9.0 RECOMMENDATIONS

The primary thrust of this study has been the application of remote sensing for evaluation of the effects of longwall mine subsidence on the forest canopy. As discussed in earlier sections of this report, remote sensing is an effective tool for detecting areas of stressed tree canopy. The recommendations developed based on this study include: (1) application of remote sensing for the location of drainage or moisture impacts from subsidence and (2) application of comprehensive ground-based tree surveys to characterize forest health at study sites and to quantify the significance of forest canopy stresses encountered.

Based on the study completed, subsidence features such as pools and slides have been observed to have generally minor impacts on the canopy of some types of trees. For example, tree types that are less moisture tolerant exhibited some decline along subsidence pools created after longwall mining beneath Enlow Fork. At a slide area associated with subsidence, soil wetness and damage to roots were concluded to be the causes of decline and mortality of young ash and sassafras trees. Where canopy stress is limited to specific tree types, or to isolated subsidence features, high-resolution remote sensing can be a useful tool.

Drainage and moisture impacts on cropland and forests from subsidence have been documented in the literature, and impacts on forests were the focus of this study. Use of remote sensing (e.g., thermal scanning) to identify such impacts would provide a simple and economic method to evaluate large areas for potential impacts to forestland. Impacted areas could then be investigated either through focused airborne remote sensing programs or ground-based tree surveys. Accordingly, it is recommended that future studies of subsidence impacts to forestland retain the remote sensing tool, using it initially to identify drainage and moisture impacts which could direct more focused airborne remote sensing programs or ground-based tree surveys.

Ground-based investigations, while not the focus of the current project, would provide a means of extending the tree surveys conducted at the locations of canopy stress observed on the multispectral imagery and developing a comprehensive characterization of the forestland at each study site. A ground-based forest survey could be designed for the

purpose of identifying on a statistical basis the dominant tree types (e.g., oak, maple, elm, hickory, sycamore, etc.) and their health at each study site. Such a study would provide further basis for quantifying the significance of the canopy stress detected in this study.

The observation of subsidence effects and analyses of predicted subsidence strain performed in the current study should also be employed as part of the forest survey to ensure that varying ground disturbance conditions are represented. This would allow a more comprehensive comparison of the health of tree types surveyed at undermined and non-undermined control study sites. Specifically, branch dieback could be evaluated at control sites for comparison with conditions at undermined study sites. Accordingly, it is recommended that a ground-based forest survey program for comprehensive characterization of the tree types and health within the study areas be designed and implemented. Such ground-based work would supplement the current remote sensing study and would provide further quantification to the evaluation of impacts of longwall mining on forestland.