Appendix A
Nonpoint Source program - Target Basin Rotation Plan

The NPS program rotates incremental funds around the state, one river basin per year, so that it takes 5 years to complete a full cycle. This rotation follows the schedule for water quality standards triennial review defined by the Water Quality Control Commission; during the fifth year the Commission reviews Statewide Basic Standards and Methodologies and the program does not define a target basin for the incremental funds (see below for the Target Basin Rotation Plan table). This strategy ensures that the NPS program is using the most updated information and latest assessments to address impaired waters while focusing the use of limited resources. The base grant and incremental grant columns in the table below identify the State fiscal year priorities for the regulatory basins. The monitoring and rule making columns show the corresponding WQCD priorities for the same years.

Nonpoint Source program - Target Basin Rotation Plan

Legend:

= Arkansas and Rio Grande Basins
= Upper and Lower Colorado Basins
= San Juan and Gunnison Basins
= South Platte and Republican Basins
= Statewide / Flexible

State Fiscal Years (from July 1st to June 30th)	Monitoring (WQCD)	Rule Making (WQCC)	*Base Funds*	*Incremental Funds*
			NPS Priorities (Funding Cycle Starts annually in September)	
19/20	SJ / Gunni	So Pl / Rep	STW	Up / Lo CO
18/19	STW	Up / Lo CO	STW	Ark / RG
17/18	So Pl / Rep	Ark / RG	STW	SJ / Gunni
16/17	Up / Lo CO	SJ / Gunni	STW	STW
15/16	Ark / RG	STW	STW	So Pl / Rep
14/15	SJ / Gunni	So Pl / Rep	STW	Up / Lo CO
13/14	STW	Up / Lo CO	STW	Ark / RG
12/13	So Pl / Rep	SJ / Gunni & Ark / RG	STW	SJ / Gunni
11/12	Up / Lo CO	STW	STW	STW
10/11	Ark / RG	STW	STW	STW

Activities

List of NPS program Priority Watersheds

List of NPS program Priority Watersheds
(grouped by WQCC regulation basins)
(current on June of 2011)

Note: each impaired segment has been identified according to Regulation № 93 Section 303(d) list of Water Quality-Limited Segments Requiring TMDLs; there is also a short description of the NPS program potential or current contribution to the restoration of the impairment.

Arkansas River Basin

Upper Arkansas R.: NPSMA contribution: there is a watershed restoration plan being developed for this area, with a potential to prioritize restoration projects. The following segments will be incorporated as priorities in the watershed plan. This could potentially result in incremental money supporting restoration work. These segments are the California Gulch to Lake Fork, Lake Fork to Lake Creek and Lake Creek to Pueblo Reservoir.

303(d) listed segments: COARUA02b (Cd and Zn), COARUA02c (Zn), COARUA03 (Zn)

Lower Arkansas R.: NPSMA contribution: there are several projects being implemented in this area – a watershed plan, a large source identification and quantification study and model development with the collaboration of Colorado State University and projects in conjunction with the Southeast Conservation District. This segment goes from John Martin Reservoir to the Kansas stateline.

303(d) listed segment: COARLA01c (Se)

Purgatoire River: NPSMA contribution: this is an area with potential for restoration projects, but there is a need to develop a watershed restoration plan. This segment is from I-25 to the Arkansas River.

303(d) listed segment: COARLA07 (Se)

Gunnison River Basin

Uncompahgre River: NPSMA contribution: currently, there is a 319 restoration project that is starting to address some of the Selenium loading into the Gunnison River. Selenium loading in surface waters is of concern in some areas of the state and the solution will require coordinated efforts and a statewide strategy. These segments include the Uncompahgre Valley below Montrose.

303(d) listed segments: COGUUN04b, COGUUN04c (Se)

Upper Gunnison River: NPSMA contribution: there is a watershed restoration plan being developed for this area, with a potential to prioritize restoration projects. The following segment will be incorporated as priority in the watershed plan. This could potentially result in incremental money supporting restoration work. This segment is the Palmetto Gulch.

303(d) listed segment: COGUUG31 (Cd, Zn)

Rio Grande

Kerber Creek: NPSMA contribution: there is watershed restoration plan for this watershed, but it needs updating. High potential to identify and implement appropriate reclamation activities. These segments include Kerber Creek and almost all tributaries.

303(d) listed segments: CORGCB09a (Ag, Cd, Pb, pH), CORGCB09b (Cd, Cu, Zn)

San Juan River

Dolores River: NPSMA contribution: this is an area with potential for restoration projects, but there is a need to develop a watershed restoration plan. This segment is in Silver Creek below the town of Rico.

303(d) listed segment: COSJDO09 (Zn)

Mancos River: NPSMA contribution: there is a watershed restoration plan being developed for this area, with a potential to prioritize restoration projects. The following segment will be incorporated as priority in the watershed plan. This could potentially result in incremental money supporting implementation and restoration work. This segment includes the Mancos River and tributaries above Hwy 160.

303(d) listed segment: COSJLP04 (Cu)

South Platte River

Boulder Creek: NPSMA contribution: this is an area with potential for restoration projects, but there is a need to develop a watershed restoration plan. These segments are Coal Creek Gamble Gulch.

303(d) listed segments: COSPBO07b (E. coli), COSPBO04a ((Cu, Zn, pH)

Clear Creek: NPSMA contribution: the watershed restoration plan has been developed. High potential to support restoration work.

303(d) listed segments: COSPCL02, COSPCL03a, COSPCL03b, COSPCL06, COSPCL09a, COSPCL09b, COSPCL11 (metals)

Saint Vrain River: NPSMA contribution: past work with a local entity, need to develop a watershed restoration plan. This could potentially result in incremental money supporting restoration work. This segment is the Left Hand Creek.

303(d) listed segment: COSPSV04a (metals and pH)

Upper South Platte: NPSMA contribution: this is an area with potential for restoration projects; existing watershed restoration plan.

303(d) listed segments: COSPUS02a (sediment)

Upper Colorado River

Peru Creek: NPSMA contribution: this is an area with potential for restoration projects, but there is a need to develop a watershed restoration plan. This segment is the Peru Creek to the Snake River.

303(d) listed segment: COUCBL07 (metals)

Eagle River: NPSMA contribution: this is an area with potential for restoration projects, but there is a need to develop a watershed restoration plan. This segment is from Belden to Lake Creek and some tributaries.

303(d) listed segment: COUCEA06 (sediment)

Reclamation of Water Quality Impairments at High Priority Abandoned Hardrock Mine Sites in Colorado

Workplan

Prepared by:
Colorado Division of Reclamation Mining and Safety (DRMS)
for:
Colorado Department of Public, Health and the Environment,
Water Quality Control Division (WQCD)

Background

This list of priority AML sites proposed for characterization and remediation designs are currently included in WQCC Regulation #93 (CCR 1002-93) Colorado's Section 303(d) List of Impaired Waters and Monitoring and Evaluation List. This fulfills requirements of Section 303(d) of the federal Clean Water Act which requires that states submit to the U.S. Environmental Protection Agency a list of those waters for which technology-based effluent limitations and other required controls are not stringent enough to attain water quality standards. Dissolved metals and acidity (pH) from legacy mining (AML-Abandoned Mine Lands) and background sources comprise 89% of the total number of impaired stream segments in Colorado (Fig. 1). These impairments are considered nonpoint sources (NPS) because they are related to run-off and drainage from AML sites for which there is no remaining financially viable "responsible party".

All of the sites included in this proposed project scope of work (SOW) are located in stream segments that are impaired because of excessive heavy metals related to legacy mining. The sites identified in this SOW can be considered a high priority for reclamation because of being the primary pollutant source; a Total Maximum Daily Load (TMDL) analysis has been completed and approved; the severity of the problem that they represent; or the potential for de-listing a segment if the mining nonpoint source impact is mitigated through reclamation work.
Some of the mine sites on the list and their related segments have already been evaluated and monitored by watershed groups, state, or federal agencies. In these cases, there are water quality data to locate the source of the WQ impairment and target the AML source. At other stream segments, there are water quality sampling data to indicate that water quality standards are not attained, but the loading sources have not been clearly identified or adequately characterized to determine the best reclamation alternative.

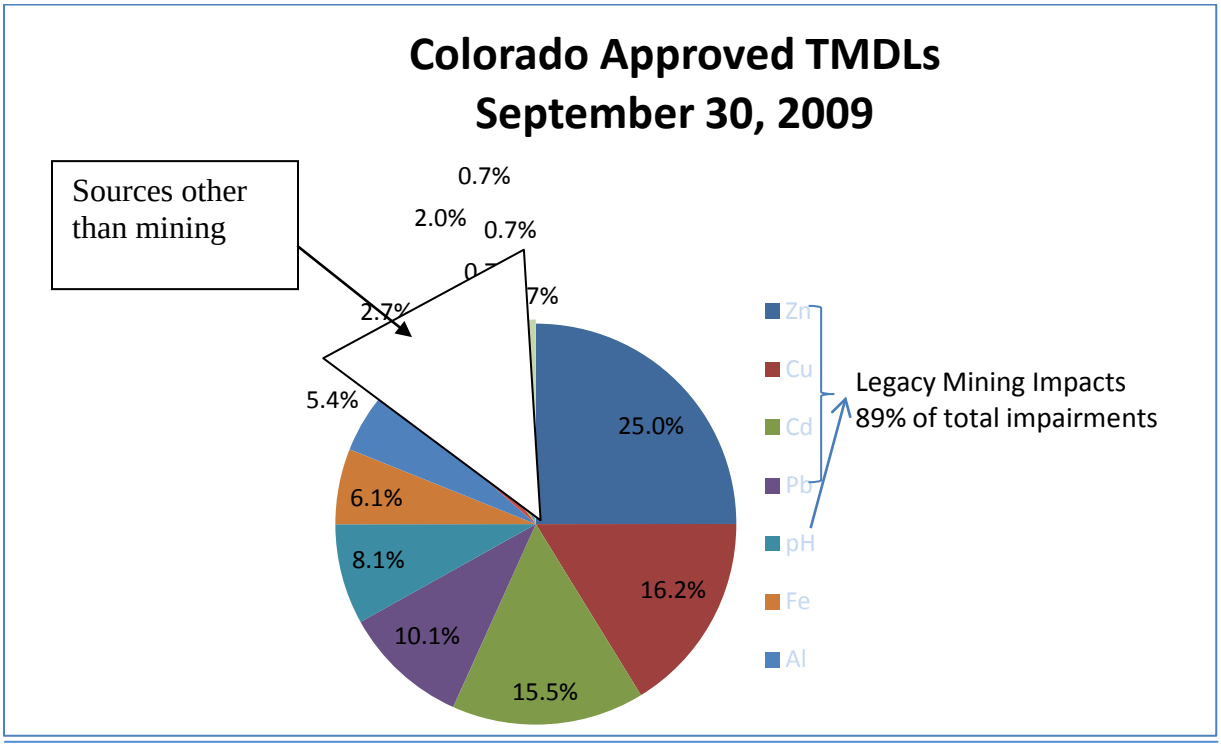
Objective

This SOW is designed to bring priority AML mine sites to the point where they are "shovel ready" for the construction of the best management practices to eliminate or reduce the present water quality problems. This proposal also identifies potential funding costs for project implementation or construction. As mentioned, a portion of the impaired segments still require additional water quality monitoring in order to characterize the source of pollutants, identify the BMPs and prioritize the sites for funding. Other segments have been adequately characterized and priority metals loading sources have been identified for future action. In this case, funding for engineering and project design will move these sites to "ready for construction" status.

The objective of this agreement is to fund the 2 initial steps of the overall work plan: a) stream characterization and water quality monitoring and/or b) engineering and design. Because the first phase of this work (Site characterization) is exploratory in nature, DRMS and CDPHE will work together on adjusting the budget as needed. Most of the costs are estimated initially, and as more information becomes available, some of the scopes of work will have to be revised. No work will be conducted prior to CDPHE NPS program approval of budget modifications. Total budget modification will not exceed 20% of the total funds available.

Project timeline

The proposed performance period is for two years. Milestones for completion of site project objectives are specific to the project's baseline data set on the continuum of characterization and design, as mentioned above. In general, any additional data collection and site characterization will take place during the first year, with engineering and design work completed by the end of the second year. For some sites, characterization is complete and engineering and design can proceed in the first year. **(Fig. 1 from WQCD)**



HIGH PRIORITY ABANDONED HARDROCK MINE SITES
Workplan by Watershed

I - South Platte Watershed
1) London Mine - Segment COSPUS02C

The historic London Mine is located in the headwaters of South Mosquito Creek and encompasses approximately 40 acres. The stream is on the 303(d) list as impaired for not meeting the applicable standards for Zinc, Iron, Manganese and Cadmium. The classified use that is not protected is aquatic life. The mine is located on private land. Several reclamation projects have been conducted at the site over the past 15 years. The site is currently not actively permitted with DRMS and there is no existing reclamation responsibility for the site.

Environmental Problem

The site contains three significant sources of pollutants that negatively impact South Mosquito Creek and the wetlands associated with the creek:

1. Butte Mine waste and tailings - 25,000 Cubic Yards
2. Historic London Tailings - 20,000 Cubic Yards
3. Constructed Tailings Impoundment - 30,000 Cubic Yards

The tailings piles are immediately adjacent to South Mosquito Creek and have impacted the underlying wetlands. The stream is perennial and the tailings continually leach acidic metal-laden water into it. In the spring, the creek significantly erodes the tailings piles and contributes metal-laden sediment to the creek. The tailings impoundment was constructed in the 1980's and is beginning to breach in several areas. There are several significant acidic seeps near the toe of the impoundment.

Past Characterization of Water Quality Problem

Numerous watershed groups and government agencies have collected water quality data for South Mosquito Creek over the past decade. The problems are clearly identified and well documented. However, it is necessary to gather additional site-specific data on a small tributary, No Name Creek, to isolate and identify any ancillary sources of metals loading contamination and to sample the numerous springs and seeps originating from the tailings piles.

Engineering and Design Activities

The preferred reclamation alternative to reduce metals migration at the site is to consolidate the tailings piles from all three locations in an engineered upland repository. Test holes would be drilled into the tailings piles to determine their depth and physical characteristics in order to ascertain the approximate volumes of material and properly design the repository. Field and geologic surveying and reconnaissance will be required to identify the appropriate location for the repository and the need for a bottom liner.

In addition, it will be necessary to analyze the composition of the tailings to determine if any amendments will be required to neutralize the acid generating potential prior to depositing the tailings in the repository.

Following removal of the tailings to the repository, the original disturbed areas will be covered with stockpiled topsoil and revegetated with appropriate plant species. The riparian areas along

the creek will be re-established with native vegetation and the stream channel morphology will be restored.

Post Reclamation Water Quality
The historic tailings piles are the most significant remaining source of pollutants in South Mosquito Creek. The removal of the tailings piles from near the creek should reduce the metal loads by at least 60% over a period of five years. Additional improvements should be realized in the next ten years as the vegetation is established in the reclaimed areas along the creek.

Task Cost Estimates

Stream Characterization/Water Quality Monitoring	$10,000
Engineering and Design	$100,000
Construction	$1,100,000
Post Reclamation Water Quality Monitoring and Maintenance	$20,000
Total project Cost	**$1,230,000**

2) Waldorf Mine - Segment COSPCL03b
The Waldorf Mine is located in the headwaters of Leavenworth Gulch, a tributary to Clear Creek. The segment is listed as impaired for not meeting the applicable Lead and Zinc standards. The classified use that is not protected is aquatic life.

Environmental Problem
The Waldorf Mine site contains a draining adit and a series of waste piles that encompass over 2 acres. The adit continually drains and intermittently discharges large surges of contaminated water that erode the mine waste pile and transport the materials into the wetlands below the mine. The site is owned by private landowners and the United States Forest Service.

Characterization of Water Quality Problem
Numerous watershed groups and government agencies have collected water quality data for Clear Creek and its tributaries over the past decade. It is necessary to gather additional site-specific data on the chemical and physical properties of the waste piles and seasonal flow measurements of the drainage from the adit.

Engineering and Design
The proposed reclamation alternative for site includes creating a concrete lined stilling basin at the portal mouth to contain surge flows and installing rock-lined channels to permanently divert clean water flow around the waste piles. This phase of work does not include any remediation of the wetlands or waste rock removal.

Post Reclamation Water Quality
The erosion and subsequent deposition of the waste rock piles into the natural wetlands is a detriment to water quality in Leavenworth Gulch. The control of the flow path of the adit will eliminate further impacts to the wetlands and promote future recovery. This work will also

compliment additional project work at numerous other abandoned mine sites within the Clear Creek watershed.

Task Cost Estimates

Stream Characterization/Water Quality Monitoring	$5,000
Engineering and Design	$5,000
Construction	$50,000
Post Reclamation Operation and Maintenance/ Water Quality Monitoring	$5,000
Total project Cost	**$65,000**

II - Upper Colorado River Basin

3) Saint Johns Mine - Segment COUCBLO6

The historic Saint Johns Mine and Mill are located at the headwaters of Saint Johns Creek, a tributary to the Snake River. The mine was one of the first producing silver mines in Colorado. The segment is listed as impaired for not meeting the applicable Zinc, Copper, Lead and Cadmium standards. The classified use that is not protected is aquatic life.

Environmental Problem

The site contains multiple mine waste piles and mill tailings that continually erode into the creek during spring runoff and leach metals into the creek. It is estimated that the site contains about 65,000 cubic yards of waste rock and 15,000 cubic yards of mill tailings. There is also a draining adit on site that is discharging water onto the waste piles.

Characterization of Water Quality Problem

Numerous watershed groups and government agencies have collected water quality data for the Snake River and its tributaries over the past decade. However, it is necessary to gather some additional site-specific data on the chemistry of the various waste piles in the Saint Johns area as well as the draining adit.

Engineering and Design

The preferred reclamation alternative for the site is to consolidate the tailings/waste rock piles from all of the individual sites in an engineered upland repository. Test holes would be drilled into the piles to determine the depth and physical properties in order to ascertain the approximate volume of material. Field and geologic reconnaissance will be required to identify the appropriate location for the upland repository site and the need for a bottom liner. In addition, it will be necessary to analyze the composition of the tailings to determine if any amendments will be required prior to depositing the tailings at the consolidation site to neutralize the acid generating potential. The adit drainage will be diverted away from contact mine waste and mill tailing piles.

Following removal of the tailings from the stream channel, the original disturbed areas will be covered with stockpiled topsoil and revegetated with appropriate plant species. The riparian areas along the creek will be re-established with native vegetation and the stream channel morphology will be restored.

Post Reclamation Water Quality

The waste rock and tailing piles associated with the Saint Johns Mine are the most significant remaining source of pollutants. The removal of the tailings from the creek should significantly reduce the Zinc and Cadmium loads. This work will compliment additional project work at numerous other abandoned mine sites within the Snake River watershed.

Task Cost Estimates

Stream Characterization/Water Quality Monitoring	$5,000
Engineering and Design	$25,000
Construction	$300,000
Post Reclamation Operation and Maintenance/ Water Quality Monitoring	$5,000
Total project Cost	**$335,000**

III - Rio Grande River Basin

4) Kerber Creek Above Brewery Creek - Segment CORGCBO9a

Characterization of Water Quality Problems

This segment, located in the vicinity of the historic Rawley Mine complex, is listed as impaired for Zinc and Cadmium. The mining sites are located on private and public lands. Initial characterization studies of the mining related problems and water quality sampling in some of the tributaries in this segment have been conducted. However, there are remaining tributaries with numerous waste piles that need to be characterized. In particular, Squirrel Creek and Rawley Creek contain many waste piles to be sampled and analyzed. Sampling should include high and low flow stream data as well as waste rock and mine tailings analysis. These data will be used to identify the appropriate best management practices and prioritize the sites for funding.

Task Cost Estimates

Stream Characterization/Water Quality Monitoring	$50,000

IV - Arkansas River Basin

5) Venture Mine Complex - Segment COARUAO2b

The Venture Mine is located in the Little Frying Pan drainage, a tributary to Colorado Gulch and the Lake Fork of the Arkansas. This segment is listed as impaired for not meeting the applicable Zinc and Cadmium standards. The classified use that is not protected is aquatic life. The waste piles are located on private and public lands. Numerous water quality improvement projects have been conducted in the watershed over the past decade. These include consolidation of the Dinero, Nelson and Tiger waste piles, and the installation of the Dinero Tunnel bulkhead. Remediation of the Venture Mine complex would complement the previous water quality projects.

Environmental Problem

The site contains numerous significant sources of metals. There are at least five discrete waste piles associated with the site with a total of 20,000 cubic yards of mine tailings and waste rock piles. The tailings piles are immediately adjacent to creek and continually leach acidic metal-

laden water. In the spring, the creek significantly erodes the waste rock piles, also contributing metal-laden sediment to the watershed.

Characterization of Water Quality Problem

Numerous watershed groups and government agencies have collected water quality data for the watershed over the past decade. The problems are clearly identified and well documented and no additional characterization is necessary.

Engineering and Design

The preferred reclamation alternative for the remediation of the site is to consolidate the waste rock piles from all three sites in an engineered upland repository. Test holes would be drilled into the tailings to determine their depth and physical properties in order to ascertain the appropriate volume of material and properly design the repository. Field and geologic reconnaissance will be required to identify the appropriate location for the repository and the need for a bottom liner. In addition, it will be necessary to analyze the composition of the tailings to determine if any amendments will be required to neutralize the acid generating potential prior to depositing the tailings in the repository.

Following removal of the tailings to the repository, the original areas will be covered with stockpiled topsoil and revegetated with appropriate plant species. The riparian areas along the creek will be re-established with native vegetation and the stream channel will be restored.

Post Reclamation Water Quality

The Venture Mine waste piles are some of the most significant remaining sources of pollutants in the Little Frying Pan drainage. The removal of the waste piles from the creek should significantly reduce the Zinc and Cadmium loads over the next five years and will complement the other work that has been completed in the watershed. Additional improvements should be realized in the next ten years as the vegetation is established in the reclaimed areas along the creek.

Task Cost Estimates

Stream Characterization/Water Quality Monitoring	$0
Engineering and Design	$55,000
Construction	$500,000
Post Reclamation Operation and Maintenance/ Water Quality Monitoring	$5,000
Total project Cost	**$560,000**

6) Champion Mine and Mill - Segment COARUAO5

The Champion Mine and Mill are located at the headwaters of Halfmoon Creek, a tributary to the Lake Fork of the Upper Arkansas. This segment is listed as impaired for not meeting the applicable standards for Zinc and Cadmium. The classified use that is not protected is aquatic life. The area is part of a pristine high altitude ecosystem near Mount Massive. Initial reconnaissance indicates that the Champion site is the only mine within the drainage. However, there has been limited investigation of the drainage.

Environmental Problem
The mine site contains an adit that drains directly into Half Moon Creek. The mill site is located about 1 mile downstream from the mine and contains a fairly significant waste pile that is located near the creek. The waste pile is eroded during high flow in the spring and continually leaches metals into the creek.

Characterization of Water Quality Problems
Very limited water quality data exist for this segment. Sampling will include high and low flow stream data as well as mine waste analysis of the Champion mill area. While it appears that the Champion is the only mine in the area, additional reconnaissance of the entire segment will be conducted to identify other possible sources of metals. The acidic drainage from the adit will be sampled. These data will be used to identify the appropriate best management practice to employ at the site.

Post Reclamation Water Quality
The Champion mine and mill waste/tailings piles appear to be the most significant source of pollutants in Half Moon Creek. Removing the tailings from the creek should significantly reduce the metal lodes to the creek and the Lake Fork of the Arkansas.

Task Cost Estimates

Stream Characterization/Water Quality Monitoring	$25,000
Engineering and Design	$55,000
Construction (TBD)	
Total Proposed Cost	**$80,000**

IV - Gunnison River Basin

7) Daisy Mine - Redwell Basin - Segment COGUUG10

The Daisy Mine lies in Redwell Basin and impacts a tributary to the Slate River. The Slate River is listed as impaired for not meeting the applicable Cadmium, Copper, Lead and Zinc standards. The classified use that is not protected is aquatic life. The Daisy Mine complex is located in private lands.

Environmental Problem
The Redwell basin area contains natural and mining-related sources of metals pollutants. The project goal is to isolate and quantify the sources of contaminants. The site contains a draining mine adit, multiple waste rock piles with seeps, and an artesian drill hole with poor water quality.

Characterization of Water Quality Problems
Sampling was conducted at 17 sites along Redwell Creek in 2010 and additional data on the basin was collected in previous years. Additional high and low flow sampling of the area is necessary to determine the pollutant loading sources.

Task Cost Estimates

Stream Characterization/Water Quality Monitoring	$24,605

SUMMARY PROJECT BUDGET ESTIMATE

PROJECT	CATEGORY		
Watershed/River Basin – Project	**Characterization (Estimated Costs)**	**Engineering (Estimated Costs)**	**Future Reclamation (Estimated Costs)**
I - South Platte Watershed			
1) London Mine - Segment COSPUS02C	$10,000	$100,000	$1,100,000
2) Waldorf Mine - Segment COSPCL03b	$5,000	$5,000	$50,000
II - Upper Colorado River Basin			
3) Saint Johns Mine - Segment COUCBLO6	$5,000	$25,000	$300,000
III - Rio Grande River Basin			
4) Kerber Creek above Brewery Creek - Segment CORGCBO9a	$50,000	TBD*	TBD*
IV - Arkansas River Basin			
5) Venture Mine Complex - Segment COARUAO2b		$55,000	$500,000
6) Champion Mine and Mill - Segment COARUAO5	$25,000	$55,000	TBD*
V - Gunnison River Basin			
7) Daisy Mine - Redwell Basin - Segment COGUUG10	$24,605	TBD*	TBD*
	$119,605	$240,000	**$1,950,000***

* TBD=Cost To Be Determined

NPS Program Implementation Matrices

The NPS program has identified specific objectives and tasks that are linked to the Watershed Program' and the WQCD's goals and are used as guidelines toward achieving and maintaining beneficial uses of water. The program has also identified tactics and indicators that will be used to implement and assess the program's success in achieving its goals and objectives. The following tables capture the tasks, tactics and indicators of success that define how each program objective will be address. Desirable outputs are also defined.

Objective 1 - To protect water quality from potential impact from nonpoint source pollution generated by anthropogenic activities.

Table 1 – Tasks and Tactics to Implement Water Quality Protection

Tasks	Tactics	Indicators of Success	Outputs	Timeframe
1 - Provide financial and technical support to watershed groups to develop / update watershed-based plans.	Continue to implement strategy to encourage partners to develop / update watershed-based plans.	All relevant stakeholders are involved; watershed is characterized and water quality issues are identified and prioritized; potential implementation projects and funding are identified.	Watershed Plans that are not older than 10 years (and preferably 5 years).	Ongoing effort.
2 - Provide technical assistance, education and training at the local level.	Education and training opportunities on water quality protection and watershed project planning; project effectiveness monitoring. This is achieved primarily via the PIP and SAPP development process.	Proposals and projects that more clearly align with the strategic goals of the WQCD and NPS program; projects are implemented correctly.	Increased technical knowledge; EPA grant requirements are met; measurable results are gathered.	Ongoing effort.
3 – Fund and implement projects that protect water quality, aquatic life and habitat integrity.	Continue to implement strategy to engage partners to address protection of water quality, aquatic life and habitat integrity.	Water quality, aquatic life and habitat integrity are maintained or improved in project area.	BMPs implemented correctly and as designed.	Every year as approved via the project solicitation process.

Objective 2 - To restore water quality in streams, rivers, lakes, reservoirs and groundwater that are impaired due to nonpoint source pollution generated by anthropogenic activities.

Table 2 – Tasks and Tactics to Implement Water Quality Restoration

Tasks	Tactics	Indicators of Success	Outputs	Timeframe
1 – Prioritize restoration activities to meet NPS program priorities and WQCD strategy to address impaired waters.	Identify pollution loading sources; utilize TMDLs when available; utilize watershed models and assessment tools to characterize watershed; identify and engage potential local partners.	Readily available information on where investment of limited resources will likely achieve water quality improvements; information accessible to potential local partners.	Prioritized list of impaired waters, restoration sites and potential local partners; data sets and data assessment reports.	Draft Priority List in 2 years; revisited every year as a living document.
2 - Provide financial and technical support to watershed groups to develop / update watershed-based plans.	Develop and launch strategy to encourage partners to develop / update WS-based plans that include EPA Nine Elements for a Watershed Plan to fully address impaired waters.	Every implementation project addressing impaired segments is identified in a complete and recently updated watershed plan.	Watershed Plans that address, at a minimum, all EPA Nine Elements for a Watershed Plan and that are not older than 10 years.	Ongoing effort.
3 – Fund and implement projects that address impaired waters, and improve aquatic life and habitat.	Develop and launch strategy to engage partners to address prioritized list of impaired waters.	Meet targets agreed upon with EPA in the Performance Partnership Agreement.	Majority of incremental funds is applied to projects in priority watersheds; successfully implemented restoration projects, including targeted outreach and education tasks.	Every year as approved via the project solicitation process.
4 - Encourage land and resource management agencies, NGOs and Tribes to identify and mitigate nonpoint source pollution impacts in the context of their program plans.	Strengthen working relationships with alliance, agencies, NGOs and tribes to encourage collaborative decision making and watershed-scale implementation of Best Management Practices. Emphasis placed on projects within priority impaired watersheds and to implement priority projects identified in a locally-driven Watershed Plans.	New strategies identified and implemented resulting in maintenance of water quality or reduced pollutant loadings.	Participation in planning efforts of federal and state agencies (e.g., planning, federal action reviews); leveraging of funding opportunities with other funding sources.	Ongoing effort.
5 - Implement BMPs that restore water quality and aquatic life and habitat.	Proactively fund projects to maintain beneficial uses.	Pollutant load reduction; trends that indicate water quality and aquatic life and habitat improvement.	BMPs implemented correctly and as designed.	Ongoing effort.

Objective 3 - Implement the Colorado NPS program to achieve measurable water quality improvement.

Table 3 – Tasks and Tactics to Evaluate Environmental Results				
Tasks	**Tactics**	**Indicators of Success**	**Outputs**	**Timeframe**
1 - Establish monitoring tools to evaluate environmental measures and indicators of success.	Continue to develop and implement Measurable Result Project to assist project sponsors in SAPP development, provide for pre- and post- project monitoring outside the timeline of the contract with the sponsor as necessary.	Field verified BMP placement for the appropriate pollution source; sampling effort identified and implemented; long-term sustainable monitoring strategy.	Toolbox of standardized monitoring methods and assessment techniques, SAPPs developed using NPS program template, completed end of project monitoring reports; accurate reporting of load reductions.	Complete in the 1st year.
2 - Develop or support a watershed assessment tool that identifies or helps identify water quality trends (DSN or e-RAMS).	Develop and gather shapefiles, develop and/or support a data repository (DSN can be an option), identify, support and /or develop a GIS, web-based site; generate assessment and analyses; prepare watershed-based reports.	Data are identified and readily available for use; the assessment tool is functional; the NPS program posts electronic analyses at the npscolorado site.	A user-friendly Website-based, GIS-based watershed assessment tool that is accessible and open to all users.	Ongoing phased effort; significant cumulative deliverables per year; for the 1st year, deliverable will be the long-term tool development plan.
3 – Update BMPs library and create field BMPs template.	Develop a BMP implementation template; complete a review of categorical BMPs and update following the programmatic priorities and using project data; make library available on the npscolorado site.	Field BMP template is easily available and is used by project sponsors; BMP library is systematically updated.	Field BMP template; updated BMP library.	Ongoing phased effort; significant cumulative deliverables per year; for the 1st year, deliverable will be the BMP priority outline and the template.
4 – Ensure that project data are uploaded to DSN / STORET	Develop procedures to upload project data; support and advise data tracking and uploading to DSN / STORET.	Data are uploaded and used in the watershed assessment tool; interested public accesses and uses the data.	Data are uploaded in DSN / STORET	Ongoing effort; procedure will be done at the end of the 1st year; data are uploaded to STORET at the end of each project.

Objective 4 – Implement the Colorado NPS program to meet EPA guidelines.

Table 4 – Tasks and Tactics to Implement the Colorado NPS program				
Tasks	**Tactics**	**Indicators of Success**	**Outputs**	**Timeframe**
1 - Ensure that funds are awarded and spent appropriately within EPA and State guidelines.	Develop and maintain spreadsheets to keep track of project and grant expenditures and match accrual; develop and maintain an internal process to submit complete invoices to the Fiscal Unit.	Federal grants closed out on 5-year cycle; project implementation plans are developed and approved no later than 1 year following annual CWA section 319 grant is awarded; reimbursement requests from projects are approved and submitted for processing within 10 days of receipt from the project sponsor.	No funds are left un-spent; grants are over-matched;	Ongoing effort; grants are closed on the end dates; every year one grant closes and one grant opens.
2 - Ensure the Grant Reporting and Tracking System (GRTS) is up-to-date for all NPS projects.	a - Pre-award information is entered; b - fully contracted project information is entered; c - semi-annual reports are loaded into GRTS by NPS project; d - load reduction information is entered.	EPA Dashboard has no identified errors in end-of-year evaluation.	GRTS is complete and up-to-date by all EPA required due dates.	Ongoing effort; every December GRTS is complete and with no errors; a – 3 months after grant award; b and c – in December of every year; d – in February of every year.
3 – Utilize GRTS enhanced functions to develop analytical and reporting documents.	Attend annual GRTS training; ensure quality and completeness of data entered in GRTS; request assistance from Headquarters to develop Colorado-specific reports as needed; generate analyses and reports.	Reports are utilized in Annual Reports to EPA; also in updates to the IR and in updates to WQCD, unit workplans and Management Plan; other status reports as appropriate.	Status and Analytical Reports as appropriate.	Ongoing effort; reports included in Annual Report every year by January.
4 - Provide educational and information materials to interested entities and project partners on a variety of water quality issues.	a - Maintain website with educational materials; b – Maintain information dissemination efforts; maintain distribution list; conduct annual workshop.	Citizens and/or project partners have easy access to educational materials of water quality issues.	a - Updated website; b - Updated educational materials and information; annual workshop trainings.	a – 1 to 2 years (depending on funding availability) b – Ongoing effort.

Table 4 – Tasks and Tactics to Implement the Colorado NPS program				
Tasks	**Tactics**	**Indicators of Success**	**Outputs**	**Timeframe**
5 - Communicate Nonpoint Source program successes and lessons learned.	Document "success stories" or "lessons learned"; project sponsors provide information and graphics in their final reports for these stories; project sponsors provide project summaries: "Fact Sheets"; project and TMDL effectiveness documented and communicated to the public.	Success stories increase public awareness of these programs; final PIPs and associated BMPs reflect past successes and lessons learned. Potential delisting of segments.	Success stories per PPA measure WQ10 published at the epa.gov site. Project Fact Sheets.	Ongoing effort and at PPA due dates.
6 - Address NPS legislative mandate regarding the Integrated Report.	Include NPS data needs and considerations in basin-wide synoptic sampling and WQCD monitoring plans; include NPS data and assessments in the Integrated Report.	NPS data are available for Sate-wide Water Quality Assessments and TMDL development.	Legislative mandate addressing NPS Assessments is met.	Every year during Environmental Data Unit data calls.
7 – Implement program efficiently and consistently.	Develop and formalize the NPS program Procedures Manual; revise and update program documents and process.	Training tool for new employees; consistent and efficient implementation of the program.	Documents are revised and updated according to program priorities.	Ongoing phased effort; significant cumulative deliverables per year; for the 1st year, deliverable will be the procedures priority list and outline.
8 - Broaden the impact of the Colorado NPS program goals and objectives.	Leverage partner's resources to address quality concerns at the local level; increase communication with Alliance partners to capture broad participation via the Annual Report.	Greater accrual of match applied to NPS; water quality restoration/protection projects that are funded outside of NPS funds; reduced nonpoint source pollution Statewide.	Track Federal contribution to NPS projects; increased matching funds from partners above the 40% required; update information in Annual Report regarding projects funded by partners and not necessarily with 319 funds.	Ongoing effort.

Table 4 – Tasks and Tactics to Implement the Colorado NPS program				
Tasks	**Tactics**	**Indicators of Success**	**Outputs**	**Timeframe**
9 - Implement appropriate strategy regarding stormwater-related projects.	The NPS program will continue to consider eligible: a) stormwater-related projects that do not require a permit and b) watershed-based plans that might include stormwater permitted areas (for example urban areas under an MS4 permit).	Incorporation of a LID/GI strategy as described in the SWQMP and as developed by the NPS program and the Alliance members.	Additional NPS funding and project solicitation guidance; specific activities in urbanized/developed areas that qualify for NPS funding are described in a document that is posted electronically at npscolorado site.	Ongoing effort; draft strategy will be delivered in the 1st year.
10 - Continued Participation on CDPHE Multi-media Pollutants Task Forces.	Attend Department meetings and participate in discussions regarding development of strategies to address multi- media pollutants.	Consistent participation and contribution in the meetings and discussions.	Meeting agenda, minutes and reports capturing development of multi-media strategy.	Ongoing effort.
11 – Meet EPA program reporting	Develop and update the Annual Report template to reflect updated tasks; write and submit the annual report according to EPA 319 Program Guidelines.	Annual Reports submitted to EPA on due date and available electronically on the npscolorado site.	Updated Annual Reports reflecting all tasks and information.	Every year in January.

Colorado NPS Best Management Practices Library

Colorado BMP Library Overview

The Colorado BMP library exists to provide project sponsors and other interested parties with information on best management practices that address nonpoint sources of pollution. See chapter 3, section 3.2 for an explanation of the elements of the BMP library. Under each NPS category, several BMPs are identified that are used in Colorado regularly and have site specific data regarding purpose, appropriate stream type and monitoring information. Colorado NPS will develop and refine this library with site specific data as they are generated through research, the NPS Measurable Results project and other sources during the timeframe of the 2012 NPS Management Plan. The Abandoned Mine Drainage category below provides an example of the framework for the library. An example of the products within the BMP library follows the Table of Contents. Following the BMP Library template, Table E-1 CO NPS Approved BMPs details approved BMPs for Colorado.

NPS program BMP Library Table of Contents

NPS Category 1 - Abandoned Mine Drainage

Erosion and Sediment Control Practices

- Planning
- Erosion Control
- Sediment Control
- Topsoil Preservation and Reuse
- Soil Amendments
- Mulch
- Maintenance
- Disposition of Temporary measures

Hydrologic Controls

- Diversion ditches
- Mine waste removal and consolidation
- Stream diversion
- Bulkhead seals
- Grouted bulkhead dams or “flume” collectors
- Grout-sealing a fracture inflow zone
- Revegetation

Passive Treatment

- Anoxic limestone drains
- Aeration and settling ponds
- Sulfate reducing wetlands
- Oxidation wetlands
- Aqueous lime injection
- Limestone water jets
- Mechanical injection of neutralizing agents

NPS Category 2: Agriculture

NPS Category 3: Forestry / Silviculture

NPS Category 4: Hydrologic Modification and Habitat Alteration

NPS Category 5: Urban Areas

NPS Category 6: Roads, Highways, and Bridges

NPS Category 7: Marinas and Boating

BMP Name: Cross Vane Weir Diversion (example draft template)

NPS Category: Hydrologic Modification
Sub Category: Stream Restoration

Purpose: The Cross-Vane is a grade control structure that decreases near-bank shear stress, velocity and stream power, but increases the energy in the center of the channel. The structure will establish grade control, reduce bank erosion, create a stable width/depth ratio, maintain channel capacity, while maintaining sediment transport capacity, and sediment competence. The Cross-Vane also provides for the proper natural conditions of secondary circulation patterns commensurate with channel pattern, but with high velocity gradients and boundary stress shifted from the near-bank region.
Appropriate Stream Type: C, D channels
Pollutants Addressed: Sediment, Habitat Alteration
Load Reduction Potential: LOW (out of low, medium or high)
Estimated time for Reduction: IMMEDIATE (out of immediate, months-2 years, greater than 2 years)
Expected Maintenance: MEDIUM (out of Low, Medium or High)
Monitoring Strategy: Comparison of pre and post project: lateral recession rate (ft/yr), thalweg survey, bank profile, pebble counts, total suspended solids (turbidity), macroinvertebrate survey, and embeddedness survey.

Table E-1 -- CO BMPs that are Eligible for Funding under the NPS program

(for more information and references on the eligible BMPs, consult Section 3.2)

Agriculture and Silviculture BMPs			
BMP	**Description**	**Use**	**Purpose**
Riparian Area Management	Vegetation and/or structures in-stream, on banks, and on immediately adjacent areas of streams or constructed channels	Riparian areas to stabilize and protect against stream bank erosion	1. Reduce sediment loads which cause downstream or in-stream damage 2. Improve or restore a stream for recreation or to enhance fish and wildlife habitat 3. Prevent the loss of land or damage to utilities, roads, buildings, or other facilities adjacent to the channel banks 4. Minimize impacts of human activities within riparian, sensitive and wet areas
Irrigation Water Management	Determining and controlling the rate, amount, and timing of irrigation water application to achieve the most effective irrigation possible based on environmental conditions	All irrigated lands	1. Manage and control the moisture environment of crops to promote the desired crop response 2. Minimize soil erosion and loss of plant nutrients and agro-chemicals 3. Control undesirable water loss either through runoff or leaching 4. Reduce degradation of water resource due to salinity
Soil Stabilization in Croplands	Utilizing existing plant residues, temporary or permanent vegetative cover and/or structures to reduce erosion and minimize sediment transport	All agricultural lands with the potential for wind and water erosion	1. Prevent sediment and soil-borne pollutants from entering surface water 2. Improve soil health 3. Improve water use effectiveness 4. Improve wildlife habitat 5. Break reproduction cycles of plant pests
Nutrient Management	Application of nutrients based on crop needs, and accounting for all sources of nutrients (commercial fertilizer, manure or sludge, irrigation water, atmospheric sources, composted products, etc.)	All lands where nutrients are applied	1. Minimize availability of nutrients for transport by eliminating over-application 2. Reduce nutrient loading to surface and ground water
Integrated Pest Management	Evaluate all options to determine the appropriate treatment to deal with target pests. Utilize integrated pest management strategies. Select the appropriate chemical, using the minimum effective rate, timing the application for the targeted pest, considering proximity environmentally sensitive conditions including surface water	All lands impacted by pests	1. Reduce reliance upon chemicals by integrating all pest management options, considering biological, cultural, and mechanical means as appropriate 2. Minimize pesticide loss to surface and ground water by eliminating over-application

Forest Management	Managing multiple uses on forestlands in a manner that will maintain or improve forest health	Any managed public or private forestland to reduce erosion and minimize sediment transport due to the activity of man	1. Maintain sufficient vegetation to reduce erosion and sedimentation 2. Maintain litter and mulch necessary to reduce erosion and sedimentation 3. Maintain natural beauty and visual quality 4. Maintain and protect existing uses 5. Minimize hazard of dangerous wildfires 6. Maintain or improve habitat conditions for fish and wildlife 7. Minimize soil loss, and maintain or improve soil quality 8. Minimize or eliminate degradation of water quality 9. Establish stream buffers sufficient to protect water quality. 10. Rehabilitate areas where an unacceptable level of erosion and/or stream/lake sedimentation is already occurring 11. Restore and maintain fisheries that have been damaged or destroyed by sedimentation 12. Maintain or improve the quality and integrity of sensitive areas such as, but not limited to, research, natural, scenic, and unstable geologic areas.
Animal Waste Management	Handling animal waste in a manner that minimizes impacts or potential impacts to surface or ground water, including issues such as collection, storage, transport, and land application	small to medium size confined animal feeding operations not categorized as a point source	1. Prevent ground and surface water contamination 2. Properly apply animal waste to cropland

Mining BMPs

BMP	Description	Use	Purpose
Diversion ditches	Ditch diverting water away from mine waste or mine workings.	waste rock piles mill tailings draining mine openings	Effective where the quality of rainwater, snowmelt or surface flow is degraded by flowing over or through mine waste, tailings or into mine workings. Diversion ditches can also be used to intercept shallow groundwater that may enter a mine waste or tailings pile.

Mine waste rock/tailings removal and consolidation	Move the reactive material in the waste rock dump or tailings pile away from water sources	waste rock located in direct contact with flowing water or pond mill tailings located in direct contact with flowing water or pond	Reduces the potential for water flow through the dump or pile will decrease the formation of contaminants, thereby reducing contamination to nearby water sources.
Stream diversion	Stream diversion involves relocating a stream away from a waste rock dump or tailings pile.	waste rock pile in direct contact with flowing stream with no place to remove and consolidate pile; mill tailings in direct contact with flowing stream with no place to remove and consolidate pile	Stream diversion involves relocating a stream away from a waste rock dump or tailings pile. Reducing the potential for water flow through the reactive materials in the dump or tailings pile will decrease the input of contaminants into the stream
Erosion control by re-grading	Preparing disturbed area for revegetation by grading to appropriate slope.	waste rock piles mill tailings	Generally, slopes with less than three feet horizontal to one foot vertical are stable from erosion and conducive to vegetation growth.
Capping	Capping of waste rock or tailings is a protective layer of soil, graded to promote runoff rather than infiltration into the reactive materials.	waste rock piles mill tailings	Prevent disturbance of the contaminated waste rock or tailings.
Vegetation	Vegetation planted on a waste rock or tailings pile	waste rock piles mill tailings	Helps to contain the reactive material by protecting the pile from erosion and reducing the amount of water that can infiltrate into the pile. In addition, vegetation growth provides nutrients to the soil cover and improves the wildlife habitat.
Aeration and settling ponds	Aeration is accomplished by channeling the mine drainage over a series of small waterfalls or drops, which will increase the oxygen content of the water into a quiet settling pond, where the metals will drop out	treating drainage from a mine opening	Aeration and settling ponds promote the precipitation of heavy metals such as iron, zinc and manganese through oxidation processes

Sulfate-reducing wetlands	The sulfides combine with heavy metals in the drainage to form relatively insoluble metal sulfides, which precipitate or drop out. The bacteria derive their energy from a carbon source, most commonly cow manure or mushroom compost.	treatment of drainage from waste rock piles; from mill tailings; from a mine opening	Sulfate-reducing wetlands will improve the quality of acid mine drainage using common bacteria found in decomposing organics to remove the heavy metals. Sulfate-reducing bacteria (SRBs) utilize the oxygen in sulfates for respiration, producing sulfides
Oxidation wetlands	Metals, such as iron, manganese, and arsenic are precipitated through oxidation by aquatic plants and algae.	treatment of drainage from waste rock piles; from mill tailings; from a mine opening	The plant materials provide aeration and, when they die, provide adsorption surfaces for the metals and sites for algal growth. Algae help in the manganese removal process.
BMPs TO TREAT ACID MINE DRAINAGE **Note: some of these BMPs are not eligible for NPS grant funding**	diversion of surface waters, dilution, land application, bulkhead seals, anoxic limestone drains, aqueous limestone injection and mechanical injection of neutralizing agents	treatment of contaminated drainage from mine openings	these BMPs must be designed and engineered to take into account the volume of water, water chemistry, and mine configuration, are expensive and require ongoing maintenance
Barriers	Barriers include fences of several types and grates made of steel bars. Chain link and iron fences	when the opening is too large for other alternatives and when construction access is restricted	Keeping casual visitors a safe distance from hazardous openings.
Plugs	Plugs include backfills, monolithic plugs, and plugs utilizing polyurethane foam (PUF)	Block access	designed to eliminate the hazard completely
Structural seals	Precast concrete panels and poured in place concrete slabs installed over vertical or near-vertical mine openings.	Block all access	Seals are designed to prevent access to all visitors
Stream Restoration BMPs			
BMP	**Description**	**Use**	**Purpose**
Plant vegetation	Plant vegetation where appropriate; however, there may be exceptions, such as ephemeral	Any stream with unstable banks or potentially	To prevent impairment of streams from construction activities and storm water runoff; stabilize banks,

Stream Restoration BMPs			
BMP	**Description**	**Use**	**Purpose**
	streams, high gradient boulder or bedrock dominated channels where vegetation may not have existed historically.	degraded due to construction or development pressure	improve aquatic habitat. Others include energy dissipation, protect banks, maintain water table and stream/riparian processes.
Reconfigure channel	Change stream morphology; add flow-steering structures and /or root wads and sinuosity.	Any channelized or degraded stream channel	Dissipate stream energy and power associated with high streamflows, minimizing erosion; filter sediment, capture bedload,, aid in floodplain development and increase sinuosity where appropriate.
Filter runoff	Plant vegetation, protect riparian buffer	Any stream with high sedimentation or pollutant runoff	Decrease sediment concentration
Improve habitat	Add root wads, boulders, trees to improve cover, vegetate banks	Any stream needing increased habitat	Decrease stream temperature
Decrease stream temperature	Decrease channel width/depth ratio; add vegetation canopy; add boulders, root wads or snags for cover and energy dissipation.	Any stream too warm to support native species	Improve fish habitat
Slow the stream	Add drop structures and/or increase sinuosity	Any stream with high sediment concentration where excessive aggradation is apparent.	Decrease sediment concentration
Weed treatments	Mechanical, chemical or biological agents to eradicate weeds. Plant native vegetation	Any stream chocked with phreatophytes and other water using weeds.	Improve species composition and water quality/quantity by removing weeds.
Urban and Construction BMPs			
BMP	**Description**	**Use**	**Purpose**

Mountain Driveways	BMPs appropriate for driveways compiled in a concise manner with engineering sketches	Construction that causes sediment and erosion products that reach streams and other waterbodies	Driveways in mountainous areas
High Altitude	Vegetation may not mature until the third growing season, requiring additional time	Where construction of roads, mines, pipelines, and ski areas have left earth bare	Revegetation and restoring land high in the Rocky Mountains
Green Industry	Design, installation and maintenance practices relevant to the Green Industry and the public that they serve	Any new or renovating landscaped area	Conservation of water resources and protection of water quality
Golf Courses	28 key BMPs for use during design, construction, and operation of golf courses	Golf courses in Colorado	Standard erosion and sediment control practices, key regulatory considerations, and lists of additional references
Low Impact Development	A series of best management practices that address reduction of impervious surfaces	To show decision-makers impacts of land use choices on water quality	Provide land use decision makers with research-based, non-advocacy information so they can make informed land use decisions

EPA 9 Elements of a Watershed Plan

Using Nonpoint Source Funds to Develop a Watershed Plan

This information is excerpted from the" 2004 Nonpoint Source Program and Grants Guidelines for States and Territories"; Page 60653-60674 of the Federal Register, October 23, 2003.

Watershed-Based Plans

These guidelines promote the use of Section 319 funding for developing and implementing watershed-based plans to protect unimpaired waters and restore impaired waters.

Watershed-based plans to restore impaired waters are required, as described in the guidance, for all projects implemented with incremental dollars. However, even for watershed projects implemented with base funds, EPA recommends that whenever feasible, watershed-based plans be developed and implemented for all watershed projects, whether they are designed to protect unimpaired waters, restore impaired waters, or both.

For projects funded with incremental dollars, where a NPS TMDL for the affected waters has already been developed and approved or is being developed, the watershed-based plan must be designed to achieve the load reductions called for in the NPS TMDL.

However, where a NPS TMDL has not yet been developed and approved or is not yet being developed for the waters, the State may use Section 319 funds to develop a watershed-based plan in the absence of the TMDL. In such cases, the plan must be designed to reduce nonpoint source pollutant loadings that are contributing to water quality threats and impairments. Where feasible, the plan should be designed to meet water quality standards. In this way, progress towards achieving water quality standards continues even before a TMDL is established.

Once the TMDL is completed and approved, the plan must be modified as appropriate to be consistent with the load allocation portion contained within the TMDL. Alternatively, through the course of implementing the plan, the State may find that water quality standards are met, obviating the need to establish the TMDL. EPA believes that improving the integration of TMDLs and watershed plans to implement nonpoint source management measures will provide the most effective means for accelerating achievement of water quality standards.

To ensure that Section 319 projects make good progress towards remediating waters impaired by nonpoint source pollution, a watershed-based plan must have been completed before a State implements a watershed-based plan funded with incremental Section 319 dollars. These watershed-based plans must include the information set forth in items (a) - (i) below. This information will help provide assurance that the nonpoint source load allocations identified in the NPS TMDL (and/or anticipated in NPDES permits for the watershed) will be achieved. Furthermore, this information is critical in any case for ensuring the development of realistic plans to achieve protection goals or water quality standards, while at the same time providing a significant degree of flexibility to work with stakeholders in the watershed to use a range of innovative approaches to implement the plan. To the extent that necessary information already exists in other documents (e.g., various State and local watershed planning documents, or watershed plans developed to help implement conservation programs administered by USDA), the information may be incorporated by reference. In addition, we encourage States to incorporate by reference any voluminous material that already exists in other documents. Thus, the State need not duplicate any existing process or document that already provides needed information.

Components of a Watershed-Based Plan

Beginning in FY 2004, the following information must be included in watershed-based plans to restore waters impaired by nonpoint source pollution using incremental Section 319 funds. These requirements are not retroactive to watershed plans developed in accordance with the FY 2002 or FY 2003 Section 319 guidelines; those plans may continue to be developed and implemented with funds available in FY 2004 and future years in accordance with the previously applicable requirements of the Section 319 guidelines.

1. An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan), as discussed in item (b) immediately below. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., X number of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded streambank needing remediation).

2. An estimate of the load reductions expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (a) above (e.g., the total load reduction expected for dairy cattle feedlots; row crops; or eroded streambanks).

3. A description of the NPS management measures that will need to be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

4. An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan. As sources of funding, States should consider the use of their Section 319 programs, State Revolving Funds, USDA's Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.

5. An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.NPS management measures identified in this plan that is reasonably expeditious.

6. A schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious.

7. A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

8. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a NPS TMDL has been established, whether the NPS TMDL needs to be revised.

9. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

EPA recognizes the difficulty of developing the information described above with precision and, as this guidance reflects, believes that there must be a balanced approach to address this concern. On one hand, it is absolutely critical that States make, at the pollutant subcategory level, a reasonable effort to identify the significant sources; identify the management measures that will most effectively address those sources; and broadly estimate the expected load reductions that will result. Without such information to provide focus and direction to the project's implementation, it is much less likely that the project can efficiently and effectively address the nonpoint sources of water quality impairments.

On the other hand, EPA recognizes that even with reasonable steps to obtain and analyze relevant data, the available information at the planning stage (within reasonable time and cost constraints) may be limited; preliminary information and estimates may need to be modified over time, accompanied by mid-course corrections in the watershed plan; and it often will require a number of years of effective implementation for a project to achieve its goals. EPA fully intends that the watershed planning process described above should be implemented in a dynamic and iterative manner to assure that projects with plans that contain the information above may proceed even though some of the information in the watershed plan is imperfect and may need to be modified over time as information improves.

Scale and Scope of Watershed-Based Plans

The watershed-based plan must address a large enough geographic area so that its implementation will address all of the sources and causes of impairments and threats to the waterbody in question. These plans should include mixed ownership watersheds when appropriate to solve the water quality problems (e.g., Federal, State, and private lands). While there is no rigorous definition or delineation for this concept, the general intent is to avoid single segments or other narrowly defined areas that do not provide an opportunity for addressing a watershed's stressors in a rational and economic manner. At the same time, the scale should not be so large as to minimize the probability of successful implementation. Once a watershed plan that contains the information identified above has been established, a State may choose to implement it in prioritized portions (e.g., based on particular segments, other geographic subdivisions, nonpoint source categories in the watershed, or specific pollutants or impairments), consistent with the schedule established pursuant to item (f) above.

EPA recognizes that States already have in place or have been developing watershed plans and strategies of varying levels of scale, scope, and specificity that may contribute significantly to the process of developing and implementing watershed-based plans. We encourage States to use these plans and strategies, where appropriate, as building blocks for developing and implementing the watershed-based plans. In doing so, to the extent that other documents contain the information identified above, this information may be incorporated by reference into States' watershed-based plans. (Where these plans and strategies have been developed at a large geographic scale, they will in many cases need to be refined at a smaller watershed scale to provide the information needed to produce effective watershed-based plans.) In particular, we recommend that States use their continuing planning processes, water quality management plans (WQMPs), Watershed Restoration Action Strategies (WRASs), comprehensive conservation and management plans (CCMPs), and other similar holistic watershed documents, to help guide their watershed-based approaches to watershed-based plan development and implementation.

EPA encourages States to develop NPS TMDLs or, where applicable, sets of NPS TMDLs on a watershed basis. We encourage States to implement watershed-based plans holistically, as this approach usually provides the most technically sound and economically efficient means of addressing water quality problems. Consistent with this approach, EPA encourages States to include in their watershed-based plans approaches that will address all of the sources and causes of impairments and threats to the watersheds in question. Thus, the watershed-based plans should address not only the sources of water quality

impairment, but also any pollutants and sources of pollution that need to be addressed to assure the long-term health of the watershed, including both surface and ground water that serve as sources of drinking water. Finally, since watersheds with completed TMDLs have the best documentation of the load reductions needed to achieve water quality standards, EPA recommends that States assign the highest priority to implementing watershed-based plans for waters that have completed TMDLs.

We further recommend that States give their highest funding priority to projects that are supported by additional funding from other Federal, State, and local agencies (particularly USDA-supported programs), SRF, or private sector funding. Additionally, States should consult their SRF Program's Integrated Planning and Priority Setting System, if such system is in use, to address the highest priority water quality improvement projects (see www.epa.gov/owm/finan.html). Given the significant expense of many watershed projects, such an approach will help expedite successful implementation of needed practices and thus speed the restoration of water quality. It will also help assure that watersheds are addressed in a holistic manner that accounts for the broad variety of stressors in the watersheds.

Colorado NPS Stream Restoration and Stabilization Guidance

I. Introduction

Properly functioning stream and riparian areas are critical in maintaining water quality, water quantity, riparian habitat, fish populations and diversity, downstream beneficial uses, social and economic viability of Colorado. Although great strides have been made in improving water quality through various environmental programs and outreach, Colorado's streams and rivers are still being impacted from current and past land use. Project sponsors are encouraged to review the Colorado NPS Manual for guidance on conducting restoration/stabilization activities. Since the term "restoration" often implies restoring aquatic and ecosystem processes to a pre-European state, rehabilitation will also be used to describe improvements to stream and aquatic habitat. Streams are not listed on the 303(d) list as impaired due to stream instability or excessive erosion, however, projects to restore streams can be a preventative measure to prevent future 303(d) listings.

II. Environmental setting

Land management activities or land disturbance, either alone or in combination, affect the timing, magnitude and duration of streamflow, as well as sediment delivery processes from contributing watersheds. These changes in streamflow and sediment routing from those activities (alone or in combination) alter stream stability and cause erosion of some streams, and aggradations of sediment in others. Changes in stream stability can trigger changes in aquatic habitat including quality of streambed substrate, embeddedness, temperature and ultimately, aquatic macroinvertebrate communities. Stream chemistry is typically affected by urbanization, mining, atmospheric deposition, and agricultural runoff. Wetlands and riparian areas are critical in ameliorating impacts from upland nonpoint source pollution, and may decrease the need for costly stormwater controls and flood protection structures. Other benefits of streams, wetlands and riparian areas include habitat for nesting, feeding, cover and breeding of birds, fish, reptiles, amphibians, and mammals. Stream restoration activities are necessary to improve water quality, stream function, and overall aquatic habitat improvement.

III. Definition

For the purposes of the NPS program, stream restoration/stabilization can be defined as the measurable improvement of stream and riparian ecosystem processes. Following restoration and stabilization activities, streams must be able to convey the sediment and flow produced by the upstream watershed without excessive aggradations or degradation of bed and banks to attain the designated uses. Activities that improve fish habitat or stream temperature, sediment and stream stability may not be an issue.

IV. Colorado's approach to the improvement of stream and riparian systems

Colorado's Nonpoint Source program is designed to address impacts to streams and riparian systems from a multitude of activities, such as mining, urban growth, stormwater, return flows, hydrologic modification, agriculture and silviculture. The NPS program advocates adaptive management in improving aquatic and riparian habitat to prevent impairment, as well as preserving the beneficial uses of water.

A. Watershed approach

The stream restoration activities must be put into the context of the upstream contributing watershed. A risk assessment should be conducted downstream of the restoration activity. The watershed (sometimes referred to as a catchment or drainage) is defined as the area of land that drains water, sediment, and dissolved materials to a common point along a stream. The common point will be the area along a stream being restored. Knowing the past, current and potential development in a watershed will greatly improve chances for success in restoring streams and avoid "band-aid" approaches to stream restoration/stabilization. It's also imperative to implement a watershed approach for calculating flow and sediment discharge, impervious areas, diversions, identification of soils and geologic types, localized climate, etc. Watersheds can be delineated on aerial photos, USGS 7 ½ minute quadrangle maps, or other topographic maps.

V. Identification of impacted areas and stream rehabilitation priorities

Stream restoration is part of an overall watershed plan to improve habitat and water quality. A watershed plan will assist watershed groups and other local entities in prioritizing restoration needs, with the most critical needs addressed first. To ensure success at the least cost, careful planning and consultation with professionals with the appropriate expertise is necessary. The steps below provide assistance in attaining the objectives of the restoration.

1) *Identify the problems* (nature of impairment) and cause(s) and (disturbances) in the watershed and cease (or modify) those activities causing the stream degradation, if possible. Often times, eliminating or modifying the degrading activity will allow the stream to recover over time on its own. If rehabilitation actions are deemed necessary, begin gathering information about the watershed. In some watersheds, there will be extensive information about vegetation, water quality, stream morphology, geology, precipitation, streamflow, land use, etc. to draw from. In cases where little information is available, stakeholders will have to spend additional time reviewing maps, aerial photography, and collecting data.
2) Develop restoration goals and objectives. They should be realistic and cost effective and be based on reference condition.
3) Consider alternative treatments appropriate to the watershed/landscape.
4) *Assess the stream* of interest with an interdisciplinary group with knowledge of water, riparian corridor, wildlife, botany and fish resources. The watershed group and other stakeholders should walk the entire stream reach (both above and below the problem area) to assess the problem areas. It is also critical to assess and identify healthy stream and riparian areas for potential reference reaches. Using the *Proper Functioning Condition* survey technique or other acceptable technique would be useful in this step (refer to *Planning and Implementation Tools* section).
5) *Quantify* the magnitude of the problem and prioritize these problems; for example, the number of feet of eroding banks, the amount and composition of riparian plants, presence or absence of aquatic life, and the quality of in-stream habitat features such as pools.
6) Develop a restoration/*rehabilitation plan*. The plan should contain a range of alternatives and develop cost estimates for each alternative. An option common to all alternatives is to cease the degrading activities, if possible, that may have caused the problem initially. Alternatives may involve just planting native vegetation in a riparian area, or in some cases, the most extreme measure of installing in-stream structures to achieve the appropriate objectives. Alternatives should also evaluate management practices in the

contributing watershed that need to be addressed to enable a stream restoration project to be successful.

7) *Riparian Area improvements*. Consider actions that improve the amount, distribution and composition of native plant species. In some cases, willow plugs may suffice to control erosion. In other situations, bioengineering techniques may be necessary. Stream bank rehabilitation may involve the "pull-back" of stream banks to attain a favorable angle of repose for planting or installing bioengineered mats (refer to Gray and Sotir, 1996).

8) *In-stream structures and bank protection*. These measures are inherently expensive and require an in-depth analysis of the physical and hydrologic processes occurring along the stream reach of interest, as well as reference reaches (consult information below and references). The need for in-stream structures must be considered in the watershed context. Often times correcting instability in one location with a fixed structure will result in creating an area of instability either upstream or downstream of the project location. This just moves the problem and is not the correct solution.
If in-stream structures are deemed necessary, they must be properly designed and installed to be self maintaining over a wide range of flows. Reputable contractors that have expertise in fluvial geomorphology and stream channel restoration are necessary for implementing successful plans. References are listed to help project sponsors and others better understand fluvial and watershed processes and the breadth of data collection needed. Any earth moving in or along a stream will require permits.

9) *Identify monitoring* and long-term maintenance needs. Annually evaluate whether you are meeting your restoration objectives (CRA, 2001). This often overlooked step is critical in determining the effectiveness of the project. Practice adaptive management for those objectives not being met. The attached references can help determine the appropriate monitoring objectives and techniques. The amount and type of monitoring conducted will vary depending on the scope of restoration/rehabilitation activities. Physical (morphology and vegetation) and biological (macroinvertebrate sampling) will be necessary to determine reference or expected conditions, as well as the relative success of the project.

10) Identify potential partnership opportunities for the sharing of information and resources (cash and in kind support).

11) Identify necessary federal, state and/or local permits. For example, a Section 404 permit from the US Army Corps of Engineers may be required for activities within waters of the United States.

VI. Reference sites and the concept of expected condition

The stream morphology data collected at the reference site are applied to the impacted site to achieve desired restoration goals and stream conditions. The reference stream reaches that define the "*Expected Condition*"[1] need not be located in pristine areas, because these streams may not available, nor have similar stream morphology, geology, climate, range of streamflow, soils, precipitation, or land use history. The Aquatic Life Workgroup and WQCD developed the concept of *Expected Condition* when comparing a potential impaired stream reach to another stream of interest. *Expected Condition* is defined as: the condition of a water body resulting from the best biological, physical and chemical conditions attainable (considering past, present and future beneficial uses) given reasonable and appropriate land, soil and water quality management practices and avoiding material injury to water rights. "Where feasible, the

expected condition for a water body, or group of water bodies, will be determined based on the best conditions that can be attained by an aggregate of similar water bodies within a regionally partitioned framework (i.e. ecoregions, elevation, and stream size)." *Expected Condition* is determined on a site specific basis and is based upon several acceptable reference sites (if available), to properly design stream restoration projects for the impacted stream of interest. The reference reaches chosen may be minimally impacted (non-urban areas), but must represent the stable form of the impacted channel within a similar valley type, stream type and physiographic characteristics.

In urban settings, most streams have been highly altered over time by check dams, diversions, canals, "hardening" of streams with rip-rap and concrete, and straightening of stream channels. Locating a stream to represent an *expected condition* for an urban stream may prove to be problematic. In urban settings, professional engineers or water resources professionals may have to focus on locating streams (expected condition) with similar streamflow, particle size distribution, bankfull width and depth, and gradient characteristics. Input from the Urban/Construction Committee will also be useful in determining proper streams for the *expected condition*.

A. Reference Site Selection

Reference site locations include sites directly upstream from the nonpoint source problem, and sites in comparable watersheds. The selection of sites may be made from areas that have the least anthropogenic influences, and represent the best attainable conditions that can be achieved by similar stream types within the watershed, or adjacent watersheds. Moreover, reference sites must be representative of the stream and habitat types of interest. Examples are offered below:

* Physical characteristics typical of the region (e.g., ecoregion (Hughes et al 1986) climate, topography, geology, and soils).
* Similar stream morphology typical of the region (e.g., Rosgen (1996) channel type, pools, riffles, runs, backwaters, and glides). For urban settings, the best attainable expected condition may be significantly altered from pre-development times.
* Representative diversity of substrate materials (fines, gravel, cobbles, boulders, woody debris) appropriate to the region.
* Similar streamflow characteristics - in some cases, the flow patterns display large seasonal differences in response to rainfall and snowmelt; in other cases, diversions, irrigation return flows, and stream alterations (in urban settings) will have to be analyzed.
* Banks representative of undisturbed streams in the region (generally covered by riparian vegetation with little evidence of bank erosion, or undercut banks stabilized by root wads.) Banks should provide cover for aquatic biota.
* Natural color and odor - in some area, clear, cold water is typical of the water body types in the region; in others, such as the Colorado River, the water may be more turbid.
* Natural riparian vegetation representative of the region.

Ideal <u>considerations</u> for good reference sites are:

- No upstream impoundments or significant diversions.
- No known point source discharges or contaminants in place.
- No known spills, pollution incidents, or hazardous waste sites.
- Low human population density, agricultural activities, and low road densities.
- Minimal nonpoint source problems.

Impaired sites displaying channel instability occur in a variety of ecosystems, from effluent dominated streams and streams receiving stormwater runoff in urban areas to high elevation streams in forested areas. The processes that determine the dimension, pattern and profile can be very different for varying geology, soils, precipitation, as well as, urban, agricultural and forested watersheds. The project proponents must also understand the streams stage of degradation or aggradation.

VII. Stream channel hydraulics and processes

To properly implement stream restoration projects, understanding channel adjustments requires an understanding of changes in streamflow and sediment delivery processes, as well as an understanding of watershed processes and land use. Streams are constantly adjusting to the water and sediment produced by the upstream watershed. It is important to understand the range of flows produced by the upstream watershed, as well as the role of bankfull discharge in moving sediment and shaping stream channels.

The bankfull stage corresponds to the discharge at which channel maintenance is most effective; moreover, the discharge at which moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing work that results in the morphologic characteristics of channels (Dunne and Leopold, 1978). The bankfull stage is the most effective or is the dominant channel forming flow over time, and has a recurrence interval of approximately 1.5 years. Bankfull flows occur every other year and may occur several times within a water year. Rosgen suggests the importance of bankfull morphologic features and identifying stream types in applying the correct restoration technique.

Regional curves and hydraulic geometry relations are useful (as a "1st cut") to gain some understanding of how bankfull channel dimensions change in the downstream direction for a particular watershed, and the potential design criteria for a stream restoration project. The curves relate independent variables, such as discharge or drainage area, to dependent variables such as width, depth, slope, and velocity.

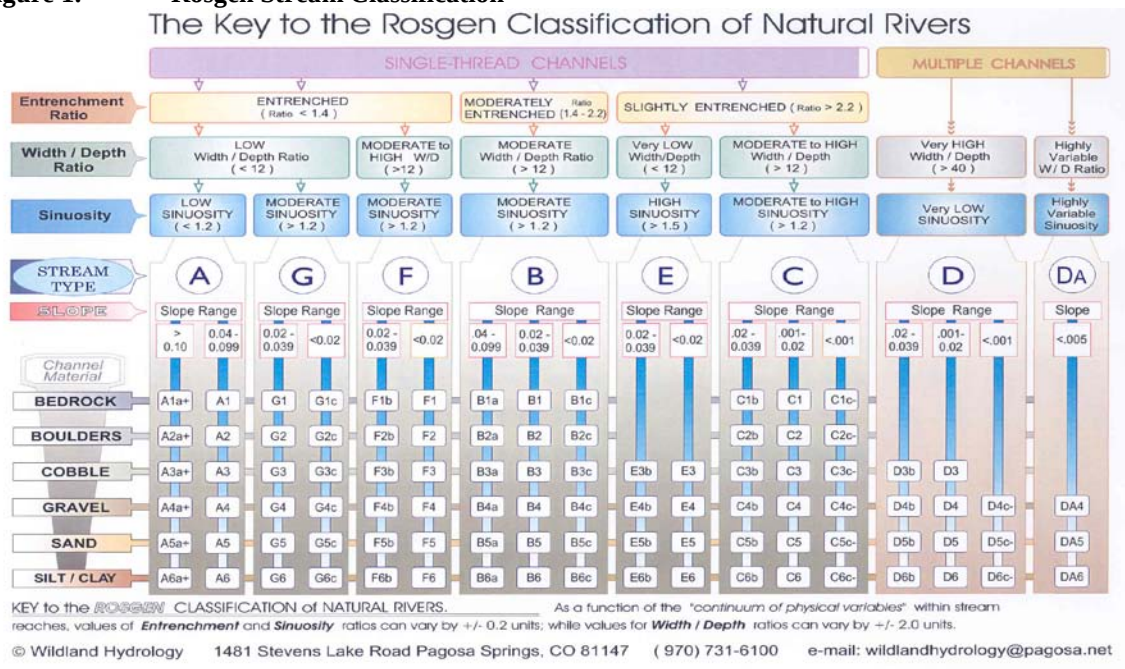
Regional curves for a particular area in Colorado can be developed by visiting current and past USGS gauging stations and gathering bankfull dimensions, as well as analyzing discharge data collected by the USGS. Regional curves should only be used as indicators to help identify the channel geometry at a restoration site, because of the large degree of natural variability in sites. For additional information on developing regional curves, review the procedure described by Rosgen, 1996. It can't be understated that field collection of channel morphology data for several cross sections at both the reference and design reaches is absolutely necessary.

A. Stream Classification

Stream classification can be useful in better understanding complex relationships between flow, sediment and stream morphology. Although following a stream classification is not necessary to design a restoration project, it does provide a step-wise process for collecting geomorphic field data that is important prior to implementing a stream restoration project. The Rosgen stream classification is arguably the most widely recognized and used classification nationwide. Refer to Applied River Morphology for more in-depth information on his classification.

The Rosgen methodology uses six morphological measurements for classifying a stream reach – entrenchment (level of incision), width/depth ratio, sinuosity, single and multi-thread channels, slope and bed material particle size. These criteria are used to define eight major stream classes (Figure 1).

Figure 1. Rosgen Stream Classification



- Rosgen uses the bankfull discharge to represent the channel forming flow and proper field identification of the bankfull stage is critical in using his classification. Moreover, all the morphological relationships are based upon the bankfull discharge; width/depth ratio is determined at the bankfull stage of the stream.

VIII. Riparian Vegetation

Riparian areas are lands directly influenced by the presence of flowing water – creeks, streams, rivers, ponds, lakes, and other bodies of surface or sub surface water (Naiman, 1992). Riparian areas are typically only a small portion of the overall watershed acres, but the diversity of vegetation and ecological processes therein are important for aquatic and wildlife species. Riparian vegetation provides the following benefits to stream channels:

- Dissipate stream energy and power associated with high streamflows, thereby minimizing erosion and maintaining existing water quality.
- Filter sediment, capture bedload (material transported downstream by rolling or bouncing along the stream bottom), and aid in floodplain development.
- Improve flood-water retention and ground water recharge.
- Provide shade that maintains or reduces temperature regime and marked fluctuations.
- Reduces nutrient loads to streams.
- Stabilize stream banks with vegetation.
- Reduce erosion by uncontrolled runoff (i.e. return flows).
- Protect fish habitat.
- Maintains ground water and surface water interactions, which are important to aquatic macroinvertebrates.

Vegetation is a fundamental controlling factor in stream corridor function, and restoration designs should protect existing native vegetation and restore native vegetation structure whenever possible. This may be challenging in deeply incised streams and/or in urban stream corridors, but every opportunity should be explored to improve vegetative cover along streams. Examination of reference reaches is a good way to determine the plant community composition and distribution needed at the disturbed site. It appears that the current trend in establishing vegetation is to plant a variety of species for improved habitat conditions. Numerous species have been used in stream restoration, including willows, alder, serviceberry, oceanspray, vine maple, cottonwood, poplar, and others. However, historical accounts of the area, as well as information from the reference reach, may dictate that only one species is planted rather than a mosaic of species.

Some streams flow through areas that receive very little precipitation, and the geology is such that little to no riparian vegetation is likely to be present. Intermittent and ephemeral streams have little to no riparian vegetation due to short periods of flow. Restoration objectives for these streams will be very different than perennial streams. Intermittent (or seasonal) streams flow at certain times during a year when they receive water from springs or snowmelt. Intermittent streams may flow longer than 30 days (+/-) as groundwater continues to recharge the channel, whereas ephemeral streams are likely to flow for very short periods (depending on the physiographic region) in direct response to convective thunderstorms, snowmelt runoff or overland flow. The amount and composition of vegetation in these streams depends on the period of flow, as well as the connectedness of the stream to the riparian area and water table. Ephemeral streams are generally above the water table. Given the importance of riparian vegetation, bioengineering must be considered in any stream bank restoration project. Even in urban settings where rip-rap has been used routinely for bank protection, willow (or other species) plugs can be installed between the rocks (Gray and Sotir, 1996).

IX. Best Management Practices/Planning

Best Management Practices (BMPs) can be defined as methods, measures or practices selected by an agency, watershed group, company or responsible party that meets Colorado's Nonpoint Source program. BMPs can describe a wide range of management procedures, scheduling of activities, operating procedures, treatment requirements and practices to control site runoff and sediment.

Nonstructural BMPs, such as preventative maintenance or preserving native vegetation, are components operational or managerial techniques. There are also structural BMPs such as diversion structures, silt fences and retention ponds to be considered. Such activities should be applied before, during and after activities to reduce or eliminate sedimentation. Since restoration/rehabilitation activities are considered construction activities, a review of the *Urban/Construction* BMPs found in this manual are suggested. Although the use of BMPs is voluntary, they are necessary to maintain or improve water quality over the long term. The following references and guides provide the specific information necessary for identifying the appropriate components to this best management practice. Many of these references are available on the Internet.

Planning and Implementation Tools

- Stream Corridor Restoration: Principles, Processes and Practices (The Federal Interagency Stream Restoration Working Group, 1998). See http://www.nrcs.usda.gov/technical/stream_restoration for the publication.
- National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Source Pollution (June 2001) EPA 841-B-01-001 (www.epa.gov/owowtr1/NPS/wetmeasures/wetmeasures.pdf)
- Applied River Morphology (Rosgen, 1996).
- Reconfigured Channel Monitoring and Assessment Program for additional information at http://co.water.usgs.gov/projects/rcmap/rcmap.html
- Colorado Riparian Association, 2001. Colorado Stream Corridor Guide. Information about the guide can be found at http://www.coloradoriparian.org
- An Introduction and User's Guide to Wetland Restoration, Creation and Enhancement. Interagency Workgroup on Wetland Restoration (www.epa.gov/owow/wetlands/restore/finalinfo.html)
- Principles for the Ecological Restoration of Aquatic Resources (USEPA, 2000) EPA 841-F-00-003 www.epa.gov/owow/wetlands/restore
- US Forest Service, Natural Resources Conservation Services and US Bureau of Land Management, 1998. A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas.
- USDA Forest Service Watershed Conservation Practices Handbook (FSH 2509.25) and other technical references www.fs.fed.us/im/directives/dughtml/fieldfsh2000.html
- Colorado Association of Stormwater and Floodplain Managers, Habitat Habitat Assessment Field Data Sheet, 2pp.

X. Who to Contact for Assistance in Planning and Implementation

The best source of assistance for planning and implementing any best management practice will be in the locality where the BMPs are used. Local offices of the various natural resource management agencies, whether local, state, or federal, can develop site-specific recommendations or designs that account for the local climate, soils, hydrology, etc., as well as any social or cultural considerations. In addition, topic-related professional organizations may also have the resources to provide assistance. There are also environmental resources consulting firms that provide stream restoration services.

XI. Examples of BMPs and other project design features

- Conduct activities during dry periods to minimize runoff and sediment delivery downstream. State and/or Federal permit(s) should have guidance on periods of operation.
- Comply with all requirements in permits. Projects may require a Phase II stormwater permit, and/or Corps of Engineer's 404 permits, respectively.
- Use silt fences and/or mulch to maintain sediment on site during construction activities.
- Complete the work in a reasonable time frame, or as designated in the permits.
- Minimize the amount of ground disturbance at the site.
- New access roads and drainage must be built to acceptable State and Federal engineering standards and reclaimed once work is completed.
- Comply with all applicable State and Federal Statutes.

- If fish are present at the site or downstream, conduct activities during periods when fish are not spawning, or when sediment delivery would not affect egg survival.
- Avoid activities near raptor nest sites or other critical habitat.
- Determine if drinking water sources downstream may be affected and notify the appropriate people.
- Re-vegetate or otherwise stabilize disturbed sites as soon as practicable following disturbance.

XII. Monitoring and Measurable Results

The Colorado Nonpoint Source program requires measurable results for all stream-restoration activities funded by EPA 319 grant money. Measurable results are numeric, and calculations for tons of sediment saved from the stream, or percent decreases in sediment load or sediment concentration must be determined. Restoration activities, such as fish structures, riparian plantings, or gravel placement in streams (for fish) typically are not sediment related and other measurable results would be valid. In these cases, pool habitat created, feet of bank restored, or acres of riparian habitat restored are reasonable measurable results. Measurable results enable the Water Quality Control Division (WQCD) to evaluate the success of the stream restoration activities by comparing pre- and post stream restoration conditions. Coordination between the WQCD and project proponents is important in collecting the appropriate data to obtain measurable results, as well as determining the measurable results of the project. Whenever practical, monitoring should be conducted through a cooperative arrangement among the various stakeholders, state and federal agencies. In some cases, state or federal agencies may have data that could supplement data to be collected per requirements in a *project implementation plan*.

The WQCD and stakeholders need to collaborate on selecting monitoring approaches, measurement and sampling methods, and overall monitoring design, including frequency and locations of sampling and measurements to evaluate success. Quality control and data quality will also be addressed in quality assurance plans. It is recommended that project sponsors consult with the Division prior to submitting a stream restoration/rehabilitation project to improve project objectives, design, and monitoring guidelines to ensure the approach is appropriate for the specific stream reach.

Measurable results can only be determined if baseline information or data are collected before the stream-restoration/rehabilitation activity. Depending on the scope of activities, maintenance and monitoring after the project will be necessary, and should be completed at appropriate time intervals. Monitoring results should guide decisions, such as the need to make potential adjustments to the project and determine measurable results. Project maintenance, monitoring schedule and approach should be adjusted (if necessary) to account for the variability in results over time. Selection of a particular monitoring approach will depend on the following factors:

- Monitoring Objectives – determining the objective is critical.
- Site and reach characteristics
- Scope of the project
- Cost
- Time available for the study
- Resources available

Examples of monitoring approaches to determine measurable results include**:**

- Collecting water-quality samples and analyzing for sediment concentration and particle size characteristics, such as percent silt- and clay-size material (Edwards and Glysson, 1999). Other constituents of concern may be collected and analyzed at this time, if necessary.
- Measuring macroinvertebrates, stream temperature or turbidity by acceptable scientific methods may be necessary in some situations depending on identified beneficial uses.

Geomorphology measurements (Elliott and Parker, 1999; Harrelson and others, 1994) and appropriate permits will be required if there is manipulation of the bed and banks of a stream. Some monitoring tools are suggested here:

- Surveying channel cross sections and longitudinal profile surveys of the streambed and channel banks to determine channel morphology through the monitoring reach
- Comparing aerial photographs to determine previous channel position, pattern, and depositional areas. After restoration to estimate improved stability of channel (channel pattern, width, sediment bar size, headcutting distance, area of vegetation) to determine sediment saved from erosion
- Measuring from bank pins to bank edge to calculate sediment saved from or lost to channel erosion
- Measuring changes in stream-bank height on bank pins or other reference point
- Measuring vertical distance from top of bank to stream bed
- Measuring stream-bank angles - these highlighted bullets can be determined from the cross section and longitudinal surveys.
- Measuring the volume or mass of sediment removed from or deposited in an area of the stream

Stream-bottom-substrate measurements (Colorado Department of Public Health and Environment, Water Quality Control Commission, 2002):

- Measuring the extent that large particles are embedded or buried by fine sediment (MacDonald et al., 1991, p. 121)
- Measuring the percent of stream bed composed of fines <2mm (CDPHE, WQCD, not dated)
- Measuring the volume of pool occupied by fine sediment (Lisle and Hilton, 1992)
- Measuring the accumulation of fine particles in interstitial spaces of coarse-particle substrate (Carling and McCahon, 1987; Frostick et al., 1984)
- Measuring the subsurface particle-size distribution in cores (Petts, 1988; Lisle, 1989)
- Measuring the subsurface particle-size distribution through an in-situ sample of known volume (Lambert and Walling, 1998; MacDonald et al., 1991, p. 119; Platts et al., 1983, p. 17)
- Measuring the particle-size distribution in a specific area of stream bank, stream bed, or bar by measuring the intermediate axis of gravels, pebbles, cobbles, or boulders (Wolman, 1954; Bevenger and King, 1995)

Bioassessment measurements (Colorado Water Quality Forum, 1995; Plafkin et al., 1989;):

- Counting or measuring growth in vegetation planted to stabilize stream banks (percent cover, stem counting or in-depth community surveys)
- Counting the number (population) or biomass of each key aquatic species
- Counting the number of species at key locations (diversity measure)
- Calculating indices of community structure from benthic macroinvertebrate data
- Testing for the presence and quantity of trace elements or organic contaminants (Shelton and Capel, 1994)

Hydrologic measurements:

- Measuring streamflow at key locations (Carter and Davidian, 1968; Buchanan and Somers, 1969)

The measurements done to determine the success of the stream-restoration activity should be appropriate for the goal (or objective) of that stream-restoration activity. The matrix below is a guide to assist in determining the appropriate monitoring for various environmental goals.

Water Quality Component of Restoration

Water-quality goal	Stream-restoration activity	Task	Baseline information	Post-activity information	Calculation of result
Decrease sediment concentration in stream or downstream	Stabilize bank	• Plant vegetation • Add root wads • Flow-steering structures (J-Hooks, cross vanes)	• Bank geometry • Vegetated area • Channel surveys (XSect, longit)	• Bank geometry • Vegetated area • Channel surveys (XSect, longit)	Estimate mass of sediment saved out of the stream
Decrease sediment concentration in stream or downstream	Change stream morphology	Reconfigure channel	• Sediment concentration in stream • Stream depth, velocity Channel surveys	• Sediment concentration in stream • Stream depth, velocity Channel surveys	Difference in sediment concentration, depth, and velocity in stream
Decrease sediment concentration in stream or downstream	Filter runoff	Plant vegetation	Vegetated area Turbidity of stream	Vegetated area Turbidity of stream	Difference in vegetated area, turbidity
Decrease sediment concentration in stream or downstream	Slow the stream	Add drop structures and/or increase sinuosity	• Stream velocity • Sediment concentration • Channel surveys	• Stream velocity • Sediment concentration • Channel surveys	Difference in stream velocity, sediment concentration
Improve fish habitat	Decrease stream temperature	• Increase channel depth to width ratio • Add vegetation canopy • Add boulders or snags for cover	• Stream temperature • Bioassessment measurements	• Stream temperature • Bioassessment measurements	Difference in stream temperature, bioassessment measurements

Biological Component of Restoration

Water-quality goal	Stream-restoration activity	Task	Baseline information	Post-activity information	Calculation of result
Increase the abundance and diversity of aquatic macroinvertebrates	- Change stream morphology - Vegetate stream banks - Add root wads, boulders, trees to improve cover.	- Decrease width/depth ratio, increase sinuosity - Reduce fine sediment - Reduce fine sediment and increase pool habitat.	- Sediment concentration in stream, stream depth, velocity - Channel surveys Bank geometry, channel cross sections - Channel surveys, streamflow characteristics	- % of vegetated area and determination of mortality. - Channel surveys - Macroinvertebrate surveys and lab results - # of structures that moved or transported downstream	# of feet or acres treated Differences in fine sediment, vegetative cover, pool – riffle habitat, and #'s of structures in-place and functioning
Improve stream corridor vegetation composition and water availability through weed treatments	Mechanical, chemical and/or utilize biological agents to eradicate weeds. Plant native vegetation	Improve species composition and water quantity and quality by removing weeds. Tamarisk and Russian Olive are phreatophytes that use more water than native plants	Establish plots and conduct weed inventory along stream corridors	Re-visit plots to determine effectiveness of treatments	# of feet or acres treated. % reduction in weeds.

Current agencies and non-governmental organizations with associated roles and interactions with the NPS program

Organization	Nonpoint Source Program Nexus	Current role in the NPS program	Programs that are or could be leveraged to help accomplish NPS program objectives
Colorado Water Conservancy, River & Conservation Districts	Provide nitrate data to producers for their nutrient management programs. Selenium listings in the Uncompahgre, Gunnison and Lower Colorado basins.	Collect nitrate from surface and ground water in Adams, Weld and Morgan Counties. Collect data and assist in projects related to selenium.	Unknown at this time.
Colorado Association of Soil Conservation Districts	Mission of the association; also represents 78 local soil conservation districts.	Education assistance and information.	Teacher conservation workshops. Youth conservation camp. District supervisor training sessions. Grazing Land Conservation Initiative.
Colorado Water Quality Forum	Mission is to achieve solutions to Colorado water quality issues through communication and understanding, balancing use and protection of the resource.	Distribution of information.	Public participation, stakeholders' input on NPS and water quality issues.
Colorado Riparian Association	Mission is to protect and enhance the riparian resources of the state.	Participates in the NPS Alliance. Has served as chair of Hydrologic Modification technical committee. Provides project monitoring.	Information and education projects, e.g., riparian trailers, Driving Guide. Sponsor for demonstration projects.
Colorado Watershed Assembly	Mission is to support, provide leadership and advocate for individual, grassroots, and nonprofit community groups to help them protect, conserve and enhance our state watersheds.	Distribution of information; education and outreach.	RiverWatch
Colorado Foundation for	The mission is to promote better understanding of	Distribution of information; education and outreach.	

Organization	Nonpoint Source Program Nexus	Current role in the NPS program	Programs that are or could be leveraged to help accomplish NPS program objectives
Water Education	Colorado's water resources and issues by providing balanced and accurate information and education.		
Colorado Water Resources and Power Development Authority	Clean Water Act, Water Pollution Control Revolving Fund.	Financial assistance in low interest loans.	Loans to governmental agencies through the Revolving Fund and Small Water Resources Projects.
Councils of Governments/ North Front Range Water Quality Planning Association	Area-wide 208 planning agencies; correction of NPS problems, and personal interest by organization's management and members	Technical assistance; implementation and/or monitoring of NPS controls; potential project sponsors; assist member governments in project planning.	Programs related to 208 planning such as listing of problem areas and recommending solutions.
Northwest Council of Governments	Area-wide 208 water quality planning agencies; correction of NPS problems, and personal interest by organization's management and members	Technical assistance; implementation and/or monitoring of NPS controls; potential project sponsors; assist member governments in project planning.	Programs related to 208 planning such as listing of problem areas and recommending solutions.
Resource Conservation and Development Councils	Interest of member organizations; generally focused on local natural resource and economic needs within a community.	Technical assistance, current and prospective project sponsors, in some instances financial assistance; local project coordination.	Varies among the RC&Ds.
Soil Conservation Districts	Local initiatives and interest, legislative requirements.	Local project sponsors; technical assistance and possibly financial assistance.	Several SCDs are or have been project sponsors.
Several watershed groups throughout the state	Local initiatives and interest.	Local project sponsors.	
Colorado Department of Agriculture	Legislative requirement, SB90-126.	Technical assistance in SB126 responsibilities.	BMP publications and programs regarding fertilizer, pesticide and water management. Monitoring program to determine impact of agricultural chemicals on ground water throughout the state.

Organization	Nonpoint Source Program Nexus	Current role in the NPS program	Programs that are or could be leveraged to help accomplish NPS program objectives
Colorado Department of Transportation	Legislative requirements.	Technical assistance internally to construction personnel on CDOT construction roadway projects regarding erosion control and water quality issues.	Provide education assistance in teaching the "Stormwater Management During Construction" course at Red Rocks Community College. Course is required for Erosion Control Supervisor certification on construction projects that require coverage under NPDES permits.
Colorado Division of Reclamation, Mining and Safety	Mission of inactive mine program is to reclaim and restore inactive and abandoned mines, which considers water quality impacts and benefits.	Technical assistance on abandoned mine projects Solicit and encourage project sponsors.	Colorado Inactive Mine Reclamation Program.
Colorado Parks and Wildlife	Mission includes habitat management for wildlife, including aquatic species. Own, lease and manage many state wildlife properties and state parks.	Technical assistance regarding NPS program priorities of drinking water and aquatic life uses at project level with private landowners; monitoring assistance in projects through River Watch Program.	Several may provide benefits to water quality: Wetlands Initiative Legacy Project ; Habitat Partnership Program; Fishing is Fun Program; River Watch Program.
Colorado State Forest Service	Agency mission is to support forest management efforts to state and private landowners. Water quality is an associated benefit.	Technical assistance on forestry practices with potential nonpoint source pollution negative impacts. Conducts training sessions for loggers and natural resource professionals.	BMP program was funded through a NPS project and will be continued with a series of workshops on specific practices.
Colorado State University Extension and Water Institute	Involvement is related to organization's mission as well as state and federal policy directives.	Educational assistance, especially addressing the agricultural sector.	Statewide Water Quality Education program, with special emphasis in local areas of intense agricultural production.
Colorado Water Conservation Board	General interest in water quality as it relates to beneficial uses of the water and the Board's statutorily based mission: "To promote the protection, conservation and development of	Directly involved in Colorado River Basin Salinity Control Program. Funding for several small irrigation BMP demonstration projects. Cooperative agreement with	Office of Water conservation demonstration projects and educational programs. CRBSCP and Endangered Fish Recovery Programs could be coordinated to meet other water quality goals, such as the current joint salinity/selenium control demonstration project

Organization	Nonpoint Source Program Nexus	Current role in the NPS program	Programs that are or could be leveraged to help accomplish NPS program objectives
	Colorado's water resources in order to secure the greatest utilization of those resources for the benefit of present and future generations."	U.S. Bureau of Reclamation to provide water conservation planning services to local irrigation districts	in the Montrose area. Irrigation improvement/ rehabilitation projects financed through the construction loan program could incorporate BMP features to facilitate NPS objectives.
State Conservation Board	Represent 78 soil conservation districts that have identified water quality as a major concern in their long range programs and annual plans of work.	Sponsored various projects; assist SCDs in preparation of proposals and implementation of projects; liaison between SCDs and other units of government.	Natural Resources Conservation Matching Grants. HB 1041 Funds, to gather natural resource information. Irrigation water management program in the Ogallala Basin. Colorado River Salinity Program cost-share.
U.S EPA	Provides funding for the NPS program via a cooperative agreement with the State and approves individual projects.	Provides NPS program implementation supervision, approval of PIPs, and participation in the NPS Alliance.	Other EPA programs also sometimes provide support for watershed efforts or individual projects. Examples include Brownfields site assessments at legacy mine sites, Brownfields grants for remediation of priority legacy mine sites identified in watershed-based plans, and direct monitoring support from the Region 8 laboratory.
U. S. Bureau of Land Management	Federal lands nexus with nonpoint sources. TMDLs and Federal Consistency	NPS Alliance member	Federal Consistency, TMDLs, and Clean Water Action Plan.
U.S. Forest Service	Federal lands management issues, TMDLs, Federal Consistency	Federal consistency audits, IPA for NPS/TMDL issues.	Federal Consistency, Clean Water Action Plan, TMDLs.
U.S. Geological Survey	Water quality data collection and interpretive studies	Technical assistance	Cooperative water quality studies. Data and interpretations are available to the public and can be used to manage water, biological, energy and mineral resources; enhance and protect quality of life; and contribute to wise economic and physical

Organization	Nonpoint Source Program Nexus	Current role in the NPS program	Programs that are or could be leveraged to help accomplish NPS program objectives
			development.
USDA Natural Resources Conservation Service	Legislative requirements.	Technical assistance in planning and on-the-ground BMP implementation.	Environmental Quality Incentives Program Small Watershed Program Conservation reserve Program Emergency Watershed Protection Program Forestry Incentives Program

MEMORANDUM OF AGREEMENT
between the
United States Department of Interior
Bureau of Land Management
Colorado State Office
and the
Colorado Department of Health

I. PURPOSE

This Memorandum of Agreement(MOA) is entered into by and between the Colorado Department of Health, hereinafter referred to as CDH, and the Colorado State Office of the U.S. Department of Interior - Bureau of Land Management, hereinafter referred to as BLM, for the purpose of delineating the responsibilities and activities to be performed by each agency pursuant to the implementation of Colorado's Nonpoint Source Pollution Control Program developed under Section 319 of the Clean Water Act of 1987.

The purpose of the Agreement is to create a framework within which the agencies involved can effectively cooperate on projects of mutual concern to protect water quality throughout the State of Colorado and to benefit the people of this State.

II. ROLES AND AUTHORITIES

WHEREAS, land management activities can be the source of pollutants such as sediment, nutrients, pesticides, salts, chemical and bacterial contamination which may lead to water pollution; and

WHEREAS, the above pollutants can degrade water quality and impair beneficial uses of waters of the State; and

WHEREAS, the BLM is charged with implementing and enforcing natural resource management programs for the protection of water quality on federal lands under its jurisdiction; and

WHEREAS, nonpoint source water quality problems are best controlled through the development, adoption, and implementation of sound resource management practices referred to as "best management practices"(BMPs); and

WHEREAS, the CDH through the Water Quality Control Act is the State agency, which under Colorado Revised Statutes 25-8-101, has the responsibility and authority to encourage voluntary cooperation by the people, municipalities, counties, industries, agriculture and other pursuits, in restoring and preserving the quality of the waters of the State in accordance with the rules and standards established by the State Water Quality Control Commission; and

WHEREAS, the CDH, under CRS 25-8-301 is designated as the lead Colorado agency for planning and implementing the Federal Water Quality Act as amended:

NOW THEREFORE, the undersigned agencies enter into the following Agreement:

III. INTERAGENCY COORDINATION

A) Under the guidelines of the Colorado Nonpoint Source Management Program and Section 319, nonpoint source project implementation plans (PIPs) will be developed on a watershed basis to restore and preserve the quality of their waters. Each PIP will include, and be developed jointly by, all land ownerships (Federal, State, private) in the watershed.

B) BMPs may need to be installed on all landownerships to reduce the amount of pollutants derived from the watershed. Section 319 funds may be used to install BMPs on federal lands if a non-federal entity agrees to contribute the funds and/or in-kind services needed to provide the match required.

The BMPs installed on BLM lands with Section 319 funds would constitute "gratuitous" services under which the provider (State and/or Contractor) of the services waives all claims against and rights to compensation from the BLM or the United States.

IV. FEDERAL CONSISTENCY

A) The BLM will participate in the Colorado Nonpoint Source Task Force and will, to the extent possible, manage nonpoint sources on BLM lands in a manner consistant with the Colorado Nonpoint Source Management Program. The BLM will, to the extent possible, prevent the creation of nonpoint source water quality problems and remedy existing nonpoint sources through proven and appropriate management practices.

B) BLM will jointly participate with the State (CDH) and other landownerships (federal and private) in developing monitoring strategies for selected watersheds. Monitoring data for which BLM is assigned and responsible will be shared with all participants annually, and the results used to select areas to be jointly reviewed in the field.

C) Annual field reviews will be conducted on selected watershed areas to evaluate on the ground BMP effectiveness. BLM will participate in the review with CDH and other appropriate landowners to determine if water quality goals are being achieved or additional adjustments need to be implemented.

V. RECORD KEEPING AND OWNERSHIP OF DATA

A) Certain records, data, and other information must be kept in good order by the BLM and must be available for review by CDH and by the public in conformance with the Freedom of Information Act and the Right of Privacy Act.

B) Records, data, and other information acquired, developed, collected, or documented under this Agreement shall be the property of the agency responsible for origination of the information. Other interested parties may, at their own expense, make, retain, and distribute copies of this information.

VI. AGREEMENT TERMINATION

A) This Agreement will remain in force until terminated by either party on sixty (60) days written notice to the other.

B) Nothing herein shall be construed as obligating BLM or CDH to expend or as involving either party in any contract or other obligation for future payment of money in excess of appropriations authorized by law and administratively available for this work.

VII. APPLICABILITY

A) The provisions of this Agreement are applicable to all the lands under the jurisdiction of the BLM in the State of Colorado.

U.S. DEPARTMENT OF INTERIOR
BUREAU OF LAND MANAGEMENT
COLORADO STATE OFFICE

Bob Moore
State Director

1/30/91
Date

STATE OF COLORADO
DEPARTMENT OF HEALTH
WATER QUALITY CONTROL DIVISION

J. David Holm
Director

11/26/90
Date

1523/4-6

United States Department of Agriculture | Forest Service | Rocky Mountain Region | 11177 W. 8th Avenue
Box 25127
Lakewood, CO 80225-0127

Reply to: 1580/2530

Date: May 1, 1994 (est.)

Subject: Memorandum of Understanding-State of Colorado

RECEIVED
APR 26 1994
WQCD-Director's Off.

To: Forest Supervisors, Directors, and Regional Attorney

REPLY DUE JUNE 17, 1994

Enclosed is a Memorandum of Understanding (MOU) on water quality drafted jointly by our watershed staff and the State of Colorado. The MOU covers management and monitoring of water quality, and the use of grant money to restore degraded water quality, on NFS lands in Colorado.

The MOU is based on existing ones that have been prepared in other western States. It highlights the Forest Service Nonpoint Source Management Strategy as a key element in complying with State water quality requirements pursuant to the Clean Water Act. It also refers specifically to our new watershed conservation practices, now being completed, as the Best Management Practices which we will implement to protect water quality and aquatic habitat.

The MOU has the concurrence of water quality experts in the Forest Service, EPA, and the State, as well as the State Attorney General's office. It also has the concurrence of the Region 2 Agreement Specialist. We believe it outlines our minimum requirements for compliance with the Clean Water Act and related State laws and regulations. Our long-term goal is to develop identical agreements with the other States in the Region.

Please review the MOU and give us your comments. Point out your concerns and recommend changes. Please submit your comments to Jim Maxwell of my staff by June 17. We will then complete the MOU using your comments.

ELEANOR S. TOWNS
Director, Physical Resources

cc: Warren Harper:W01A
LuAnn Waida, MSA

MEMORANDUM OF UNDERSTANDING
between the
USDA Forest Service, Rocky Mountain Region
and the
Colorado Department of Health

1. PURPOSE

This Memorandum of Understanding (MOU) is established between the USDA Forest Service Rocky Mountain Region (FS) and Colorado Department of Health (CDH). It defines agency responsibilities in implementing the Colorado Nonpoint Source Management Program and achieving Federal compliance with Sections 313 and 319(h) of the Clean Water Act (33 USC 1329) on National Forest System (NFS) lands in Colorado. Nothing herein relieves the FS from its obligation to comply with point source, including storm water, regulatory requirements.

The MOU's purpose is to promote effective cooperation between FS and CDH in protecting water quality, consistent with Colorado water quality requirements and FS requirements to supply goods and services, including quality water. Water quality will be protected by meeting State water quality standards and protecting classified uses of water.

2. ROLES AND AUTHORITIES

WHEREAS, land management activities can be the source of water pollutants which can degrade water quality or impair classified uses of water; and

WHEREAS, nonpoint source water pollution is typically addressed by applying watershed conservation practices, or "best management practices" (BMPs); and

WHEREAS, the State of Colorado is responsible under the Clean Water Act for protecting water quality, and CDH is designated under CRS 25-8-301 as lead agency for planning and implementing State water quality programs; and

WHEREAS, CDH under Colorado Revised Statutes 25-8-101 has the responsibility and authority to protect, maintain, and improve the quality of the State's waters in accordance with the rules and standards established by the State Water Quality Control Commission; and

WHEREAS, FS is responsible under the federal Clean Water Act and Executive Orders 12088 for complying with State water quality protection requirements to the same extent as any nongovernmental entity; and

WHEREAS, FS is responsible, under federal laws such as the Organic Act, Multiple Use-Sustained Yield Act, and National Forest Management Act, for managing NFS lands to provide goods and services and to protect water quality and ensure favorable conditions of water flows; and

WHEREAS, CDH has identified FS as the Designated Management Agency charged with ensuring that land management programs protect water quality on NFS lands, and FS has developed and implemented specific programs to protect water quality and desires assurances that it is complying with State water quality requirements;

NOW THEREFORE, the undersigned agencies enter into the following Agreement:

3. WATER QUALITY PROTECTION

a. FS will manage NFS lands consistent with the Colorado Nonpoint Source Management Program by implementing the FS Nonpoint Source Management Strategy (NPS Strategy, Attachment A).

b. In implementing its NPS Strategy, FS will apply watershed conservation practices (BMPs) to its land use activities, monitor BMP implementation and effectiveness in protecting water quality, and adjust BMPs or mitigate actions as needed to ensure that State water quality standards are met and classified uses of water are protected (Attachment A).

c. CDH will support implementation of the FS NPS Strategy (Attachment A) as compliance with the Colorado Nonpoint Source Management Program, the Colorado Water Quality Control Act, and the Clean Water Act, unless monitoring shows that State water quality standards or classified uses have been violated despite application of BMPs, and will so state in its Section 319 plan.

d. FS will monitor BMPs and water quality for its activities (Attachment A) and share monitoring results with CDH each year. These results may be used to select areas to be jointly field-reviewed.

e. FS and CDH will conduct annual field reviews of various watersheds and activities on NFS lands, to evaluate implementation and effectiveness of BMPs on the ground. Based on these reviews, BMPs may be jointly adjusted to improve protection of water quality, or joint recommendations to adjust State water quality standards may be made.

f. If FS suspects that State water quality standards or classified uses are being violated on NFS lands, or is so notified by another party, FS will contact and, if appropriate, meet with CDH to evaluate the situation. FS and CDH will conduct a joint plan-in-hand field review of the activity within 10 days or an agreed-to time after notification.

g. If CDH notifies FS that a State water quality standard is being violated, FS will promptly consult with CDH and provide for CDH approval a plan to achieve and maintain compliance with the standard. This plan will include an implementation schedule to achieve compliance as soon as practicable.

4. WATER QUALITY RESTORATION USING SECTION 319 FUNDS

a. Under the guidance of Section 319 and the Colorado Nonpoint Source Management Program, nonpoint source project implementation plans (PIPs) may be **JOINTLY** developed for **IMPACTED** watersheds having multiple landowners to restore the quality of their waters. BMPs may need to be installed on all land ownerships to restore water quality in these watersheds.

b. Section 319 funds may be used to install BMPs on NFS lands if a non-federal entity agrees to contribute the funds or in-kind services needed for the required match. Such work would constitute "gratuitous" services under which the provider (State and/or Contractor) of the services waives, to the extent allowed by law, all claims against, and rights to compensation from, FS or the United States. Lack of Section 319 funds does not relieve FS from its responsibility to apply watershed conservation practices (BMPs) to all its land use activities.

c. Nothing herein will obligate FS or CDH to expend money, or involve either party in any contract obligation for future payment of money, in excess of appropriations authorized by law and administratively available for this work.

5. RECORD KEEPING AND OWNERSHIP OF DATA

a. FS will keep pertinent records, data, and other information in good order, and available to CDH and the public, in conformance with the Freedom of Information Act and the Right to Privacy Act.

b. Records, data, and other information acquired, developed, or documented under this MOU will be the property of the agency responsible for originating the information. Other parties may make, retain, and distribute copies of this information.

6. REVIEWS AND REPORTS

a. CDH and FS will meet annually to review the MOU's provisions and effectiveness, assess the progress of each agency, explore coordination needs, and identify new objectives or other needed changes in the MOU. CDH will provide minutes of the meeting, and a jointly-prepared status report on the MOU, to EPA as part of the annual report required under Section 319(h) of the Clean Water Act.

b. FS will provide CDH with information on watershed condition as part of the reporting procedures established by Sections 319(a) and 319(b) of the Clean Water Act.

7. AMENDMENT OR TERMINATION OF AGREEMENT

a. Based on the annual status report, CDH and FS may jointly prepare a new MOU, or may amend or revise the MOU by jointly executing an addendum containing the desired amendments or revisions.

b. This MOU will remain in force until terminated by either party on thirty (30) days written notice to the other.

8. APPLICABILITY

The provisions of this Agreement are applicable to all national forests and grasslands in the State of Colorado.

ELIZABETH ESTILL Date Regional Forester USDA Forest Service Rocky Mountain Region	J. DAVID HOLM Date Director Colorado Department of Health Water Quality Control Division

ATTACHMENT A

FOREST SERVICE NONPOINT SOURCE MANAGEMENT STRATEGY

1. The Forest Service shall apply specific watershed conservation practices (BMPs) to its land management activities. These BMPs are contained in the report "Watershed Conservation Pratices for USDA Forest Service Rocky Mountain Region", shall be tailored to local conditions, and shall be implemented to meet State water quality standards and protect classified uses of water.

2. The Forest Service shall monitor (1) BMP implementation to assure that BMPs are applied as designed, and (2) BMP effectiveness to assure that State water quality standards are met and classified uses of water are protected. The Forest Service shall document the results of all such monitoring.

   a. Monitoring of BMP implementation will primarily occur as recorded visual certification that BMPs have been applied as prescribed, and shall be done on all ongoing project activities.

   b. Monitoring of BMP effectiveness will include recorded visual observations of the delivery of pollutants to streams and lakes, and recorded measures of various stream and lake parameters which will often include morphology, bank stability, bed sediments, pool depth and frequency, woody debris, and other parameters. Water samples shall be collected and analyzed for key physical, chemical, and biological constituents as the need is indicated by the other monitoring described above. Emphasis will be on monitoring representative conditions and activities where the information gained is most likely to improve the degree of protection provided over a large geographic area.

3. The Forest Service shall use monitoring results as a feedback mechanism as needed to modify the land management activity, adjust BMPs, or recommend changes to State water quality standards.

   a. If monitoring identifies a water quality problem created by an activity such that State water quality standards are not being met or classified uses are not being protected, the activity shall be suspended and mitigation measures that remedy the problem will be promptly installed. Contracts and project plans shall be modified to assure that these added measures are implemented as prescribed, and monitoring shall continue to ensure that the measures are effective in meeting State water quality standards and protecting classified uses of water.

   b. If BMPs are found to be inadequate to meet State water quality standards or protect classified uses, they shall be adjusted to provide adequate protection.

   c. Where it appears impossible to meet a State water quality standard and still provide the goods and services mandated by Congress, the Forest Service may recommend that the State change the water quality standard, but shall continue to be responsible for compliance with the standard unless and until it is changed.

Explanation of Text Changes

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Items 3c and 3f: The phrase "or designated uses" has been inserted in addition to water quality standards with the understanding that we are responsible to both meet WQ standards and protect designated uses (some uses aren't covered very well by Colorado's water quality standards).

Items 3d and 3e: The word "selected" has been changed to "various". Commenters were asking who "selected" the watersheds, and we were only trying to say that a sampling of watersheds would be monitored and reviewed.

Item 4a: The word "jointly" has been inserted to answer the question as to who develops the PIPs. The word "selected" has been changed to "impacted" in the belief that it is only impacted watersheds that PIPs will be developed for.

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Item 2: The wording of the first sentence has been changed to more clearly show the difference between implementation and effectiveness monitoring. The word "watersheds" has been changed to "conditions" in the 2nd sentence to reflect that representativeness means more than watersheds, but really is more tied to representative stream types and representative geoclimatic areas.

Jim Maxwell
Sept 29, 1993

Glossary

Abandoned Mine Drainage (AMD): surface or ground water contaminated as a result of passage through a physical environment created by mining activities of the past. This contamination can occur in the underground voids created by deep or underground mining or it can occur by water passing through mining refuse left on the surface.

Activities: sustainable organizational capacity; the actions necessary to achieve the various outputs including who does what, when, where, in what ways.

Aquatic Life Use Attainment: surface water bodies that meet the aquatic life use designations included in **Colorado's** water quality standards; in Colorado there are two categories of aquatic life use: coldwater habitat and warmwater habitat.

Bankfull Stage: level at which water just begins to flow from the stream onto the floodplain and is associated with the discharge most effective at moving sediment. Bankfull stage results in the average form or morphology of the stream.

Beneficial Use Designations: existing or potential uses of waterbodies including public water supplies, protection and propagation of aquatic life, recreation in and on the water, agricultural, industrial and other purposes. There may be more than one beneficial use designation assigned to a waterbody.

Best Management Practices (BMPs): structural, managerial, regulatory, and/or preservation/conservation mechanisms designed to 1) reduce or prevent quantities of pollutants that are generated at and/or delivered from a nonpoint source to a receiving water body; 2) preserve, improve or restore in-stream or riparian habitat, and aquatic life uses; and/or 3) preserve, improve, or restore self-sustaining stream channel and associated floodplain function can be used in lieu of BMPs.

Community: people who live in, work in or have an interest in a watershed.

Dynamic Equilibrium: state of balance between stream inputs and outputs, primarily sediment and water supply and discharge.

Evaluation: a process for examining and documenting whether the core components of successful watershed planning and implementation are in place. Core components are EPA Required Nine Elements.

Floodplain Form: elevation and extent of land adjacent to a stream channel that is periodically saturated or inundated with excess flow from the stream during storm events or after ice/snow melt.

Goal: qualitative statement generally outlining what is to be achieved without defining how it will be measured or when it will occur. For example, an environmental goal would be to reduce

water quality degradation due to urban run-off. For example, a planning goal would be to improve stakeholder participation in watershed planning.

Habitat: dwelling place of an organism or community that provides the requisite conditions for its processes (Society for Ecological Restoration Science and Policy Working Group, 2002. The SER Primer on Ecological Restoration). Some attributes of habitat include: the four basic necessities for wildlife (i.e., food, water, shelter, and space to survive) which are needed in sufficient supply and structural arrangement to meet a species life needs. Habitats vary over space and time and depending on the life cycle of individual species. Also, specific locations where physical, chemical, and biological factors provide life support conditions for a given species (IJC 1989).

Habitat Modification: physical, man-made alterations to the channel, floodplain, and/or riparian zone of a stream (e.g., channelization, culverting headwater streams, destruction of riparian cover)

Hydrologic Unit Code (HUC): The Hydrologic Unit system is a standardized watershed classification system developed by USGS in the mid 1970s. Hydrologic units are watershed boundaries organized in a nested hierarchy by size. They range in size from regions, as shown on the map below, to the smaller cataloging units (HUCs), which are roughly equivalent to your local watershed.

Hydromodification: subset of habitat modification because it is often the RESULT of habitat modification. Hydromodification occurs when man-made structural changes to the landscape alter the amount or physical character of the water in the stream (e.g. - increased overland flow and higher storm flows as a result of development, tile drainage, dams).

Hypoxic Zone: zone on the Gulf of Mexico's Texas-Louisiana Shelf with seasonally low oxygen levels (less than 2 mg/l).

Impaired waters: surface water bodies that do not meet beneficial use designations, narrative "free from" standards, numeric criteria and anti-degradation provisions as outlined in Colorado's ambient water quality standards.

In-kind services: donated labor, land, machinery, equipment, food, etc.

Inputs: sustainable organizational capacity, resources allocated in what amounts at what times.

Invasive Species: any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem; and whose introduction does or is likely to cause economic or environmental harm to human health.

Macroinvertebrate: small, but visible with the naked eye, animals without backbones (insects, worms, larvae, etc.). Water bodies have communities of aquatic macroinvertebrates. The species composition, species diversity and abundance of the macroinvertebrates in a given water body can provide valuable information on the relative health and water quality of a waterway.

Maximum Contaminant Levels (MCLs): federally derived health limits for treated drinking water based on the Safe Drinking Water Act. Specifically, the MCL is the highest level of a contaminant that is allowed in treated drinking water, MCLs are enforceable standards, and many MCLs (e.g. atrazine, simazine) are based on annual running average concentrations.

Nine Key Elements: EPA's Nine Key Elements are major considerations in developing new or updated NPS management programs.

Nine Watershed Elements: EPA's nine minimum elements that are critical for achieving improvements in water quality. EPA requires that these nine elements be addressed in watershed plans funded with incremental Clean Water Act section 319 funds and strongly recommends that they be included in all other watershed plans intended to address water quality impairments.

Nonpoint Source (NPS): pollution from land use activity or disturbance of the stream or aquifer system. Sources can be classified into two categories: *polluted runoff* and *physical alterations*. *Polluted runoff* is rain and snowmelt flowing across the land surface or within ground water that picks up contaminants and carries them to the stream or into the aquifer. *Physical alterations* are changes to the stream channel or its corridor, including straightening, deepening, widening or changes in flow patterns.

Numeric (Water Quality) Criteria: numeric criteria are estimations of concentrations of chemicals and degree of aquatic life toxicity allowable in a waterbody without adversely impacting its beneficial uses. Although numeric criteria are applied to waterbodies, they primarily are used to regulate dischargers through NPDES permits. Numeric criteria consist of chemical criteria, whole effluent toxicity levels and biological criteria.

Objective: a method or vehicle used to obtain a goal or target. Often answers the question of "how" something will be achieved without being quantitative. For example an environmental objective would be to increase water quality by implementing more natural channel restoration projects. For example, a planning objective would be to attain local watershed group sustainability (the target) by diverse and effective stakeholder participation (the objective).

Outcomes: sustainable NPS Implementation; describes the reason for a program, activity, or task in terms of the "desired" state, once the program, activity, or task is completed. Therefore, outcomes drive the activities selected. For performance-based measurement to improve both outcome accountability and effectiveness, outcomes must be concrete and linked to actions (Source: Measuring Community Success and Sustainability: An Interactive Workbook, North Central Regional Center for Rural Development, Iowa State University)

Outputs: sustainable organizational capacity; products that are controlled by the organization and stem directly and measurably from the inputs and activities.

Preservation: to keep from harm, damage; protect; save; to treat an area as the special domain of a particular ecological condition.

Problem Statements: characterize the "as is" surface or ground water quality impairment or surface or ground water quality threat and the reasons for it.

Purpose: reason for the existence of something (e.g., Agency mission statements). Often answers the question of "why" something is being done, without being quantitative or clearly identifying how achievement of the purpose will be measured.

Reclamation: process to recreate the functions and processes of a naturally stable ecosystem with the understanding that it will be quite different from the condition prior to disturbance (e.g., Successive Alkalinity Producing Systems (SAPS) for AMD reduction or elimination; setback ordinances; bank stabilization, fish passage structure on dams).

Rehabilitation: process of working to recover natural functions, ecosystem processes, productivity and services within the context of the existing disturbance (e.g., wetland restoration, greenway preservation, channel rehabilitation).

Research: scholarly or scientific study of a given subject, field, or problem; a close examination of a matter in search for information or truth; close careful study.

Restoration: to fundamentally change the existing condition or land use; process of working to return a habitat or ecosystem to its original state by removing the cause of degradation. Goal is to re-establish the pre-existing biotic integrity in terms of species composition and community structure (e.g. dam removal, natural channel restoration).

Riparian Zone: A transitional area between terrestrial and aquatic ecosystems, and adjacent to perennial, intermittent, and ephemeral streams, lakes, and estuarine-marine shorelines, that is distinguished by gradients in biophysical conditions, ecological processes, and biota, through which surface and subsurface hydrology connect waterbodies with their adjacent uplands. The riparian zone includes those portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with aquatic ecosystems (i.e., a zone of influence). (source: National Research Council)

Scientific Method: method of investigation involving observation and theory to test scientific hypotheses; the process by which scientists, collectively and over time, endeavor to construct an accurate (that is, reliable, consistent and non-arbitrary) representation of the world.

Self-sustaining Stream Channel: stream channel form has the ability to maintain its character (dimension, pattern and profile), and repair itself over time without man-made interventions; the stream channel must be vertically stable, maintaining the same bed elevation, but may adjust laterally by eroding outside banks and depositing inside bends.

Shear Stress: the force per unit area that is parallel to a surface. In the case of stream morphology, this is the force of the stream flow on the bed and banks of the channel.

Social Learning: people sharing diverse perspectives and experiences to develop a common framework for understanding and basis for joint action (Schusler, Decker, and Pfeffer 2003).

Stakeholders: individuals or organizations with an interest and/or ability to take action on a watershed issue.

Stream Aggradation: sediments raise the stream bed elevation or fill the stream channel up. Stream Bed Form: generally refers to the pattern of stream bed features such as pools, riffles, runs or glides, but may also include features such as point bars or other channel bars composed of deposited material. Stream Bed Material: are the surface and subsurface materials that compose the stream bottom, banks, or other channel features, whether bedrock, boulders, cobble, gravel, sand, or finer-grained materials.

Stream Beltwidths: area of the stream corridor occupied or expected to be occupied by stream meanders.

Stream Channel Form: the size and shape of the stream, typically described by longitudinal slope profile, cross sectional dimension and meander pattern.

Stream Cross Sectional Dimension: refers to measurements of channel shape conducted perpendicular to the flow of the stream. The photo at right shows the cross section of a ditch being measured.

Stream Degradation: downcutting of the stream bed.

Stream Entrenchment: streams are characterized by low stream quality and long-term instability due to separation from a functional floodplain.

Stream Evolution: describes the series of morphological adjustments or changes that occur as the stream attempts to self stabilize. The series of changes may be in response to changes in magnitude of major inputs such as water, sediment, discharge, or other driving factors.

Stream Meander Pattern: characterization of stream curvature along its length. See also stream sinuosity.

Stream Morphology: see stream channel form.

Stream Sinuosity: ratio of stream length to valley length.

Urban: The development intensity of a riverfront corridor can be classified according to the degree or percentage of impervious cover-hard surfaces such as buildings, streets, parking lots, and sidewalks-found within the corridor.
A basic classification system is: ultra-urban (80 to 100 percent impervious cover), urban (40 to 79 percent impervious cover), and suburban (10 to 39 percent impervious cover) (Schueler 2003).

Vertical Channel Stability: the stream channel form maintains the bed elevation by neither degrading (down-cutting) nor aggrading (filling up). Note: geologic profile adjustments and long term storage of sediment fines in floodplains do not constitute channel instability.

Watershed Coordinator: a person responsible for: organizing watershed action planning, education, and implementation to restore and protect a local water resource; networking with agencies, organizations, and citizens on a multi-county basis; and establishing a permanent local water resource restoration or protection program.

Acronyms

AFOs = Animal Feeding Operations
AML = Abandoned Mine Land
ASIWPCA = Association of State and Interstate Water Pollution Control Administrators, now renamed Association of Clean Water Administrators (ACWA)
AWQMS = Ambient Water Quality Monitoring System
BE = Biological Evaluation
BMPs = Best Management Practices
BLM = Bureau of Land Management
CAFO = Concentrated animal feeding operations
CDPHE = Colorado Department of Public Health and Environment
CDPS = Colorado Discharge Permit System
DRMS = Colorado Division of Reclamation, Mining and Safety
CDOT = Colorado Department of Transportation
CFR = Code of Federal Regulations
CNMP = Comprehensive Nutrient Management Plan
CSU = Colorado State University
COG = Council of Governments
CWCB = Colorado Water Conservation Board
CWA = Federal Water Pollution Control Act (Clean Water Act)
CWAP = Clean Water Action Plan
CWQCA = Colorado Water Quality Control Act
DRMS = Colorado Division of Reclamation, Mining and Safety
DO = Dissolved Oxygen
DSN = Colorado Data Sharing Network
EPA = U.S. Environmental Protection Agency
EDU = Environmental Data Unit
GIS = Geographic Information Service
GRTS = Grants Reporting and Tracking System
HUC = Hydrologic Unit Code
IR = Integrated Water Quality Monitoring and Assessment Report
ISDS = Individual Sewage Disposal Systems
MRP = Measurable Results Project
NPDES = National Pollution Discharge Elimination System
NPS = Nonpoint Source
NPS program = Nonpoint Source Management Area within the Water Quality Control Division
PAMs = Program Activity Measures
pH = a measure of the acidity or basicity of an aqueous solution. Solutions with pH at or close to 7 are said to be neutral. Solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are basic or alkaline.
PIP = Project Implementation Plan
PPA = Performance Partnership Agreement
PPA = Performance Partnership Agreement
SAPPs = Sampling and Analysis Project Plans
SDWA = Safe Drinking Water Act

SWAP = Source Water Assessment and Protection
SWQMP = Statewide Water Quality Management Plan
TMDL = Total Maximum Daily Load
USFS = U.S. Forest Service
USGS = U.S. Geological Survey
UWA = Unified Watershed Assessments
WQCC = Water Quality Control Commission
WQCD = Water Quality Control Division
WRAS = Watershed Restoration Action Strategy