekly, winter-monthly.	T1, C1 *Citizen Science compatible*	CDPHE-WQCD Regulation 31 standards. Data formatted for storage on EPA STORET and USGS NAWQA centers	Local non-profits, CDPHE, USGS	B	C
Stream Flow Monitoring Objective: To detect changes in timing and magnitude of surface waters entering and exiting the property									
• Establish timing and magnitude of flows on the San Miguel River and major tributaries (Butcher, Mill, Eider, No Name, and Prospect).	Measure in-stream flows across a range of temporal periods and spatial areas. High flow monitoring in the main stem will be limited to bridge crossing sites.	High	Changes in magnitude of annual flow, timing of snow melt, and hydrograph curve	Continuous stage that is calibrated: summer-weekly, winter-monthly.	T2 , C2, C1 *Citizen Science compatible*	Pressure Transducers in stilling wells, calibrated with stage discharge curves developed using velocity-area method	Local non-profits, upstream/ downstream jurisdictions	E	D
Groundwater Monitoring Monitoring Objective: To detect how groundwater dynamics (level, movement, extent) respond to changes in surface water parameters. Specifically, how management actions are maintaining or changing groundwater dynamics on the property (restoration and irrigation)									
• Monitor groundwater dynamics (level, movement, extent) in relation to hydrologic drivers such as irrigation, climate, and re-channelization via restoration.	Measured groundwater depths manually for most wells, install automated water depth logger in select wells	High	Changes in groundwater flow, depth, and hydrograph	Monitored: summer-weekly, winter-monthly. Ongoing in select wells	T3, T2, T3, C2 *Citizen Science compatible*	Long term changes, correlated to surface water flows, spatial modeling of water tables possible	Student groups, local non-profits	E-F	D

Monitoring Action	Monitoring Protocol	Ecologic Priority	Indicator	Monitoring Frequency	Expertise Level & Citizen Science	Analysis/Validation	Potential Partnerships	Initial Capital Investment	Estimated Annual Costs (order of magnitude)
VEGETATION AND PLANT COMMUNITIES							Type: nonprofit, agency, volunteers, etc	Cost for initial installation *See cost categories at bottom of document*	Cost for annual monitoring, data collection, analysis
Upland Plant Communities Monitoring objective: To identify changes in extent, conditions, and trends of specific plant communities across the Valley Floor.									
• Determine baseline conditions of diversity and density of plant species and plant communities. Monitor changes over time.	Utilize Transects using Railroad Grade as axis. Establish 10 North-South transects and couple with groundwater monitoring locations to identify species and groundwater trends and relationships.	High	Changes in species and community composition	Annual	C3 + T2 Botanist leading a crew of trained technicians NOT Citizen Science compatible	Calculate annual changes in species diversity, richness, percent ground cover.	CNHP, students, researchers, plant enthusiasts	E	D
Wetland Communities Monitoring Objective: To monitor changes in character and extent of wetland habitat, functions and values.									
• Monitor for changes in character and extent of wetland habitat functions and values.	Vegetation plots and water levels. Journal of management actions, including changes in irrigation patterns, if applicable.	Medium	Changes in wetland community species and distribution along a gradient of wetland obligate species	Annually during growing season (July-August)	T2, C3, C2 NOT Citizen Science compatible	Primarily driven by goals of restoration plans, Natural Resources Conservation Service	Wetland enthusiasts, professional wetland / restoration societies, researchers, students	Included in costs for establishment of vegetation plots above	Included in costs for establishment of vegetation plots above
Plants of Conservation Concern Monitoring Objective: Establish baseline diversity and density of sensitive and protected plant species, and Monitor change in response to restoration, management activities, and natural dynamics.									
• Determine diversity and density of sensitive and protected plant species. • Monitor change in response to restoration, management activities, and natural dynamics.	Site specific plots following Colorado Natural Heritage Program (CNHP) methods.	High	Changes in extent and distribution of Plants of Conservation Concern species	Annual	T2, C3, C2 Citizen Science compatible with extensive training	CNHP database	trained Citizen Scientists, CNHP, students, researchers	Included in costs for establishment of vegetation plots above	C
Fuels and Fire Risks Monitoring Objective: Determine what the current distribution of forest health issues is and what is the level of potential fire fuels; to understand how forest health and fuels change in response to management practices or climate.									
• Determine current distribution of forest health issues and fuels • Monitor how forest health conditions change in response to management practices or climate.	Aerial photography interpretation to identify pockets of fuel timber and field review/ ground truth fuel pockets.	Low	Changes in forest structure, canopy, and fire starts	Annually	C3, C2 NOT Citizen Science compatible	Monitor per USFS protocol for beetle-kill and tie with Town of Mountain Village fire mitigation planning	Town of Mountain Village and USFS, Colorado State Forestry, Natural Resources Conservation Service	B (cost for photography which can be utilized for other purposes as well)	C

Monitoring Action	Monitoring Protocol	Ecologic Priority	Indicator	Monitoring Frequency	Expertise Level & Citizen Science	Analysis/Validation	Potential Partnerships	Initial Capital Investment	Estimated Annual Costs (order of magnitude)
VEGETATION AND PLANT COMMUNITIES							Type: nonprofit, agency, volunteers, etc	Cost for initial installation *See cost categories at bottom of document*	Cost for annual monitoring, data collection, analysis
Noxious Weeds Monitoring Objective: to identify and document the location of Colorado-designated Class 1 and 2 weed species, inform and evaluate weed management priorities and practices, and identify areas for retreatment.									
• Locate and document noxious weeds residing within the Valley Floor.	Thorough informal walk-thru surveys of Valley Floor identifying locations of Class 1 & 2 noxious weeds. GPS perimeter of the weeds; record weed species and a qualitative description of weed density.	High	Changes in extent of weeds	Annually initially until current infestations have been successfully managed	T2 Citizen Science compatible with training	Record infestations, treatment areas, and meta-data in GIS system	trained Citizen Scientists, native plant enthusiasts	A	C
• Track the status of individual infestations after appropriate treatments.	Visit treated weed sites before seed heads form to determine efficacy of control efforts. Record presence and level of remaining weeds and schedule for further treatment as needed.	High	Changes in areal extent of infestations areas	Annually until site is weed-free.	T2 Citizen Science compatible	Record status of infestation site connected to GIS database	trained Citizen Scientists, native plant enthusiasts	A	Cost incorporated in cell above

Appendix A — Telluride Valley Floor Integrated Monitoring Plan Action Table

Monitoring Action	Monitoring Protocol	Ecologic Priority	Indicator	Monitoring Frequency	Expertise Level Required	Analysis/Validation	Potential Partnerships with Town	Initial Capital Investment	Estimated Annual Costs (order of magnitude)
WILDLIFE							**Type: nonprofit, agency, volunteers, etc**	**Cost for initial installation** *See cost categories at bottom of document*	**Cost for annual monitoring, data collection, analysis**
Resident Elk Herd Monitoring Objective: To determine the size of the seasonal elk herd using the Valley Floor and identify impacts associated with potential over-utilization of the vegetation.									
• Document size of the elk herd using the Valley Floor each year.	Maximum herd counts conducted several times during summer & fall	High	Changes in herd visitation frequency	Annually during winter and summer occupancy	T1, T2 *Citizen Science compatible*	Record annual record of surveys in electronic format	Local non-profits	A	B-Year 1 A-Year 2 and biennially thereafter
• Document elk-associated impacts (if any) occurring on Valley Floor vegetation.	Casual walk-thru exams of vegetation in high use areas	High	Changes in browse patterns	Annually during growing season	T2, T1 *Citizen Science compatible*		Local non-profits, Colorado Division of Parks and Wildlife	A	A-Year 1 A-Year 2 and biennially thereafter
• Measure the extent and influence of elk browse as compared to areas of non-utilization.	Vegetation plots in areas where elk influence is substantial and compare to similar areas not highly influenced by elk. Create exclosures in high use areas to compare vegetation differences between utilized and non-utilized areas. Compare photo record and vegetation sampling procedures appropriate for the habitat.	Medium	Differential changes in browse density and impact	Every 2-3 years depending on the level of change occurring.	T2, T1 *Citizen Science compatible*	Photo-record. Compare mean vegetation sampling values between exclosures and open areas	Local non-profits, Colorado Division of Parks and Wildlife	C	A-Year 1 B-Year 2 and biennially thereafter
Avian Populations Monitoring Objective: Survey seasonal Valley Floor bird populations in a manner that allows for the reliable (statistically) detection of changes in overall species richness (number of species) and changes in the density of individuals within each species occurring across the various vegetation communities. If significant changes are detected, determine if these shifts might be attributable to ecosystem health, open-space management approach or other causes.									
• Establish a survey procedure to measure the breeding bird populations (both number of species and number of individuals within a species) track changes over time.	Monitoring Colorado Birds Protocol (Rocky Mountain Bird Observatory (RMBO) point-transect approach).	High	Notable changes in populations, species and densities	Survey twice during the breeding season for first 2 years followed by surveys every other year	T2 or C2 Individual skilled in bird ID by sight-sound. *Citizen Science compatible with* limited- highly skilled birders	Data must be analyzed using the *DISTANCE* survey analysis. May be best to have data processed and analyzed by outside entity.	Local non-profits, birding groups and volunteers	A	C -Year 1, Year 2 & biennially thereafter
• Identify active raptors nesting territories during bird surveys or through some other mechanism. • Determine if nesting success is being influenced by open-space management.	Nest location and monitoring for nestling development and nest productivity. (May be used as part of a seasonal closure program to determine when fledging has occurred)	High	Changes in raptor activity or nesting success	Monitor active nest annually	T2, T3 Individual highly skilled in bird ID by sight and sound. *Citizen Science compatible*	Minimal data processing and storage requirements. Photo record.	Local non-profits, birding groups and volunteers	A	(Cost to be determined as needed through results of other bird surveys)
• Monitor winter bird populations (number of species and number of individuals within a species) and track changes over time.	Christmas Bird Counts (CBC). Monitoring would be done in conjunction with on-going annual CBC program	Medium	Notable changes in wintering species populations	Annually	T2, C2 *Citizen Science compatible,* limited to skilled birders	Data processing would be done in conjunction with the CBC data processing program	Local non-profits, Colorado Parks and Wildlife, volunteers	A	A

Cost Categories: A: $0-500 | B: $501-1000 | C: $1001-5000 | D: $5001-10,000 | E: $10,001- $20,000 | F: $20,001- $50,000 | G: $50,001+

Monitoring Action	Monitoring Protocol	Ecologic Priority	Indicator	Monitoring Frequency	Expertise Level Required	Analysis/Validation	Potential Partnerships with Town	Initial Capital Investment	Estimated Annual Costs (order of magnitude)
WILDLIFE							**Type: nonprofit, agency, volunteers, etc**	**Cost for initial installation** *See cost categories at bottom of document*	**Cost for annual monitoring, data collection, analysis**
Benthic Macro-Invertebrates Monitoring objective: Establish baseline conditions and conduct subsequent sampling to detect changes in aqueous benthic macro-invertebrate populations over time, to detect potential shifts in water quality associated with Valley Floor management activities (including proposed restoration activities) or off-site influences.									
• Document changes in abundance, species richness and composition occurring in benthic macro-invertebrate (BMI) populations at different river locations. • Investigate indicators that might indicate changing water quality conditions.	Select locations for monitoring, considering opportunities to co-locate with other measurements. Periodically employ the Rapid Bio-assessment Protocols for Use in Streams and Wadeable Rivers.	Yes	Change in sensitive BMI species by river stretch	Annually to establish baselines and monitor effects of restoration activities. Shifting to biennial surveys in post restoration period.	C2 + T2 *Citizen Science compatible but* will require rigorous oversight for dependable data. Lab analysis will also require high level of care	Data compilation as shown in Valley Floor Env. Rpt. (Table 2.6) and summaries as shown in Table 2.5.	Local non-profits, Colorado Parks and Wildlife, volunteers, students	A	C -Year 1 and annually through stream restoration phases, biennially thereafter
Fish Monitoring objective: Establish baseline conditions and conduct subsequent sampling to detect changes in introduced and native fish populations over time, which may indicate shifts in water quality or stream morphology.									
• Document water quality and stream structural characteristics associated with fish habitat quality track changes over time.	Habitat Suitability Index (HSI) Methodology for Brook Trout at designated locations along the San Miguel and major tributaries within the Valley Floor. (Approach may be coordinated with other stream sampling activities.)	High	Changes in HSI	Annually to establish baselines and monitor effects of restoration activities. Biennial surveys in post-restoration period.	T2, T1 *Citizen Science compatible*	Will require data input on electronic forms recording the various parameters at designated locations.	Local non-profits, Colorado Parks and Wildlife, volunteers, fish enthusiasts, recreation groups	A	B -Year 1 and biennially thereafter through the stream restoration phases. Triennially post-stream restoration.

Monitoring Action	Monitoring Protocol	Ecologic Priority	Indicator	Monitoring Frequency	Expertise Level Required	Analysis/Validation	Potential Partnerships with Town	Initial Capital Investment	Estimated Annual Costs (order of magnitude)
WILDLIFE							**Type: nonprofit, agency, volunteers, etc**	**Cost for initial installation** *See cost categories at bottom of document*	**Cost for annual monitoring, data collection, analysis**
Beaver Monitoring objective: Establish a baseline census of beaver colonies and extent of beaver-influenced habitat; measure changes to populations and beaver-associated habitat components over time.									
• Identify the active colonies occupying the Valley Floor and the extent of beaver influenced habitats.	Walk-through surveys of the riverine corridor to identify active colony areas and activity centers. Document location of dams, perimeter limits of impoundments, and lodges.	High	Change in areal extent and changes habitat	Biennially (consider annual monitoring during restoration phases.	T2, T1 Citizen Science compatible	Record data on electronic monitoring form for storage. GIS mapping of beaver-associated structures and impoundments.	Local non-profits, students	A	C -Year 1 and biennially thereafter
• Quantify level of influence on vegetation communities resulting from beaver activities.	Establish vegetation plots in beaver influenced habitats and compare with vegetation plots in similar habitats not influenced by beaver. Periodic walk-through surveys to identify beaver activity.	High	Changes in extent and magnitude of beaver associated vegetation effects		T2, T1 Citizen Science compatible		Local non-profits, students	A	Costs will be covered under vegetation surveys and routine activities like well monitoring
Prairie Dogs Monitoring Objective: To determine baseline prairie dog population; track population changes over time, and examine how prairie dogs may be influencing conditions on the Valley Floor									
• Document locations and extent of the individual colonies occurring on the Valley Floor.	Locate colonies through thorough walk-thru surveys/ define and GPS perimeter of colonies.	High	Change in areal extent of perimeter	Annually	T2, T1 Citizen Science compatible	GIS Mapping on satellite imagery.	Local nonprofits, Wildlife enthusiasts, volunteers, students	A	B-Year 1-5, consider biennially thereafter
• Establish population size (number of colonies, number of individuals within each colony) and track changes over time. *Optional* • Survey burrow densities within individual colonies.	Maximum above-ground counts. Circular fixed plots along transects within the defined colony boundaries.	High	Change in number of colonies and individuals Changes in burrow density and proportions of active/inactive burrows	Annually Biennially	T2, T1 Citizen Science compatible T2, T1 Citizen Science compatible	Yearly data stored electronically by colony on spreadsheets and compared with previously years' data Yearly data stored electronically by colony on spreadsheets, compared with previously years' data	Local non-profits, Wildlife enthusiasts, students, volunteers Local non-profits, Wildlife enthusiasts, students, volunteers	C A	C-Year 1 C -Annually thereafter (if no training necessary for field tech.) C-Year 1 C –Biennially, thereafter (if no training necessary for field tech.)
• Establish the status and trends of the vegetation communities and other resources in and immediately adjacent to the prairie dog colonies. (in concert Vegetation Monitoring program)	Vegetation plots/visual examination of areas associated with colonies. Exclusion fencing to compare foraged and non-foraged areas.	High	Changes in plant community composition	Biennially	T2, T1 Citizen Science compatible	Collected data can be compiled and recorded with the above data by colony.	Local nonprofits, Wildlife enthusiasts, societies, volunteers, students	C-Year 1 C -Annually thereafter (if no training necessary for field tech.)	B-Annually
Multiple Species: Winter Snow Tracking Monitoring objective: Identify wildlife (multiple species) use during the winter months on the Valley Floor through snow-track surveys.									
• Document winter wildlife activity (species and frequency of use) on the Valley Floor that could potentially be influenced by open space management.	Snow track surveys along existing trails. Transects are run multiple times during the winter after new snowfall events.	Medium	Changes in migration, population, and frequency	Annually to establish baseline then shift to biennial	T2 Must be able to identify tracks Citizen Science compatible	Electronic storage of data forms and potentially a photo-record of notable tracks (e.g., lynx)	Local nonprofits, trained citizen volunteers, wildlife enthusiasts, CPW	A	C – cost decreases slightly after year one. Monitoring to occur annually

Monitoring Action	Monitoring Protocol	Ecologic Priority	Indicator	Monitoring Frequency	Expertise Level Required	Analysis/Validation	Potential Partnerships	Initial Capital Investment	Estimated Annual Costs (order of magnitude)
RECREATION							**Type: nonprofit, agency, volunteers, etc**	**Cost for initial installation** *See cost categories at bottom of document*	**Cost for annual monitoring, data collection, analysis**
Trails and Trail Use for Summer and Winter Activities Monitoring Objective: to monitor trails and recreational trail use, and potential changes in trail and site conditions, relevant to the values									
• Document trail conditions, including the baseline condition, trends and status of the trail system including surface conditions, tread width, erosion, plant dispersal and trampling, and invasive weeds.	Monitor drainage, social trails, soil compaction, trampling, changes in vegetation, and presence/absence of weeds. Establish photo points.	Medium	Change in class level by trail section	Annual	T2, C2 Citizen Science compatible	Develop data dictionary and GPS form; yearly, data compiled in spreadsheets.	USFS, volunteers, Local non-profits, sensitive resources- enthusiasts as listed above. Trail and weed monitoring: volunteers, native plant enthusiasts	C Basic Equip GPS unit, GIS Software See appropriate resource sections	YR1- Class C YR2-4- Class C YR5- Class D
• Document trail use and compatibility through measuring levels of trail use, user safety issues and where conflicts, if any, occur along the trail system with trail counters and field observations.	Monitor 1) the amount of trail and recreation use in winter and summer (semi-annual), 2) the number and location of visitor accidents and user type and 3) the number, user type and location of reported trail user conflict incidents.	Medium	Changes in number of users, changes in types of users, changes in concentration of conflicts by trail segment	Biannually, during winter and summer seasons	T2	Maintain data in spreadsheets. Evaluate trail segments with multiple occurrences.	Local nonprofits, volunteers	C	YR1-5: Class C
• Monitor for new social trails, if occur, as the proliferation, extent and condition. Where social trails are closed and habitat restored, monitor restoration efforts.	Measure density of occurrence, length, use and condition of informal trails using a condition class system. Monitor habitat response to closed social trails.	Medium	Change in density and condition of informal trails. Change in vegetation following restoration.	Annually	T2 Citizen Science compatible with training	Maintain data in spreadsheets. Evaluate trail segments with multiple occurrences.	Local nonprofits, volunteers, USFS	Included in above	Included in Trail Condition and Trail Use
• Monitor for grooming impacts to trail side vegetation for potential changes in vegetation and stream banks along groomed routes over time.	Casual walk/ski through surveys along groomed corridor and riparian crossings during season as needed.	Medium	Possible, with proper training or experience	Biannual, at season start and finish	T2 Citizen Science compatible with extensive training	Maintain data in spreadsheets and GPS files. Evaluate trail segments where wet areas and fast growing vegetation encroach the trails.	Recreation enthusiasts, volunteers, trained Citizen Scientists	A	B
Water-based Recreation Uses Monitoring Objective: to monitor river and stream conditions that are sensitive to disturbance by recreation use.									
• Identify areas for concentrated river access and use for monitoring water quality, vegetation, and trail conditions (see appropriate sections above).	Monitor sensitive resources associated with stream and river crossings through surveys and repeat photography.	Medium	Changes in vegetation, water quality, or social trails	Ongoing	Included in above Citizen Science compatible with training	Evaluate river segments with multiple occurrences of social trails, bank erosion, or vegetation trampling.	Local nonprofits, volunteers, USFS	Included in above	Included in previous sections
Recreation/Wildlife Interactions Monitoring Objective: to provide baseline information on patterns of interactions and reactions by people and wildlife.									
• Identify and monitor wildlife corridors for recreation-wildlife interactions.	Monitor number of reports of wildlife-recreator contacts and potential conflicts	Medium	Changes in number of interactions or conflicts both on the property and surrounding it	Ongoing	Included in above Citizen Science compatible with training	Maintain data in spreadsheets. Evaluate river segments with multiple occurrences of wildlife interactions	Local nonprofits, volunteers, USFS	Included in above	Included in previous sections

Monitoring Action	Monitoring Protocol	Ecologic Priority	Indicator	Monitoring Frequency	Expertise Level & Citizen Science	Analysis/Validation	Potential Partnerships	Initial Capital Investment	Estimated Annual Costs (order of magnitude)
RECLAMATION AND RESTORATION							**Type: nonprofit, agency, volunteers, etc**	**Cost for initial installation** *See cost categories at bottom of document*	**Cost for annual monitoring, data collection, analysis**
Water Monitoring Monitoring Objective: To identify changes in hydrologic parameters specifically related to reclamation and restoration efforts									
• Document the surface water and local groundwater flows and water quality located in relation to reclamation and restoration efforts (coordinated with Water Resources section).	Follow existing protocol for surface and groundwater monitoring with additional sites added to address target areas as identified by restoration plan	Medium	Possible	Same as ongoing monitoring or as defined by restoration objectives	C3, T2 Citizen Science compatible	Target sites correlated to established control sites	Idarado Mining, CDPHE, USFS	B	D
Revegetation Monitoring Monitoring Objective: To measure changes in vegetation in reclaimed/remediated and degraded areas.									
• Establish the baseline and trends of re-vegetation, plant establishment, and weeds (if any) in reclamation areas.	Plot or transect based plant surveys identifying species and growth rates of plants used for re-vegetation, and other species that may/may not be considered invasive.	Medium	Changes in stem density, percent cover, and plant communities	Same as ongoing monitoring or as defined by restoration objectives	T2, T1 Citizen Science compatible	Pre-construction data will serve to establish baseline conditions ***prior*** to restoration and remediation activities, with changes as primary analytical tool.	USFS, CDPHE, Idarado Mining	A	A
Soils Conditions Monitoring Objective: To identify location and extent of contaminated/introduced materials; to establish a correlation between vegetative health and soil quality									
• Inventory the soil conditions, chemical composition, and potential contamination levels of soils along riparian corridors and planned restoration corridors.	Soil cores and profiles in randomized locations and along transects in know areas of tailings deposition, laboratory analysis for metals/contaminants	Medium	Presence/absence and concentration of Chemicals of Concern (COC)	Prior to landscape alterations linked to reclamation /restoration	C2-C3 NOT Citizen Science compatible	Data and lab results stored in spreadsheets and georeferenced to understand spatial distribution on a map.	Idarado Mining, CDPHE, USFS	A	C
Tailings Remediation Monitoring Objective: To identify location and extent of contaminated/introduced materials and influence (leaching, etc) relative to current and proposed location of potential mobilization pathways (areas downstream of future redirected surface waters).									
• Determine if dissolved metals and potential contaminants are leaching into surface and groundwater and monitor for signs of mobilization (refer to Water Quality section and Appendix B). Monitor remediated areas for changes in vegetation and soil conditions.	Install and monitor wells for water quality. Quantify changes in stream morphology and erosion trends. Quantify changes in vegetation and soil conditions.	Medium	Presence/absence and concentration of Chemicals of Concern (COC). Increases in desired vegetation and soil productivity.	Monthly during the runoff period (April-August)	C2-C3 Citizen Science compatible	Follow State WQ standards	Idarado Mining, CDPHE, USFS	A	C

Monitoring Action	Monitoring Protocol	Ecologic Priority	Indicator	Monitoring Frequency	Expertise Level & Citizen Science	Analysis/Validation	Potential Partnerships	Initial Capital Investment	Anticipated Annual Costs Category
VISUAL RESOURCES							**Type: nonprofit, agency, volunteers, etc**	**Cost for initial installation** *See cost categories at bottom of document*	**Cost for annual monitoring, data collection, analysis**
Visual Resources: establishing a Photographic Record Monitoring objective: Establish permanent photo-point locations across the Valley Floor; maintain a broad photo-record of conditions on the Valley Floor..									
• Establish visual record of resources throughout the Valley Floor to document visual resources.	Establish and GPS well-distributed photo-points across the Valley Floor emphasizing areas of high social and biological importance, including panoramic or partial panoramic set of digital photos to capture the view from that sight. Record azimuths of the photo direction; describe key elements within the photo field.	High	Changes in general and specific conditions identified by each photo point	Triennially. (May choose a more frequent schedule or rotating panel for critical resources and for restoration areas.)	T2, C2 Citizen Science compatible	Permanent photo points and photos at each photo-point are assigned a discrete identification number and placed in a GIS record. Photos are stored digitally and organized by the identifier and date of photo (large file sizes).	Local non-profits, historical societies, plant societies , open space enthusiasts, students	A	B

Cost Class Categories	
A	$0-500
B	$501-1000
C	$1001-5000
D	$5001-10,000
E	$10,001-20,000
F	$20,001-50,000
G	$50,000+

Personnel Type	Description	P Code
Consultant- Level 1	Generalist 1-4 years experience	C1
Consultant- Level 2	Generalist or field technican with specific training- 5 years+	C2
Consultant- Level 3	Advanced degree or specialty for high level analysis, or indepth knowledge of a phenomena	C3
Telluride Seasonal	Seasonal staff, with relevant degree and on-the-job training	T1
Telluride Staff Specialist	Staff with specialized training or experience (GIS, etc)	T2
Telluride Manager	Staff with specialized training, experience or management	T3

APPENDIX B

Water Quality in the San Miguel River

The Colorado Department of Public Health and Environment's Water Quality Control Division (CDPHE-WQCD) is the state agency and the Water Quality Control Commission (WQCC) is the governor appointed commission, which has the authority to implement the Colorado Water Quality Control Act. Regulation No 31 of the act, the *Basic Standards and Methodologies for Surface water*, provides basic standards, and anti-degradation rule and implementation processes. The regulation also provides a system for classifying state surface waters, assigns water quality standards based on the uses, grants temporary modifications and provides for periodic review of the classification standards. Regulation 31 is intended to implement the Colorado Water Control Act by maintaining and improving the quality of the State surface waters. The regulation is based on the best available knowledge to insure the suitability of Colorado waters for beneficial uses including public water supplies, domestic, agricultural, industrial, and recreational uses and the protection and propagation of terrestrial and aquatic life.

The WQCD's classification system recognizes 5 major river basins in the state: the Rio Grande, San Juan River, Colorado River, Green River, Platte River and Republican River Basins. Regulation number 35 provides the Classification and Numeric Standards for the Gunnison and Lower Dolores River basins and the San Miguel River Basin is part of the Lower Dolores River Basin, which is part of the Colorado River Basin. The WQCD has delineated the San Miguel river into 15 water body segments, which vary from high mountain headwater streams to ephemeral washes in the desert.

The water bodies are classified by use including aquatic life cold water, aquatic life warm water, recreation, water supply and agriculture. Water quality standards have been established to protect the various uses for each water body segment. Standards are set for:

- physical and biological parameters including temp., dissolved oxygen, pH, and E. coli
- inorganic parameters including ammonia, chlorine, cyanide, fluoride, nitrate, nitrite, sulfide, boron, chloride, sulfate and asbestos
- 156 organic parameters
- metals including As, Cd, CrIII, CrIV, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Zn
- uranium and radionuclides
- salinity and suspended solids

State water quality standards are the "yard stick" by which the State assesses the status of the water body or stream segment. The state compares recent information regarding the physical, chemical, and biological condition of a stream segment with the associated water quality standards for that segment. Water quality of water bodies is reviewed by the WQCC every 3 years.

When streams do not meet the State's water quality standards they are determined to be "water quality limited". In 2006, of the 1,826 miles of streams in the San Miguel River basin, only 12.7 miles (0.7%) were determined to be water quality limited. However, the San Miguel river, from where it forms at the confluence of Ingram and Bridal Veil Creeks to the South Fork confluence in Ilium, was previously identified as being water quality limited for zinc as a result of historic mining operations. (For reference Ingram Creek has been previously on the Monitoring and evaluation list for cadmium and manganese while the Howards fork in Ophir has iron as the contaminant/metal of concern)

The Idarado Mine Remediation resulted from an agreement between Idarado Mining Company and the State of Colorado's Natural Resouce Trustees (CDPHE, AGO & DNR) to remediate damages to the states natural resources, including water quality. Work was conducted from 1993-1999 and by 2005 Idarado had met the total zinc performance objective in the San Miguel River, which was a 50% reduction in zinc concentration in the river below the confluence with Bear Creek. The values that were to be obtained were Dissolved zinc (≤ .276 ppm) and Total zinc (≤ .336 ppm).

Given the known and potential impacts from the Idarado mining operations to the Valley Floor it would be appropriate to continue to monitor for changes in the above-mentioned metals concentrations both above and below the property. This may become especially important if river restoration alters the interaction between river channel and tailings dispersed throughout the Valley Floor.

Information can be obtained on the CDPHE-WQCD page at:
http://www.colorado.gov/cs/Satellite/CDPHE-WQ/CBON/1251583425927

Data is stored on the Colorado Data Sharing network (CDSN) where Monitoring locations are updated annually from the EPA National Data Warehouse (WQX/STORET) & USGS (NWIS/NAWQA), data for existing (displayed) monitoring locations for these databases are real-time. Data is often collected directly by state or federal agencies (CDPHE, USGS, EPA, etc.), organized citizen groups like Colorado River Watch, and third parties like Telluride Open Space Commission.

Existing sampling locations for the main stem occur upstream within Town boundaries and downstream at Society turn and both above and below the WWTP. The Society Turn location does not seem to have data past 2008 while the data collection from above the WWTP appears to be ongoing at monthly time steps.