2. Ability of Mined Area Reclamation Practices to Restore Stream Habitat and Aquatic Functions Impacted by Mining

This issue addresses the effectiveness of reclamation practices to restore stream habitat and aquatic functions impacted by mining. In contrast to Issue 3, this issue considers mitigation efforts which may be effective within the impacted watersheds. These practices may include stream construction or enhancement or the construction of other aquatic systems such as wetlands to compensate for the loss of aquatic functions. The use of some type of "mitigation bank" may be used for mitigation although this practice would tend to occur at locations beyond the watershed impacted by the mine.

Stream habitats and functions have been discussed in Section III.B. and in the cumulative impacts. Among the most critical ecological functions of headwater streams include nutrient cycling and the maintenance of unique species and populations which providing an unparalleled reservoir for genetic diversity in aquatic systems on a national basis.

To date, neither stream construction and enhancement or wetland creation have been demonstrated to fully compensate for the functions lost by the filling of headwater streams or the indirect effects to downstream segments of streams from filling upstream portions. This issue discusses proposed actions that might improve our ability to successfully restore at least some functions provided by headwater stream systems.

A. Consequences of the Baseline Alternative

Surface mining operations in steep slope terrain generate excess spoil that is often placed in adjacent valleys. Large valley fills encroach and bury significant lengths of the stream headwaters. These first and second order headwater streams receive, process and transport a major portion of the downstream biological energy budget from leaf litter and other terrestrial sources of carbon. The ecological functions of Appalachian streams are described in Chapter III.C. Downstream biological communities are adapted to existing physical, chemical, and biological conditions within these stream arrays. Valley fills destroy stream habitats, alter stream chemistry, impact downstream transport of organic matter, and affect thermal and flow regimes available to downstream biological communities. Valley fills also destroy stream habitats before adequate pre-mining assessment of biological communities has been conducted.

Statements provided during scoping of this EIS indicate that wetland habitats and functions are being re-created on reclaimed mine sites either purposely or as the result of the construction of erosion and sediment controls that may provide suitable mitigation for the stream functions being eliminated by valley fill activities. Some scoping commentors also asserted that the construction of sediment ponds can replace aquatic values lost by filling headwater streams. However, independent corroboration of these findings by unbiased scientific observers has not occurred at present. Studies to date suggest that wetlands constructed on mining sites do not replace in-kind many of the functions provided by headwater streams. Isolated wetlands on reclaimed mines (i.e., wetlands that are not connected via flowing water to streams) will provide habitat for some species of wildlife, but obviously cannot contribute to the biological needs of the aquatic ecosystem downstream of the mine in the same way that the destroyed stream segments used to.

While aquatic life may be present in sedimentation ponds constructed at the toe of valley fills, and it is logical to assume that some processing of organic matter and downstream energy transport may be occurring, these ponds are temporary (they are usually eliminated following mining) while the loss of the filled stream segments is permanent.

Few would argue that recreating a biologically healthy stream on the mined site would be the most desirable option. However, this possibility is limited by the ability to intercept sufficient groundwater to maintain a base flow (Symposium on Aquatic Ecosystem Enhancement at Mountain Top Mining Sites, USEPA March 20, 2000). In certain situations, it may be possible for operators to design backfill slopes to intercept and direct groundwater flows on the down slope side of the mined area. In those situations, stream channels should be designed to provide maximum opportunity for the reestablishment of benthic populations and riparian habitat. In addition, regulation changes would be required to allow valley fill configurations that would accommodate stream restoration. In most cases, the inability to provide sufficient flow on a site will curtail stream creation opportunities on mined sites, and at best, only intermittent flow could be expected (Symposium on Aquatic Ecosystem Enhancement at Mountain Top Mining Sites, USEPA March 20, 2000).

Other stream restoration options may be available if currently degraded streams are identified which can be improved through riparian plantings, substrate improvements, and/or other enhancement measures. Restoration projects located within the same watershed to be impacted by the mining operation would be preferred. Currently, mining company officials, Federal and State fish and wildlife experts and citizen representatives are not involved in early (pre-permitting or pre-permitting application) discussions to identify aquatic restoration opportunities. Furthermore, the controls governing riparian zone restoration requirements to aid in stream restoration are unclear. The current SMCRA/CWA permit application process does not require the assessment of opportunities to replace any lost aquatic habitat values due to previous mining and valley filling within the mined watershed.

The WVDEP indicates that on-site mitigation of stream and associated wetland impacts was not the norm for pre-settlement MTM/VF mining operations in West Virginia. The threshold for wetland mitigation was 1/3 acre of impacts. It should be emphasized that while this figure represents the threshold for all wetland types, streams would be included in this analysis. This threshold was seldom met because wetlands are typically of limited extent within the narrow hollows and valleys of most valley fill sites, and also uncommon on steep slopes or ridge crests. On-site mitigation of stream impacts was also not usually practical due to the configuration of valley fills. In West Virginia, most coal companies opted to pay into a stream impact mitigation

fund. Impacts were assessed at a rate of $120,000 per acre for stream impacts to the toe of a fill, measured as length times width at the high water mark of Waters of the US. Temporary sedimentation ponds in stream channels were assessed at a rate of $20,000 per acre for each five-year block of channel occupancy. Coal companies could also perform other local mitigation or improvement projects of equal value to the mitigation payment requirements in lieu of direct cash payment.

The approximate percentage of MTM/VF operations that have been required to perform on-site mitigation of wetland impacts, including streams considered as wetlands, is being explored and additional information will be presented as available. The approximate percentage of MTM/VF mine operations required to perform on-site restoration of stream channels is being explored and additional information will be presented as available. It seems, in West Virginia, that the majority of mine operations satisfied mitigation requirements by payment to a mitigation fund. Additional information will be presented as available. Descriptions of the types of in-kind restoration/mitigation activities allowed or promoted, particularly regarding reclamation of previous mining impacts will be added to later versions of this EIS. The types of post-construction monitoring, if any, performed to evaluate the success of restoration activities is being evaluated. Additional information will be presented as available. A similar brief narrative will be added for Virginia, Kentucky, and Tennessee.

We do not, as of this date, have a clear understanding of the nature and extent of wetland resources being impacted by mountaintop mining/valley fill operations. However, it is anticipated that most of the aquatic habitat that could potentially be impacted by MTM/VF constitutes headwater streams. Claggett et. al. (2000) state that about 1400 miles of headwater streams are potentially impacted by existing or proposed valley fills. A review of National Wetland Inventory mapping in conjunction with status and trends information for the study area indicates that wetland areas typically found in the steep slope region are generally narrow linear vegetated wetlands along the stream valleys. As indicated above, wetland areas are being created on reclaimed mine sites, but the extent or value of these wetland areas is unknown. Because steep slope areas are being flattened, it is anticipated that wetland acreages have actually increased as a result of these mining activities. Studies to date indicate that replacing headwater streams by constructing wetland systems at the toe of fill does not suitably mitigate for many of the values lost upon filling the headwater stream areas (See B. Wallace and R. Powell in Symposium on Aquatic Ecosystem Enhancement at Mountain Top Mining Sites, USEPA March 20, 2000).

a. Ability of Wetlands on Reclaimed Mines to Restore Aquatic Functions Impacted by Mining

While wetland areas may be forming on mined sites, the functions being provided by these areas are largely unknown. A technical study was performed by the USEPA to address this issue (USEPA, 2000). To investigate this, field work was performed in November 1999 on ten wetland sites (mainly linear drainage structures and basin depressions) to assess the water quality, wildlife, and sediment trapping functions being provided by wetland areas typically being created on mined lands. The Evaluation for Planned Wetlands technique developed by Environmental Concern, Inc. (USEPA, 2000) was utilized by the field teams to perform these field assessments. The results for three habitat quality descriptors were based upon a score of 0 to 1 (lowest to highest).

Three parameters were evaluated in this study including sediment stabilization, water quality and wildlife. Sediment stabilization is the capacity to stabilize and retain previously deposited sediments. The water quality function is the capacity to retain and process dissolved or particulate materials to the benefit of downstream surface water quality. The wildlife parameter is the degree to which a wetland functions as habitat for wildlife as described by habitat complexity. Many of the wetland systems were providing excellent sediment stabilization functions, and a few were providing good water quality and wildlife functions. These findings are expected. Generally speaking, sediment stabilization is not a difficult function to establish in a wetland system. Water quality functions are also possible to establish with modest planning. In many of these cases, we suspect that the wetland systems were largely unplanned, and that the low percent vegetative cover was a significant influence on the low degree of water quality function being provided. Finally, wildlife functions are highly dependent on the vegetative communities present, the degree of interspersion, and other physical and biological features of the system. It is not surprising, therefore, to see that this function did not score highly in many of the systems studied. Those areas that scored highly for wildlife function tended to be older systems with more complex structures. It should be noted that the wetlands studied represented wetlands with surface water connects to stream systems as well as isolated wetlands which lacked connectivity to stream systems.

b. Ability of Sediment Drainage Ditches and Sediment Ponds to Replace Aquatic Functions Impacted by Mining

A study conducted by Pen Coal, entitled *An Evaluation of the Aquatic Habitats Provided By Sediment Drainage Ditches and Sediment Control Ponds Located on Mine Permitted Areas in Southern West Virginia* (Pen Coal, 1999), examined the water chemistry and biological communities located in sediment control structures. Three sediment ponds and three sediment ditches were studied. When comparing total abundances and taxa between the ponds, the study found that two of the ponds contained large total abundances of aquatic insects and a desirable number of taxa. One pond contained relatively low abundances and low taxa diversity compared to the other ponds sampled, but this pond had only recently been constructed and may have not yet established an aquatic community. Similar results were found in the sediment ditches. One recently constructed ditch contained a low abundance but moderate taxa diversity. The other ditches contained moderate and high abundances and varied taxa diversity (one was high and the other low). In general, most of the ponds and ditches sampled were well represented by the groups of aquatic insects which are normally present in these lentic habitats. The functional feeding groups scrapers and collecters/filterers were never present, but this was not surprising since these groups need silt free environments and faster moving water. The shredder functional feeding group (those that consume leaves and other detrital material) was also not well represented, but this group is sensitive to disturbances and pollution. Alternatively, the ditches may have lacked an adequate food supply for shredders. Generally, the sites contained mostly tolerant organisms such as midges, dragonflies, and aquatic worms which can tolerate pond habitats.

While the results of this study indicate that the sediment control structures are not functioning as healthy headwater streams based upon metrics commonly used to make such an assessment, it should not be automatically assumed that these systems are of little value to downstream resources. Some nutrient cycling functions may occur in these wetlands. Merritt et al. (1984)

summarized the nutrient resource utilization in a variety of aquatic habitats including headwater streams, eutrophic lakes and temporary ponds and discussed that aquatic insects in freshwater ecosystems played roles in the processing, turnover, storage and cycling of nutrients. Published studies demonstrating the occurrence of this function in wetlands established on mining sites are lacking.

c. Summary

In summary, the findings indicate that functional wetland systems are becoming established on mined sites, and that with proper planning, these systems may be capable of providing important sediment stabilization, water quality, and/or wildlife support functions. However, little conclusive evidence exists that would suggest that constructed wetland systems may contribute to a lotic system in an equivalent fashion to existing headwater reaches. However, while these benthic communities are significantly different from the communities being found in natural headwater streams, their contributions to downstream resources should not be discounted without further study. Comparative studies are recommended to evaluate the amount and types of organic matter that are being provided by wetland communities on mined sites. Currently, no monitoring requirements exist which necessitate evaluation of the success of aquatic restoration initiatives.

B. Actions Specific to Alternative B

Action 1: Amend SMCRA, COE and EPA regulations as appropriate to restrict all valley fills to the ephemeral (wet weather flow only) portions of headwater streams.

The goal of this action is to eliminate direct impacts and reduce indirect impacts to downstream (i.e., intermittent and perennial) aquatic systems. Impacts from this action include direct impacts to the stream segments filled and indirect impacts to downstream reaches through changes in the physical, chemical or biotic components of the stream.

Under this issue, mitigation potentially consists of stream restoration including stream creation and downstream enhancement, or substituting other aquatic habitats such as wetlands with their associated values in place of the filled stream. Stream creation on filled areas is very difficult in general due to the inability to capture sufficient groundwater flows necessary to provide a source, in this case, an ephemeral source of flow for the new stream. The flow regimes required to restore the flora and fauna typical to ephemeral reaches of streams may be impossible to design. While wetlands appear to mitigate for some wildlife functions provided by streams, wetlands could not mitigate for most of the stream functions provided by ephemeral streams relating to organic material processing, species diversity and richness and habitat support for rare and endemic species. In addition, fill impacts to downstream areas are caused in part by changes in water chemistry and thermal regimes. In-stream wetlands may be designed to improve water chemistry and thermal regimes. The success of these biotic treatment systems appears to be highly variable and dependent on the initial severity of the impact.

C. Actions Specific to Alternative C

This action would allow valley fills to be constructed in ephemeral and intermittent streams. This action would require a revision to the existing stream buffer rule to allow the placement of excess spoil into the intermittent zone. The intended goal of this action is to eliminate direct impacts to perennial streams and reduce indirect impacts to downstream aquatic systems. Direct impacts to aquatic resources in ephemeral and intermittent reaches will persist. Those faunal and floral species reliant upon habitats that are provided by, or are unique to ephemeral or intermittent zones would realize a decrease in available habitat.

Under this issue, mitigation potentially consists of stream restoration including stream creation and downstream enhancement, or substituting other aquatic habitats such as wetlands with their associated values in place of the filled stream. Stream creation on filled areas is very difficult in general due to the inability to capture sufficient groundwater flows necessary to provide a source, in this case, an intermittent source of flow for the new stream. The flow regimes required to restore the flora and fauna typical to intermittent reaches of streams may be impossible to design. While wetlands appear to mitigate for some wildlife functions provided by streams, wetlands could not mitigate for most of the stream functions provided by intermittent streams relating to organic material processing, species diversity and richness and habitat support for rare and endemic species. In addition, fill impacts to downstream areas are caused in part by changes in water chemistry and thermal regimes. In-stream wetlands may be designed to improve water chemistry and thermal regimes. The success of these biotic treatment systems appears to be highly variable and dependent on the initial severity of the impact.

D. Actions Specific to Alternative D

Action 3: Amend SMCRA, COE, and EPA regulations, as appropriate, to authorize the placement of valley fills in perennial streams.

This action would require a revision to the existing stream buffer rule to allow the placement of excess spoil into stream segments which flow all or part of the year. Minimization of fill would be achieved through a more comprehensive program of evaluation and alternatives analysis.

Under this issue, mitigation potentially consists of stream restoration including stream creation and downstream enhancement, or substituting other aquatic habitats such as wetlands with their associated values in place of the filled stream. Stream creation on filled areas is very difficult in general due to the inability to capture sufficient groundwater flows necessary to provide a source. However, there is some evidence that perennial flow could be established on a contour between the fill and the native rock by the use of some type of impermeable liner. No demonstration projects have yet been performed to validate this hypothetical design. Were such a stream to be constructed, over time, it could mitigate for some natural stream functions as macroinvertebrate

communities become established and begin performing these functions.

While wetlands appear to mitigate for some wildlife functions provided by streams, wetlands could not mitigate for most of the stream functions provided by perennial streams relating to organic material processing, species diversity and richness and habitat support for rare and endemic species. In addition, fill impacts to downstream areas are caused in part by changes in water chemistry and thermal regimes. In-stream wetlands may be designed to improve water chemistry and thermal regimes. The success of these biotic treatment systems appears to be highly variable and is dependent on the initial severity of the impact.

E. Actions Common to Alternatives C and D

a. Actions designed to primarily address Issue 2

Action 11: Change existing regulations to allow different configuration of valley fills to facilitate stream creation.

Descriptions of different fill configurations proposed by this action have been presented in Section IV.D.2. Overall, this action would modify regulations to promote configurations that more closely mimic a site's pre-mining topography and enhance the opportunity for stream restoration through re-creation of streams.

Stream re-creation is a young but advancing science. In order for streams to be successfully re-created or restored, a range of natural variables must be integrated into the design including: fluvial geomorphology, sediment transport mechanics, hydraulics, hydrology, plant ecology, fisheries biology and land use (Inter-Fluv 1998). The development of functional, stable stream beds requires the establishment of appropriate channel planform configurations among other factors. As such, stream re-creation can more easily occur where configurations of valley fills are not limited to legally prescribed 50 foot lift contouring. The establishment of more natural post-mining landscapes should improve the opportunity for the re-creation of streams on the deposited valley fills. However, speakers from the Stream Restoration Symposium (March 20, 2000 or Jan? 2000) concluded that, at best, streams recreated on mined lands would be expected to have only intermittent flow.

Action 12: Require SMCRA/CWA permit application to assess opportunities to replace any lost aquatic habitat values due to previous mining and valley filling within the mined

In many instances, it may not be possible to fully restore or mitigate the impacts to the aquatic habitat from a MTM/VF operation on the fill site alone. Under this action, further restoration or reclamation efforts may be required on sites impacted historically within the same watershed to

compensate for any lost aquatic habitat values resulting from fill activities.

Allowing a MTM/VF operation to mitigate some impacts to aquatic resources by improving off-site areas may result in some long term degradation of aquatic areas immediately downstream from the site from effects such as decreased nutrient and energy transfer. However, this action should result in decreased impacts on a long term basis for downstream areas within the watershed as a whole by providing greater opportunities for aquatic habitat restoration.

b. Actions designed to primarily address other Issues, but are relevant to Issue 2

Action 7: Develop water and biological monitoring protocols to collect pre-mining baseline data to characterize mitigation. These data will serve as the scientific basis for evaluating watershed and water resource impacts related to both SMCRA and/or CWA permit decisions. To implement the monitoring plans, permit applicants will receive guidance on how to collect biological stream data, report monitoring information to public agencies, and receive and use third party information.

This Action has been discussed in Issue 1. Implementation of this action will facilitate the evaluation of changes over time (pre-mining to post-mining). Collection of better data will enhance permitting decisions and improve mitigation procedures.

Action 8: OSM and SMCRA regulatory authorities will amend rules, where appropriate, to augment probable hydrologic consequences (PHC) analyses to include consideration of water quality and aquatic biology impacts. Biological indices will be used to measure stream impacts and improvements over time. Reference areas of undisturbed aquatic habitat will be used as a baseline to assess the impact of mining and set mitigation requirements. OSM and SMCRA will also incorporate additional requirements for groundwater impact analysis if found to be necessary, based on the review of existing requirements.

This Action has been discussed in Issue 1. Data collected during PHC analyses would be used to establish mitigation requirements. In a similar fashion to Action 7, this action would be anticipated to result in better mitigation efforts as the ability to determine the success of mitigation through improved evaluation procedures is developed.

This Action has been discussed in Issue 1. The proposed analyses would be used to determine mitigation requirements and during monitoring of mitigation efforts. Once specially protected areas are identified, mitigation may include preservation of these areas. This action is also discussed in more detail under Issue 3 since it is anticipated that areas supporting high quality aquatic populations may be located off-site from most mines.

Action 14: Develop State-Federal mitigation agreement that will result in better identification of stream restoration/compensation requirements during permit application processes. A sliding compensation/credit scale will be developed to minimize mining and valley fill impacts, and provide incentives for the restoration of aquatic resources.

This Action is discussed in Issue 3. While this action would be more applicable to mitigation through compensation rather than through restoration, the partial intent of this action is early

Action 15: A monitoring plan for mitigation projects will be incorporated into SMCRA/NPDES inspection schedules.

identification of mitigation needs during the permit application process.
This Action is discussed in Issue 3. The discussion presented in that section is however applicable to mitigation projects performed under for stream restoration purposes. The most critical features of any monitoring plan include the evaluation criteria and the recourse planned if the evaluation criteria are not being met. It is anticipated that this action would result in more successful mitigation efforts and provide data on which to base future mitigation efforts.

Action 16: SMCRA and CWA requirements will be merged to establish financial liability (e.g., bonding and/or insurance) to assure mitigation projects are completed successfully.

This Action is discussed in Issue 3. The discussion presented in that section is however applicable to mitigation projects performed under for stream restoration purposes. This type of funding mechanism would help keep mitigation projects active because of the financial liability for a company and would be an incentive to encourage companies to complete their mitigation efforts.

F. Actions Common to Alternatives B, C and D

a. Actions designed to primarily address Issue 2

There is limited information on successful restoration of streams that are adjacent to or on valley fills. In addition, the functions served by ephemeral streams are not well defined. Biological communities have been found to be present in the ephemeral portions of headwater streams (Interagency Invertebrate Study Group 2000). It is known that ephemeral stream areas such as spring brooks or seepage areas in the southern Appalachian region have been found to harbor rare and endemic species (Wallace in USFWS April 13, 1999). Little is known about the nutrient and energy flow relationships between ephemeral streams and downstream intermittent and perennial reaches. As a result of these data deficiencies, it is difficult to determine whether restoration methods exist which would be capable of restoring all or some stream functions lost through filling activities.

Under this action, activities to collect information on the application of ecosystem restoration methods to mined lands and streams that are adjacent to or on valley fills would be continued. One method of collecting pertinent information would be to construct and monitor demonstration sites.

It is possible that some functions of ephemeral streams may be restored by mitigation efforts while others, such as establishing habitat for rare and endangered species, may be very difficult to effect. Further, we do not know how valley fills on ephemeral streams may affect downstream chemistry. Continuing to assess aquatic ecosystem restoration methods including demonstration sites would provide empirical data on using restoration to mitigate for the loss of natural, ephemeral streams.

Action 30: Promote aquatic habitat restoration as part of reclamation. Clarify regulations governing riparian zone restoration requirements to aid stream restoration.

Riparian zones are known to be important determinants of ecosystem function in headwater stream systems. Although few studies have occurred on ephemeral streams, the presence of significant populations of shredders in these streams (Interagency Invertebrate Study 2000) indicate their reliance on riparian zone vegetation as an initial energy source as is commonly found in other types of headwater streams (Wallace et al. 1992). Including riparian zone restoration requirements during stream restoration would be critical to the creation of a functioning stream system. In order for riparian zone restoration to occur on a consistent basis, the regulatory status of riparian zones requires clarification.

During the permitting phase, the regulatory authority, in consultation with the wildlife agencies, have the authority to define the extent of the riparian zone (regulations provide for a 100 foot buffer zone). Valuable fish and wildlife habitats can be defined under 30 CFR 780.16. Clarifying the regulatory status of riparian zones such that the restoration of these areas occurs concurrently with stream restoration should improve the success of stream restoration efforts. Limited studies focusing on the restoration of the functions lost from the filling of headwater streams through the re-creation of aquatic habitat as part of reclamation have been conducted. In addition, it is not

known whether the limited studies that have been performed would be applicable to restoring functions when fills occur in ephemeral stream systems. Several studies have shown that some restoration of aquatic functions through aquatic habitat substitution does occur when wetlands are constructed on mined sites (USEPA Wetland Study 1999 or 2000– see from page V.A.2-2 and Pen Coal 1999). These studies indicated that functions relating to sediment stabilization, water quality and wildlife may be restored to some extent by the creation of wetland areas on mined sites. In addition, some nutrient cycling functions may occur in these wetlands. Merritt et al. (1984) summarized the nutrient resource utilization in a variety of aquatic habitats including headwater streams, eutrophic lakes and temporary ponds and discussed that aquatic insects in freshwater ecosystems played roles in the processing, turnover, storage and cycling of nutrients. Published studies demonstrating the occurrence of this function in wetlands established on mining sites are lacking. In addition, many mining site wetlands/ponds are not hydrologically connected to the unfilled streams. Unconnected wetland/pond systems cannot restore the nutrient cycling function provided by the filled stream reaches.

Based on the information available, it appears that promoting aquatic habitat re-creation, whether through actual stream restoration or through aquatic habitat substitution, during reclamation activities has the potential to restore some to many of the functions lost when headwater streams are filled. It is clear that some functions relating to the preservation of unique and endemic flora and fauna may not be restored by creating lentic or wetland aquatic systems. Also, data demonstrating the restoration of a headwater stream's nutrient and energy recycling function by the construction of lentic or wetland aquatic systems is largely lacking, though studies exist in the primary literature demonstrating that nutrient cycling does occur in lentic aquatic systems. Success of this action would be improved by involving key federal and state natural resource agencies such as the US Fish and Wildlife Service in the development and review of aquatic habitat restoration plans. The involvement of these agencies would help ensure that aquatic habitat restoration plans address key functions and contain provisions for restoring the identified key functions.

Action 31: Establish monitoring requirements to evaluate the success of aquatic restoration initiatives.

This action entails including monitoring requirements into permits to certify that the stream restoration has been constructed as designed and/or is functioning as intended. Monitoring requirements may go as far as stipulating that additional intervention will occur if certain performance standards are not met. Establishing monitoring requirements for headwater stream restoration projects would assist with the following:

I. determine success of restoration for current project
– provide data useful for improving restoration efforts on future projects
– provide information on types of monitoring that are good indicators of success
– provide information on types of monitoring that indicate lack of success in a restoration effort

Monitoring may include a post-construction evaluation of: 1) the physical characteristics of the

stream/riparian zone such as the slope, flow or hydrology; 2) the chemical characteristics of the stream such as conductivity, pH, dissolved organic carbon; and 3) the biotic characteristics of the stream such as characterization of the macroinvertebrate or microbial community.

Implementation of this action has the potential to positively influence the success of both current and future aquatic restoration efforts.

b. Actions designed to primarily address other Issues, but are relevant to Issue 2

Action 32: Federal-State interagency teams will be established to evaluate, modify, or develop "best management practices" for aquatic resources, which will be published and updated in a detailed "how to" manual on the delineation, protection, mitigation, restoration and replacement of streams and other ecological resources.

This Action is discussed in Issue 3. The development of a best management practices manual for aquatic resources would serve a variety of functions. First, its creation would serve as an impetus to develop delineation techniques for evaluating a multitude of pre-fill characteristics for the potentially impacted aquatic habitat including: the size of area to be impacted, the quality of the aquatic habitat, its chemistry, its biological community, and its physical characteristics.

Secondly, depending on which actions are implemented, there may be a somewhat complex decision-making process that should be engaged in order to select alternatives to minimize impacts to the aquatic habitat. This may include an evaluation of alternative non-aquatic fill locations, consideration of alternative land form creation, considerations of placing fill in already impacted aquatic environments rather than in a health aquatic system. A manual of this type would be one forum for codifying this decision-making process.

Thirdly, when impacts cannot be avoided, alternatives for mitigating impacts must be evaluated. Considerations would include onsite versus offsite mitigation, mitigation in-kind versus out of kind or evaluation of participation in some type of aquatic habitat banking program. This type of BMP manual would be useful in summarizing the options available for this step.

Finally, this manual could be used to present case studies, state, federal, and industrial contacts and other useful information.

Action 65: Create "land trusts," mitigation "banking" of pristine areas, or other creative mitigation techniques (such as AML reclamation) to offset mining impacts.

Under the section 404 of the CWA, compensatory mitigation is allowed to offset unavoidable impacts to streams, rivers, and wetlands. States have applied their authority under section 401 of the CWA to require compensatory mitigation. This action encourages the use of "land trusts",

"banking", and the reclamation of unreclaimed mined lands as acceptable compensatory mitigation techniques.

This action would encourage land trusts for areas containing unique or rare aquatic or terrestrial organisms. This type of mitigation banking may be the most reliable method for ensuring the preservation of unique flora and fauna and maintaining a high level of genetic diversity within fish, amphibian, mussel and macroinvertebrate populations found in this area.

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V. Environmental Consequences