

AML HANDBOOK

TAB IV REMEDIATION METHODS

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Mining and Minerals Branch
Land Resources Division-WASO
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*Dimensions given in this handbook are typical of the particular remediation method and are intended only for guidance. For a specific application, dimensions should be determined by detailed engineering design.

INTRODUCTION

Remediation measures for AML sites are grouped into five main categories, as follows:

- 1) Site characterization and monitoring.
- 2) Underground mine closures.
- 3) Surface mitigation.
- 4) Erosion and sedimentation control.
- 5) Revegetation.

The guidelines emphasize mine closure measures because information on these measures are not readily available to park staff.

The site characterization and monitoring guidelines are organized by environmental media including land (mine openings and waste), groundwater and surface water (mine drainage), vegetation, and wildlife. A section on air quality has not been included. Except for mine fires and fugitive dust, AML sites generally have little impact on air quality. No known fires exist in National Parks, and fugitive dust is mitigated in the course of correcting the other AML disturbances.

After remediation, the sites must be monitored to evaluate success of the work and to identify maintenance necessary for continuing health and safety, and environmental protection. Monitoring methods are related to site characterization, and the these two topics are discussed together.

There are a number of alternatives available for mine closures including measures that are temporary, permanent, or preserve the historical values.

- * Typical temporary closures are fencing, cable nets, grates or bat gates.
- * Intermediate closures are concrete caps, plugs, and bulkheads.
- * Permanent measures are backfilling with mine waste rock and sealing by blasting or with polyurethane foam.
- * Mine access roads, quarries and pits, waste dumps, and other surface disturbances are mitigated with backfilling, reshaping, and landscaping.
- * Historic preservation options range from documentation to interpretive signs to stabilization of the site.

Permanent mine closures reduce or eliminate health and safety hazards, reduce the need for future monitoring and maintenance, and reduce the threat of additional environmental

disturbance. Conversely, temporary closures allow continued access by wildlife, and access for geologic, archaeology, and park administrative purposes.

Mine closure methods also differ in scale. The small 1 to 2 acre 19th century site located in a remote area requires different remediation than a large quarry with highwalls and waste dumps. The small site may need nothing more than a little backfill and some hand built erosion control. The large site may require a modern earthmoving project utilizing special measures to isolate toxic waste, stabilize backfills, landscape highwalls, reshape drainage basins, revegetate grasses and trees, and may need years of maintenance and monitoring. Needless to say, the mine closure method must be suitable for the particular site, and in the following section, the handbook provides guidance on the selection of appropriate remediation measures.

The guidelines provide more detail on the small 19th century sites which make up the bulk of AML problems. Many parks have the resources to close these sites with their maintenance crews, and all they need is some guidance on what works. No one needs a \$30,000 engineering study for a \$2,000 mine closure project. (True story.) The larger sites invariably involve contract engineering and construction, and the guidelines for these closures are more general.

Surface mitigation is a combination of correcting the adverse impacts, and then controlling erosion and sedimentation until vegetation is re-established. This mitigation requires the reshaping of highwalls, roads, and dumps, correcting acid mine drainage, and removing or restoring abandoned structures and equipment.

Many AML sites are barren, and are the cause of significant erosion. Additionally, in the process of mitigating an AML site, the landscape often must be reshaped or regraded, and while the surface is vulnerable, special measures must be taken to prevent erosion and sedimentation.

- * Hillslopes must be protected from rainsplash, sheet runoff, gullyng, wind, and ground instability (landslides, creep, earthflow, rockfalls).
- * Drainage channels must be protected from bank erosion, scour, sedimentation, and changes in drainage patterns.

The guidelines first outline a landform design approach to the control of erosion and sedimentation. This guidance is primarily useful for large projects, on small projects control measures will be obvious. Landform design provides the basis for choosing appropriate control measures including salvage of topsoil, hillslope erosion control, various water energy dissipaters (drop structures and riprap), water diversion

(ditches and culverts), sedimentation basins, and handbuilt structures for small and remote projects.

The last step in a remediation project is revegetation. The guidelines provide a step-by-step outline for the revegetation of a site including topsoil replacement, fertilization and seedbed preparation, seeding and transplanting, and mulching. Most parks will have considerable local experience in revegetation, and this experience should prevail when developing a revegetation plan. Even where a park has considerable experience, the guidelines may be of help in special problems unique to AML sites such as treatment of acidic soils.

Mitigation plans must be consistent with park and regional requirements. Where there are conflicts between this handbook, and local park and regional requirements, final decisions regarding remediation lie with park management. The guidance given here is not mandatory, it is offered as a starting point and reference on methods that have been successful in mitigating AML sites. The following space is provided to write in references to local and regional guidance that must be consulted in completing a remediation plan.

PARK AND REGIONAL REQUIREMENTS DOCUMENTS

All of the remediation measures described below have been used successfully in State AML programs, some NPS parks, and the reclamation of modern mines. Many states have very efficient and mature programs with sites that have now been restored for a number of years.

METHOD SELECTION

This section provides guidance on how to select appropriate measures for the remediation of a particular site. Charts, tables, and matrices provide selection criteria. In some categories, the remediation measures are self-evident or a step-by-step procedure, and not a question of choice. It is assumed that the decision has already been made whether a site will be temporarily or permanently closed, or preserved for its historic values.