11 – INTRODUCTION

Soil and water resources are most efficiently protected from nonpoint sources of pollution by implementation of the iterative Best Management Practices (BMP) process, and the site-specific application of BMPs. The BMPs presented in this Handbook were compiled from Federal Law, Forest Service Manual and Handbooks, contract and permit provisions, policy statements, planning documents, Regional guides, applicable State laws and regulations, and other pertinent sources.

This handbook provides the complete package of BMPs for consideration in project plans. The site-specific application of individual BMPs involves consideration of design standards and risks; environmental effects; practicality; and institutional, political, social, economic, and technical feasibility. (For additional discussion, see: W.C. Harper, "A Resource Agency's Perspective on Nonpoint Source Management", Symposium on Monitoring, Modeling, and Mediating Water Quality, American Water Resources Association, May 1987, pages 641-652).

BMPs are grouped by management activity for ease of presentation and understanding. The management activities are: Watershed, Timber, Transportation and Facilities, Vegetation, Recreation, Minerals, Fish and Wildlife Habitat Improvements, and Fire Suppression and Fuels. Although a practice might be shown under only one activity designation, it may also apply to other activities.

The purpose of BMPs is to directly or indirectly protect water quality and abate or mitigate adverse water quality impacts while meeting other resource goals and objectives. BMPs have three basic forms: administrative, preventive, and corrective. These practices are neither detailed prescriptions nor solutions for site-specific problems. They are action initiating mechanisms which call for the development and application of detailed prescriptions and solutions. They identify management requirements and considerations which are to be addressed prior to and during the formulation of alternatives for land management actions. They serve as standards which are considered in formulating a plan, a program, and/or a project.

The term "Best Management Practice," or BMP, is a legal term relating to practices used for the protection of water quality. The term BMP has also been used to describe good management techniques unrelated to water quality (for example, for habitat improvement projects). These other uses of the term BMP do not have legal implications under the Clean Water Act and may confuse the water quality program with other resource goals.

11.1 - BMP Application

BMPs can be:

Corrective or Preventive	- Restore or maintain water quality
Site-specific Method	- Structural (dams and ditches) - Nonstructural (vegetation, mulch)
Pre-Project	- Operations (planning and design of activities)
Post-Project	- Maintenance (to assure function of structures and facilities)
Temporal	- Schedules (season or chronology of activity initiation)
Spatial	- Distribution (activity location relative to water)

11.2 - BMPs as Administrative, Preventive, and Corrective Actions

1. Administrative actions are implemented as organizational controls. Examples are:

   a. Incorporating water quality protection measures into a contract

   b. Scheduling an activity to avoid wettest season

   c. Criteria that govern road layout and design

   d. Review project implementation documents to ensure protection method and measures are incorporated

   e. Inspect project sites to ensure protection measures are in place and working properly

   f. Controlling the magnitude or aggregate of activities in a watershed

2. Preventive actions are measures that are applied to an activity to minimize its effect on water quality. Examples are:

   a. Construction of water bars across roads or skid trails

   b. Spreading grass seed on exposed soil

   c. Placing mulch and/or erosion fabric as a temporary cover on cut or fill slopes

3. Corrective actions are measures that are applied on the ground to solve a problem. Many methods used in prevention are also suitable for correction. Examples are:

a. Adding large woody debris to a stream channel (to form pools for the benefit of fish habitat)

b. Placing riprap to stop stream bank erosion

c. Reconstructing or obliterating an abandoned road that is degrading water quality.

The site-specific application of BMPs lead to custom fit practices, measures, and methods for water quality protection. They are applied following inventory and/or scientific analysis of a land management proposal. Some BMPs require that several resource specialists visit the proposed project area to assess on-site potential for adverse impacts to water quality and the designated beneficial uses as defined in Alaska Water Quality Criteria (18 AAC 70.020). Field data is collected to help predict impacts and identify mitigation measures. Analysis often involves interaction with other specialists (for example, design engineers, economists, contracting officers). Field data is analyzed to identify site-specific specifications designed to protect water quality and/or reduce pollution. BMPs establish a procedure to follow that will result in the formulation of site-specific methods and techniques for nonpoint source pollution control.

11.3 – Development Considerations

The effects of land management activities on soil and water resources, and water-related beneficial uses can vary considerably. The effects are a function of:

1. Physical Environment. The physical, meteorological, hydrological, and biological environment where the activity takes place (topography, physiography, precipitation, channel density, geology, soil type, and vegetative cover.

2. Current or Prospective Beneficial Uses. The specific water-related beneficial use(s), importance to various publics, and sensitivity to management influences.

3. Activity Type. The type of activity imposed (recreation, mineral exploration, timber management), its extent, and its magnitude.

4. Project Prescription. Site-specific implementation (road construction method(s) or silvicultural practice(s) used, constant use v. seasonal use, recurrent or one-time application, etc.).

5. Duration. The length of time that the activity occurs or is applied.

6. Timing. The season of the year that the activity occurs or is applied.

7. Maintenance Strategy. How will effectiveness of the project be assured?

Site-specific BMP applications will vary since no single practice, method, or technique is best in all circumstances. BMPs presented in this Handbook include qualifiers such as "according to design," "as prescribed," "where practicable," and "within acceptable limits." BMP applications are developed through professional interdisciplinary involvement. These applications are tailored to meet local resource and environmental requirements.

Since land managers work with the natural environment, with all its complexities and uncertainty, it is necessary to accept some level of risk with any design. This important (and difficult) task of project risk assessment must be based on predictable effects on other resources, and the overall need to conduct the management activity. Evaluation of risk is part of the interdisciplinary NEPA analysis for each project. Determining the appropriate risk level is part of the line officer's decision for each project.

11.4 – NEPA and Interdisciplinary Involvement

The NEPA process and interdisciplinary involvement is critical for the development of the site-specific application of BMPs. Direction for the NEPA process (environmental analysis and documentation) is contained in Forest Service Policy and Procedures found in FSM 1950 and FSH 1909.15. These sources also provide direction to incorporate the interdisciplinary process in planning and decision making.

Interdisciplinary involvement is the use of a team of individuals who represent two or more areas of professional knowledge and/or skill. Team members combine the skills necessary to provide input for alternative formulation and evaluation, BMP selection, and aid in the Forest Service decision-making process. The final responsibility for decision-making lies with the Line Officer (District Rangers, Forest Supervisors, or Regional Forester). The team's task is to provide the decision maker with alternatives and evaluations needed to make a responsible decision.

11.5 – Training

After BMPs are selected, they are applied to site-specific conditions. Training in the application of BMPs is critical for effective water quality protection. A training and information program should include: 1) objectives for water quality protection and management; 2) State designated beneficial uses of water; 3) cause and effect relationships in nonpoint source pollution and storm water runoff; 4) the relevance of BMPs; 5) legal aspects; and 6) the site-specific application of BMPs.

Training should be given to personnel with contract responsibilities and specialists involved in activities which have the potential to affect water quality, beneficial uses, and soil resources.

11.6 – Monitoring Process

Monitoring is an essential part of all BMPs as well as the overall BMP process. Regionally approved monitoring techniques will be used. Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska, EPA, May 1991, will be the starting point for all BMP monitoring plans. Specific monitoring plans will be coordinated among Forests and Areas and with the Alaska Department of Environmental Conservation. Monitoring plans should include or consider the following:

1. Development of monitoring questions
2. Define personnel and budgetary constraints
3. Review of existing data and literature
4. List of parameters to be measured
5. Methodology for analysis and evaluation, and the rational
6. Location of monitoring sites
7. Intensity, frequency, and duration of monitoring
8. Responsibilities and roles of monitoring personnel
9. Report preparation and dissemination

When impacts from management activity are detected, the appropriate Forest Service Line Officer will evaluate the significance and determine appropriate action. Where project level activities are not meeting Forest Plan or State Water Quality Standards, they will be redesigned, rescheduled, or modified.

Water quality data will be placed or duplicated in a recognized computer system for storage, analyzation, and public review. It is also desirable to place appropriate data into GIS Data Bases.

11.61 – Monitoring

Monitoring is the first step of the feedback mechanism. It responds to questions about the site-specific application of BMPs, and their implementation, effectiveness, and validation.

1. Implementation monitoring determines whether the necessary BMPs, mitigations, constraints, and decisions were actually applied to an activity as planned.

2. Effectiveness monitoring determines the success of BMPs in protecting water quality and beneficial uses**.**

3. Validation monitoring determines if an underlying assumption, or model, is correct.

When monitoring BMP effectiveness the appropriate level of monitoring should also be determined using the guidelines found in G.E. Dissmeyer's, "Evaluating the Effectiveness of Forestry Best Management Practices in Meeting Water Quality Goals or Standards", pg. 41, 54, and 55. USDA, Forest Service Misc. Pub. 1520, July 1994

The monitoring level selected is appropriate to the objective of the monitoring program. Four levels of monitoring are used for evaluating the effectiveness of forestry BMPs in meeting water quality goals or standards: BMP I, II, III and IV They are defined as follows:

BMP Effectiveness I uses empirical observations and a limited amount of qualitative data to evaluate effectiveness. A heavy reliance on experience is used to judge whether BMP's are effective in protecting water quality. It is a professional judgment as to whether there is a problem or not.

BMP Effectiveness II depends mainly on qualitative data and limited quantitative data for analysis leading to the evaluation of effectiveness.

BMP Effectiveness III relies predominantly on quantitative data, with some qualitative data for detailed analysis to evaluate effectiveness.

BMP Effectiveness IV relies predominantly on quantitative data, with some qualitative data for detailed analysis to evaluate effectiveness, to establish water-quality criteria, goals, or cause and effect. This level of monitoring is usually associated with research.

Low-level monitoring (BMP Effectiveness I and II) identifies high-level needs and also extends the information developed by high-level monitoring. High-level monitoring (BMP Effectiveness III and IV) develops information that supports or validates decisions made in low-level monitoring.

The level selected is determined by:

1. The type of question or issue to be addressed.

2. The resources available.

3. The number and stratification of reference and study streams.

4. The practicality of acceptable monitoring methods for evaluating: (a) on-slope conditions, (b) chemical and physical components, (c) channel geomorphology and stability, (d) biology, (e) habitat, and (f) aquatic vegetation.

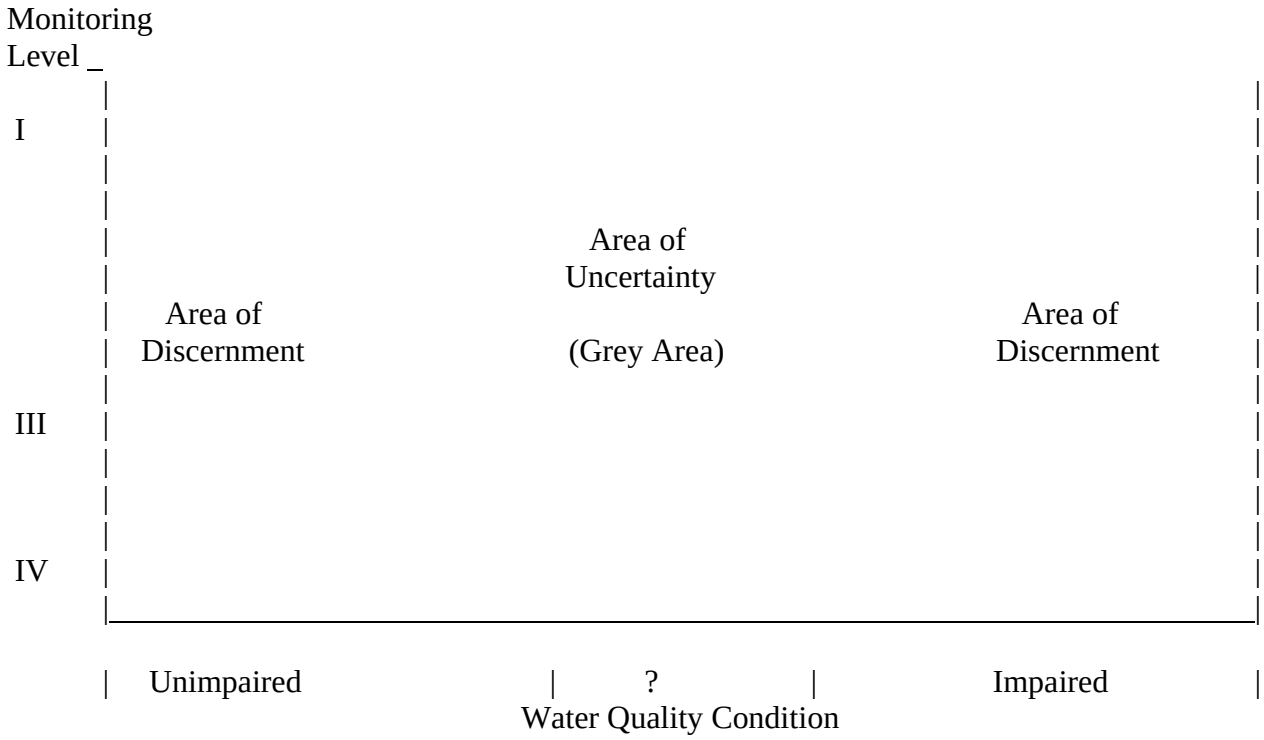
5. Amount of data to be collected, time required, and number of streams that can be monitored.

6. The quality of data needed for making decisions.

7. The kind of decisions needed and the potential risk in making the wrong judgments.

The quality of data vary by monitoring level, methods used, and the skill of the people involved. Three types of data are taken: (1) empirical, (2) qualitative, and (3) quantitative.

The methods used at each level do not always clearly reveal whether goals or standards have been met. This uncertainty is termed the "grey area." As the monitoring level increases, the grey area decreases. Within these grey areas, the tendency is to assume the goals or standards have been met, even though higher levels of monitoring might reveal impairment. Uncertainty occurring with BMP Effectiveness I and II monitoring could trigger the use of higher levels of monitoring to resolve grey-area issues.



The area of discernment of water quality condition by BMP effectiveness monitoring level. (From Figure 8, pg 55. G.E. Dissmeyer, Evaluating the Effectiveness of Forestry Best Management Practices in Meeting Water Quality Goals or Standards. USDA, Forest Service Misc. Pub. 1520, July 1994.)

11.62 – Evaluation

Evaluation is the second step in the feedback mechanism. To evaluate monitoring information and judge the effectiveness of site-specific application of BMPs, criteria must be defined. The Forest Plan Standards and Guidelines, and State Water Quality Standards serve as evaluation criteria. When possible, criteria should be defined in quantitative terms and should consider:

1. Attributes and characteristics of the particular resource or use
2. Natural background temporal and spatial variability
3. Limits of acceptable change in magnitude and duration
4. Transport mechanisms and pathways
5. Time delayed effects
6. Risk

Monitoring and evaluation are designed to improve knowledge of the link between land management activities and the resulting impacts on soil and water resources. Monitoring and evaluation provide an early warning system where research information may not exist for guidance. If site specific application of BMPs is based on sound research that addresses water quality issues, monitoring and evaluation can be less intensive.

11.63 – Refinement

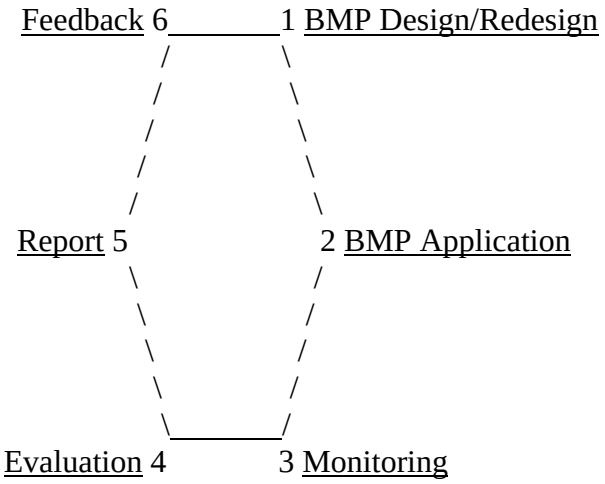
The last step of the feedback mechanism is refinement. If monitoring and evaluation indicates evaluation criteria are not being met, an adjustment of the site-specific application of BMPs is needed, and/or the BMP itself needs modification.

Adjustments vary depending on the type and severity of the impact to the soil and water resource or designated beneficial use. For minor to moderate impacts, the application of site-specific BMPs are redesigned or upgraded to assure the criteria are not exceeded. If the impact is major, the project activity is re-evaluated, redesigned, or terminated. Corrective actions to prevent or minimize significant negative resource impacts will be initiated immediately.

The feedback mechanism is an iterative process involving monitoring, evaluation, and refinement of BMP applications or the BMPs themselves, and/or refinement of the evaluation criteria, which can include the State Water Quality Standards.

This Handbook will be evaluated annually for its effectiveness in protecting water quality and the designated beneficial uses, and in meeting State Water Quality Standards. Establishment of a cooperative evaluation process between ADEC and the Forest Service is specified in the Alaska Non-point Source Pollution Control Strategy (pg. 2, Items 2.3 and 2.4) as approved by EPA August l990.

When monitoring results consistently indicate the implementation of BMPs are effective in protecting the designated beneficial uses, yet do not totally comply with State Water Quality Standards, it may be necessary to revise and/or refine the standards. This may be particularly appropriate for the recognition of the great temporal and spatial variability of both flow and water quality parameters within natural stream systems.



STEP DESCRIPTIONS

1. **STEP 1** - BMP DESIGN

IDENTIFY BENEFICIAL USES	Fisheries, domestic water supply, wildlife, or other beneficial uses
IDENTIFY FS GOALS & OBJECTIVES	Forest Plans, State Management Plans, Water Quality Standards
PHYSICAL CONDITIONS	Climate, geology, hydrology, topography, soils, vegetation, land disturbance history
BMP ALTERNATIVES	List BMPs and site-specific design
FEASIBILITY	Social, political, technical, economic, and institutional constraints
RISK	Hazard analysis, design risk
FINAL BMP DESIGN	Select BMP alternative(s) or fine-tune BMP design(s) to protect recognized beneficial uses and meet resource management objectives

In the selection and site-specific design of BMPs, water quality controls are tailored to each site. This approach evaluates a multitude of control opportunities for preventing and mitigating impacts from nonpoint source pollution. BMPs will protect water quality, if properly implemented, on those sites where conditions are appropriate.

2. **STEP 2** - BMP IMPLEMENTATION AND APPLICATION.

The BMPs should be documented in the NEPA document so that there is no confusion about what is expected for water quality protection. The documentation should include requirements for when the BMP will be applied. The BMPs are translated into contract clauses, special use permit requirements, project plan specifications, regulatory framework, and so forth. The last step is to ensure that the BMP process is implemented and the individual BMPs are applied to the site-specific conditions as designed.

3. **STEP 3** - BMP MONITORING.

Types of Monitoring:

I. IMPLEMENTATION	II. EFFECTIVENESS	III. VALIDATION

Purpose of Monitoring:

BMP APPLICATION AS DESIGNED ? contract specs followed ? timely in application	PROTECTING BENEFICIAL USES ? fish habitat affected ?fish population down MEETS GOALS AND OBJECTIVES ? Forest Plan Thresholds PROJECT SITE POTENTIAL ? erosion ? productivity ? channel conditions	WATER QUALITY STANDARDS Numeric Criteria Valid Models - improve coefficients - develop/improve statistical basis

Responsibility for Monitoring:

Forest Supervisors' Office Ranger Districts Regional Office	Forest Supervisors' Office Regional Office	Forest Supervisors' Office Regional Office Research

Monitoring is imperative to ensure that BMPs are being implemented and are effective in protecting beneficial uses. In monitoring, the criteria (either numeric or narrative) assigned to either a beneficial use or a specific stream segment are used as the yardstick to measure BMP effectiveness. For example, to test whether fish and aquatic life are impaired, the turbidity, dissolved oxygen and temperature numerical criteria for cold water biota might be agreed upon as the parameters to monitor. If one of these parameters is exceeded as a result of a land management activity where BMPs are applied, then the BMP or activity would be modified. Where a criteria is consistently exceeded, and the beneficial use is not impacted, it is possible that the water quality criteria may need to be re-evaluated. Where no numerical criteria exists for a parameter assigned a beneficial use, the limits set for sediment or water yield increases, channel stability, and fry emergence success identified in Forest Plans should be used as the yardstick to measure BMP effectiveness.

Within each Forest Plan, monitoring and evaluation requirements are described to track compliance with the standards and guidelines and direction in the Plan. Monitoring and evaluation of the Forest Plan and project level effects on water quality is conducted at various levels. Project plans and administrative contracts are reviewed during and after project implementation. More specific monitoring is performed by the Forest Service on a representative sample basis to evaluate site-specific BMP application effectiveness in protecting beneficial uses, and to test if they are appropriate to achieve Forest Plan and project objectives. Checks and balances (also viewed as monitoring) are planned to occur throughout the Forest planning and project level planning processes.

4. **STEPS 4 and 5** - EVALUATE and REPORT.

The monitoring data will be evaluated and summarized in an annual monitoring report. The report identifies what was done, how it was done, what was found, and recommended actions on BMPs based on the findings. Water quality standards, natural variability, time delayed effects, hydrologic risk, and other factors are considered in the interpretation of the results. The report is provided to the appropriate line officers and interested public, as requested.

If monitoring shows that the project design and mitigation measures are inadequate to meet management goals, objectives, or standards, then the practices will be changed in future projects, and further corrective actions will be taken, if needed, to mitigate damaged caused by BMP failure. When the mitigation measures need to be modified or upgraded, more stringent soil and water conservation practices will be applied, or the implementation process revised.

5. **STEP 6** - FEED BACK.

The ultimate purpose of monitoring is to provide feedback information that can be used to improve future land management decisions. Monitoring and evaluation in all phases of our resource decisionmaking process are used as tests. Feedback mechanisms are needed within management decisionmaking and work processes to assure the utility of validated assumptions and estimations of effects. This information can be used to revise BMPs, to initiate changes and amendments to Forest Land Management Plans, and revisions to State Water Quality Standards.

LAND USE ACTIVITY EXAMPLE: Construction of four miles of road.

STEP DESCRIPTION

STEP 1 – BMP DESIGN: Design to protect beneficial uses and to meet resource management objectives.

Identify Beneficial Uses	Fish, domestic water supply, certain wildlife
Identify FS Goals and Objectives	Prevent soil erosion Meet water quality standards
Physical Conditions	FIELD INVESTIGATION: 1. road is 200 feet up sope from a stream 2. hill slope is 35 percent 3. soils very deep, well drained and highly erosive when vegetative cover is removed 4. 85% ground cover 5. land stability problems are not evident 6. channels stable OFFICE INVESTIGATION: 1. total precipitation averages 90 inches
BMP Alternatives	BMPs 12.17, 14.5, and 14.8 apply to this situation. The soil scientist and hydrologist identify three possible applications of these BMPs to control road cut and fill slope erosion. All three applications have proven equally effective elsewhere in the watershed. 1. Broadcast seed the exposed slopes with grass and cover with jute matting. (Seeding to occur within one week of fill slope construction.) 2. Broadcast seed with grass and put a filter windrow at base of fill slope toe. 3. Contour furrow cut and fill slopes to enhance infiltration and prevent slope surface runoff.
Feasibility	Interaction with the design engineer indicates contour furrowing is not cost-effective for this road. The wildlife biologist expresses concern ovr the use of jute matting in the proximity of deer fawning area. Through IDT interaction, the team agrees on application 2.
Risk	Grass fails to become established. Erosion/sedimation occurs.

Final BMP Design	The IDT agrees on application 1 and 2 with modification: fescure grass seed in place of rye, and placement of jute matting on ½:1 cutslopes.

STEP 2 - BMP IMPLEMENTATION:

Implementation	Erosion control needs are identified in NEPA document. BMPs 12.17, 14.5, and 14.8 are applied through the Road Cards and Road Management Objectives for project implementation.
Application	Contract stipulations are written that require the contractor to broadcast seed the slopes with fescue. Stipulations are incorporated into the contract and it is put out for bids. Apply practices as called for in contract.

STEP 3 - BMP MONITORING:

a. Types of Monitoring:

I. IMPLEMENTATION

II. EFFECTIVENESS

b. Purpose of Monitoring:

BMP APPLICATION AS DESIGNED Contract specs followed Timely in application	PROTECT BENEFICIAL USES Fish Habitat Affected MEETS GOALS AND OBJECTIVES State Water Quality Standards PROTECT SITE Erosion Reduced/Prevented

c. Who Monitors:

COR inspects the application of seed during road construction	Hydrologist/Soil Scientist/Fish Biologist evaluate effectiveness of the BMP to reduce erosion, protect fish habitat, and meet water quality standards.

STEP 4 - **EVALUATION**:

IMPLEMENTATION MONITORING DATA SHOW	EFFECTIVENESS MONITORING DATA SHOW
BMPs Implemented with site-specific Application	Erosion Reduced to Background Levels? Beneficial Uses Protected? Water Quality Standards Met? (Numeric Criteria Met?)

STEP 5 - **REPORT**:

What were the monitoring questions?
How and where were they monitored?
What does the raw data show?
Based on data analysis and evaluation:
Supply feedback to the BMP iterative process
Make management recommendations

STEP 6 - **FEEDBACK**: - ENSURES WE LEARN FROM WHAT WE DO. The documented data, along with the Report, are the mechanism to communicate the total of our experience for the benefit of future land management activities.

11.7 - Format

The general format used to present each BMP is as follows:

HEADING	CONTEXT
PRACTICE	Includes the sequential number of the practice and a brief title. The numbering of the activities does not have any intended significance.
OBJECTIVE	Describes the desired results or attainment of the practice as it relates to soil and water resource or beneficial use protection.
EXPLANATION	Further defines the brief title and expresses how the practice is applied. Describes criteria or standards used when applicable.
IMPLEMENTATION	Describes where the practice is applied, who is responsible for application, direction and supervision, and when the practice is employed.