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