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Mountaintop Mining/Valley Fills in Appalachia Draft Programmatic Environmental Impact Statement

Mountaintop Mining/Valley Fill
DEIS

Mountaintop Mining/Valley Fills in Appalachia
Draft Programmatic Environmental Impact Statement

This Draft Programmatic EIS has been prepared by the lead agencies listed below pursuant to the Settlement Agreement entered in Bragg v. Robertson, Civ. No. 2:98-0636 (S.D. W.V.). That Agreement provided for the preparation of the EIS but the agencies did not concede that the EIS was required by the National Environmental Policy Act. This EIS is "programmatic" in that it considers new or revised program guidance, policies, or regulations relevant to mountaintop mining and valley fills within the Appalachian study area in West Virginia, Kentucky, Virginia, and Tennessee. The purpose of this EIS, published in the Federal Register on February 5, 1999, is "to consider developing agency policies, guidance, and coordinated agency decision-making processes to minimize, to the maximum extent practicable, the adverse environmental effects to waters of the Unites States and to fish and wildlife resources affected by mountaintop mining operations, and to environmental resources that could be affected by the size and location of excess spoil disposal sites in valley fills." The objective is consonant application of the Clean Water Act and the Surface Mining Control and Reclamation Act to improve the regulatory process and effect better environmental protection for mountaintop mining and valley fill operations in steep slope Appalachia.

For more information – please contact any of the following lead agency representatives:

John Forren	U.S. Environmental Protection Agency	**(215) 814-2705**
Katherine Trott	U.S. Army Corps of Engineers	**(202) 761-4617**
Michael Robinson	**U.S.** Office of Surface Mining	**(412) 937-2882**
Cindy Tibbott	**U.S.** Fish and Wildlife Service	**(814) 234-4090**
Russell Hunter	WV Department of Environmental Protection	**(304) 759-0510**

Commenting on this Document –

All individuals, agencies, organizations, companies, and the public are invited to submit written comments on this document. All **comments must be submitted to the U.S. EPA at the address to the right and received by August 29,2003.**

John Forren
U.S. EPA (3ES30)
1650 Arch Street
Philadelphia, PA 19103
Fax: (215) 814-2783

Kathryn A. Hodgkiss
U.S. Environmental Protection Agency
Philadelphia, Pennsylvania

Dr. Mark F. Sudol
U.S. Army Corps of Engineers
Washington, DC

Brent Wahlquist
U.S. Office of Surface Mining
Pittsburgh, Pennsylvania

Dr. Richard O. Bennett
U.S. Fish and Wildlife Service
Hadley, Massachusetts

Matthew B. Crum
WV Department of Environmental Protection
Charleston, West Virginia

TABLE OF CONTENTS

EXECUTIVE SUMMARY ES-1
LIST OF ACRONYMS
PULL OUT USER GUIDE TO ACRONYMS

I. PURPOSE AND NEED I-1
A. INTRODUCTION I-1
B. PROPOSED ACTION I-2
C. PURPOSE OF THE EIS I-2
D. NEED FOR PROPOSED ACTION I-3
E. STUDY AREA I-5
F. CHRONOLOGY OF ISSUES I-5
1. 1997-1999 Chronology I-5
a. Federal Activities I-6
b. WV Governor's Study I-6
c. Litigation I-7
c.1. *Bragg v. Robertson* I-7
c.2. Clean Water Act Allegations I-7
c.3. SMCRA Allegations I-7
c.4. *Bragg* 1998 Settlement I-8
c.5. 1999 Consent Decree I-9
c.6. 1999 *Bragg* decision I-9
3. 2000-2003 Chronology I-9
a. Revision to Definition of "Fill Material" under CWA Section 404 and Issuance of Revised NWPs I-10
b. Litigation I-10
b.1. *Bragg v. Robertson* I-10
b.2. *KFTC v. Rivenburgh* I-11
G. SCOPING AND PUBLIC INVOLVEMENT I-11
1. Public Participation I-11
a. Public Meetings I-12
b. Meetings with Citizen Groups I-12
c. Meetings with Coal Mining Industry Groups I-12
2. Issues Raised During the Scoping Process I-12
a. Direct Stream Loss I-12
b. Stream Impairment I-13
c. Fill Minimization I-13
d. Assessing and Mitigating Stream Habitat and Aquatic Functions I-14
e. Cumulative Impacts I-15
f. Deforestation I-15
g. Blasting I-16
h. Air Quality I-17
i. Flooding I-17
j. Land Use I-18
k. Threatened and Endangered Species I-18
l. Scenery and Culturally Significant Landscapes I-19
m. Exotic and Invasive Species I-19

n. Valley Fill Stability I-20
o. Economics I-20
p. Environmental Justice I-21
q. Government Efficiency I-21

II. ALTERNATIVES II.A-1
A. ACTIONS CONSIDERED TO ADDRESS ISSUES IDENTIFIED IN SCOPING II.A-1
1. Programmatic Review II.A-1
2. Technical Studies II.A-2
3. Disposition of the Issues II.A-5
a. Blasting II.A-6
b. Land Use II.A-6
c. Scenery and Culturally Significant Landscapes II.A-6
d. Valley Fill Stability II.A-8
e. Economics II.A-8
f. Environmental Justice II.A-8
B. SUMMARY OF ALTERNATIVES CARRIED FORWARD II.B-1
1. Overview of the Alternatives II.B-4
a. No Action Alternative: The Regulatory Program Today . . . II.B-4
a.1. COE CWA Section 404 Program II.B-5
a.2. EPA CWA Section 402/404 Programs II.B-6
a.3. SMCRA Programs II.B-6
b. Summary of Alternative 1: The Number, Size, and Location of Valley Fills in Waters of the U.S. would be Determined by the COE CWA Section 404 Permit Process. II.B-7
c. Alternative 2: (Preferred Alternative) The Size, Number, and Location of Valley Fills in Waters of the U.S. would be Determined by a Coordinated Regulatory Process II.B-8
d. Alternative 3: The Size, Number, and Location of MTM/VF Valley Fills in Waters of the U.S. would be Determined by an Enhanced SMCRA Regulatory Program . II.B-9
2. Specific Actions Proposed by the Alternatives II.B-10
a. Proposals Common to Action Alternatives 1, 2, and 3 . . . . II.B-10
b. Actions Common to Alternatives 1 and 2 . . . . . II.B-12
c. Actions Common to Alternatives 2 and 3 . . . . . II.B-12
d. Actions Unique to Alternative 1 . . . . . II.B-12
e. Actions Unique to Alternative 2 . . . . . II.B-12
f. Actions Unique to Alternative 3 . . . . . II.B-12
3. Regulatory and Environmental Benefits of the Alternatives II.B-13
a. Regulatory Process Benefits of All Action Alternatives . . . II.B-13
b. Distinguishing Process Benefits Between the Alternatives . II.B-14
c. Environmental Benefits of the No Action Alternative II.B-15
d. Environmental Benefits of the Action Alternatives II.B-17

C. DETAILED ANALYSES OF THE ACTIONS TO ADDRESS ISSUES . . II.C-1
1. Government Efficiency; Sub-issue: Coordinated Decision Making . II.C-2
a. No Action Alternative: The Regulatory Program Today . . . II.C-3
a.1. CWA Section 404 . . . . . II.C-4
a.2. CWA Section 404 State Assumption and Programmatic General Permits II.C-8
a.3. SMCRA II.C-9
a.4. Other Regulatory Programs II.C-11
a.5. Permit Sequencing II.C-11
b. Alternative 1: The Size, Number, and Location of Valley Fills in Waters of the U.S. are Determined by the COE CWA Section 404 Permit Process II.C-11
b.1. Process and Regulatory Responsibilities II.C-12
b.2. Memorandum of Agreement (MOA) and Field Operating Procedure (FOP) II.C-16
c. Alternative 2: (Preferred Alternative) The Size, Number, and Location of Valley Fills in Waters of the U.S. are Determined by a Coordinated Regulatory Process II.C-17
c.1. Process and Regulatory Responsibilities II.C-18
c.2. Memorandum of Agreement (MOA) and Field Operating Procedure (FOP) II.C-21
c.3. Joint Application II.C-22
d. Alternative 3: The Size, Number, and Location of Valley Fills in Waters of the U.S. are Determined by an Enhanced SMCRA Regulatory Program II.C-23
d.1. Process, Regulatory Responsibility, and Coordination II.C-24
d.2. Memorandum of Agreement (MOA) and Field Operating Procedure (FOP) II.C-26
2. Government Efficiency, Sub-issue: Consistent/Compatible Definitions for Stream Characteristics and Analyses II.C-26
a. No Action Alternative: The Regulatory Program Today . . II.C-28
a.1. CWA Section 404 . . . . . II.C-28
a.2. SMCRA II.C-29
a.3. Other Regulatory Programs II.C-29
b. Alternatives 1,2 and 3 . . . . . II.C-29
3. Direct Stream Loss II.C-30
a. No Action Alternative: The Regulatory Program Today . . II.C-31
a.1. CWA Section 404 . . . . . II.C-31
a.2. SMCRA II.C-33
b. Alternative 1 . . . . . II.C-35
c. Alternative 2 and 3 . . . . . II.C-36
d. Alternative 1 and 2 . . . . . II.C-36
4. Stream Impairment II.C-37
a. The No Action Alternative: The Regulatory Program Today II.C-38
a.1. CWA Antidegradation policy II.C-38

a.2. CWA Water Quality Standards II.C-38
a.3. CWA Section 402 NPDES Permits and Water Quality Protection II.C-41
a.4. CWA Section 401 Certification II.C-42
a.5. Stream Bio-monitoring II.C-42
a.6. Stream Monitoring of Metals and pH II.C-43
b. Alternatives 1, 2, and 3 . . . . . II.C-43
5. Fill Minimization II.C-45
a. No Action Alternative: The Regulatory Program Today . . II.C-46
a.1. CWA Section 404 Program II.C-46
a.2. SMCRA Program II.C-47
b. Alternatives 1, 2, and 3 . . . . . II.C-49
6. Assessing and Mitigating Stream Habitat and Aquatic Functions . II.C-49
a. No Action Alternative: The Regulatory Program Today . . II.C-51
a.1. CWA Section 404 Program II.C-51
a.2. SMCRA II.C-56
b. Alternatives 1, 2, and 3 . . . . . II.C-58
7. Cumulative Impacts II.C-62
a. No Action Alternative: The Regulatory Program Today . . II.C-64
a.1. CWA II.C-64
a.2. SMCRA II.C-66
b. Alternatives 1, 2, and 3 . . . . . II.C-69
b.1. Data Integration II.C-70
b.2. Delineation of Cumulative Impact Areas (CIAs) . . II.C-72
b.3. Establishing Cumulative Impact Thresholds II.C-73
8. Deforestation II.C-75
a. No Action Alternative: The Regulatory Program Today . . II.C-77
a.1. CWA Program II.C-77
a.2. DOE Program II.C-78
a.3. SMCRA Program II.C-79
b. Alternatives 1, 2, and 3 . . . . . II.C-81
b.1. Forest Product Recovery and Organic Utilization . . II.C-82
b.2. Revegetative Success and Growth Media for Forest PMLUs II.C-83
b.3. Natural Succession II.C-83
b.4. Technology Transfer and Outreach II.C-83
9. Air Quality II.C-84
a. No Action Alternative: The Regulatory Program Today . . II.C-84
a.1. Clean Air Act II.C-85
a.2. SMCRA II.C-86
b. Alternatives 1, 2, and 3 . . . . . II.C-86
10. Flooding II.C-87
a. No Action Alternative: The Regulatory Program Today . . II.C-88
a.1. CWA II.C-88
a.2. SMCRA II.C-89
b. Alternatives 1, 2, and 3 . . . . . II.C-90
11. Threatened and Endangered Species II.C-90

a. No Action Alternative: The Regulatory Program Today . . II.C-91
a.1. Migratory Birds II.C-93
b. Alternatives 1, 2, and 3 . . . . . II.C-93
D. ALTERNATIVES CONSIDERED BUT NOT CARRIED FORWARD IN THIS EIS II.D-1
1. Restricting Individual Valley Fills II.D-1
a. Limiting Individual Valley Fill Sizes by Type of Stream Segments II.D-1
b. Limiting Individual Valley Fill Sizes by Watershed Size . . II.D-3
c. Watershed Fill Restrictions Based on Past Mining Practice and COE Workload Management II.D-3
d. Cumulative Impact Restrictions II.D-6
2. Fill Restrictions Based on Identification of High-Value Aquatic Resources II.D-6
a. CWA Advanced Identification (ADID) of Potential Fill Sites II.D-7
b. CWA Special Aquatic Site Designation II.D-7
c. Advance Veto II.D-8
3. Fill Prohibition II.D-8
4. Summary of Fill Restriction Alternatives II.D-8

III. AFFECTED ENVIRONMENT AND CONSEQUENCES OF MTM/VF III.A-1
A. DESCRIPTION OF THE STUDY AREA III.A-1
B. PHYSICAL SETTING III.B-1
1. Physiographic Province III.B-1
2. Geology III.B-2
a. Regional Geologic History III.B-2
b. State Geology Summaries III.B-3
b.1. Kentucky III.B-3
b.2. Tennessee III.B-3
b.3. Virginia III.B-3
b.4. West Virginia III.B-4
3. Soils III.B-4
a. Soil Characteristics III.B-4
a.1. Soil Formation III.B-4
a.2. Soil Profile III.B-5
a.3. Soil Classification III.B-5
b. Study Area Soils III.B-5
b.1. Distribution III.B-6
4. Soil Productivity III.B-8
a. Applicable Regulations and Observations on Implementation III.B-9
b. Mine Soil/Forest Relationships III.B-12
c. Effect of Site Index on Timber Value: Oak III.B-13
d. Soil/Overburden Chemistry III.B-15
e. Soil Compaction III.B-16
f. Mycorrhizal Relationships III.B-16
g. Planting Trees on Mined Land III.B-17

5. Topography and Geomorphology III.B-19
   a. Topographic Characteristics III.B-19
   b. Geomorphic Characteristics III.B-23
   c. Steep Slopes and Slope Stability III.B-23
   d. Unstable Slopes III.B-24
6. Climate III.B-25

C. APPALACHIAN AQUATIC SYSTEMS III.C-1
1. Lotic (Flowing) Aquatic Systems III.C-1
   a. Representative Streams III.C-1
      a.1. Physical Characteristics III.C-1
      a.2. Stream Classification III.C-1
      a.3. Habitats in Streams III.C-2
   b. Energy Sources and Plant Communities III.C-3
      b.1. Vascular Plants and Bryophytes III.C-4
      b.2. Algae III.C-4
      b.3. Primary Production III.C-4
      b.4. Allochthonous Energy Sources and Processing III.C-4
   c. Animal Communities III.C-7
      c.1. Invertebrates III.C-7
      c.2. Vertebrates III.C-9
   d. Ecosystem Function III.C-11
2. Lentic (Non-flowing) Aquatic Systems and Wetlands III.C-13
   a. Overview III.C-13
   b. Physical Environment III.C-14
   c. Energy Sources and Plant Communities III.C-14
      c.1. Phytoplankton and Benthic Dwelling Micro-organisms III.C-14
      c.2. Vascular Plants III.C-15
      c.3. Primary Production III.C-15
   d. Animal Communities III.C-16
      d.1. Invertebrates III.C-16
      d.2. Vertebrates III.C-16
   e. Ecosystem Function III.C-17
   f. Wetlands in Study Area III.C-18
3. Interrelationship Between Headwater Streams and Native Forests III.C-21

D. IMPACT PRODUCING FACTORS TO HEADWATER STREAMS FROM MOUNTAINTOP MINING III.D-1
1. Studies Relating to Direct and Indirect Surface Water Impacts from Mountaintop Mining and Valley Fills III.D-1
   a. Loss of Linear Stream Length from Filling and Mining Activities Associated with Fills III.D-1
   b. Loss of Biota under Fill Foot Print or from Mined Stream Areas III.D-2
      b.1. Primary Literature Review of Aquatic Communities in Streams with Ephemeral or Intermittent Flow Regimes III.D-2
      b.2. Studies in the MTM/VF Study Area III.D-3

b.3. Conclusions Regarding the Existence of Aquatic Communities in Streams Potentially Impacted by Direct Filling or Mining Activities III.D-4
c. Loss of Upstream Energy from Buried Stream Reaches . . . III.D-4
d. Changes in Downstream Thermal Regime III.D-5
e. Changes in Downstream Flow Regime III.D-5
f. Changes in Downstream Chemistry III.D-5
f.1. Studies Addressing this Impact Factor III.D-6
f.2. Summary and Conclusions III.D-7
g. Changes in Downstream Sedimentation (Bed Characteristics) III.D-7
h. Effects to Downstream Biota III.D-8
h1. Summary of Results from Upstream-Downstream Comparison Type Studies III.D-9
h2. Results of Comparisons of Pre-mining Biotic Conditions to Post-mining Aquatic Communities . . III.D-9
h3. Results of A Multivariate Analysis Study on Benthic Invertebrate Communities and Their Responses to Selected Environmental Factors III.D-10
h4. Studies of Macroinvertebrate Communities in Stream Sites Located Downstream From Mined or Mined/Valley Filled Areas in Comparison to Reference Locations III.D-11
2. Studies Relating to Mitigation Efforts for MTM/VF Impacts to Aquatic Systems III.D-17
a. Definition of Mitigation III.D-17
b. Mitigation Goals III.D-17
c. Requirements for Development of a Successful In-kind Replacement Mitigation Project III.D-18
d. Limiting Factors for In-kind Mitigation Projects III.D-18
e. Types of Out-of-kind Mitigation III.D-19
e.1. Onsite III.D-19
e.2. Offsite III.D-21
E. COAL MINE DRAINAGE FROM SURFACE MINING III.E-1
1. Study Area Water Quality Summary III.E-1
2. Coal Mine Drainage III.E-2
a. Indicator Parameters III.E-3
b. Effects of Coal Mine Drainage III.E-6
3. Methods of Controlling CMD III.E-8
a. Overburden Blending III.E-9
b. Isolation Methods III.E-9
c. Submergence Methods III.E-9
d. Alkaline Addition III.E-9
4. Abandoned Mine Lands III.E-10
5. Remining III.E-10
a. Water Quality Benefits of Remining III.E-11
b. Regulatory Aspects of Remining III.E-12

F. APPALACHIAN FOREST COMMUNITIES III.F-1
1. Broadleaf Deciduous Forest Communities III.F-2
a. Mixed Mesophytic Forests III.F-2
b. Appalachian Oak Woods III.F-4
c. Northern Hardwoods III.F-4
d. Floodplain Forests III.F-5
2. Other Forest Communities III.F-5
a. Oak-Pine Forests (Hardwood/Conifer Forests and Mountain Hardwood/Conifer Forests) III.F-5
b. Pine Forests (Mountain Conifer Forests) III.F-6
3. Animal Communities III.F-6
a. Birds III.F-7
b. Mammals III.F-8
c. Herpetofauna III.F-9
4. Interior Forest Habitat and Area Sensitive Species III.F-9
5. Deforestation III.F-10
a. Forest Fragmentation III.F-12
b. Forest Edge Habitat, Edge Effect III.F-13
c. Patch Size III.F-14
d. Corridors III.F-15
6. Carbon Sequestration III.F-16
G. RELATIONSHIPS OF MOUNTAINTOP MINING TO SURFACE RUNOFF QUANTITY AND FLOODING III.G-1
1. Regulatory Background III.G-1
2. EIS Peak Flow Studies III.G-2
a. Peak Flow Study III.G-3
b. Fill Hydrology Study III.G-7
c. July 2001 Floods Study III.G-7
d. Citizen Complaints Study III.G-8
e. Other Studies III.G-8
H. RELATIONSHIP OF MOUNTAINTOP MINING TO GROUNDWATER QUALITY AND QUANTITY III.H-1
1. EIS Workshop Findings III.H-1
2. Pre-mining Appalachian Groundwater Flow System III.H-1
3. Impacts to Groundwater Quantity from MTM/VF III.H-2
a. Conceptual Model of MTM / VF III.H-3
b. MTM/VF impacts to the physical Ground Water system . . III.H-3
c. Impacts to Valley-bottom Groundwater Recharge From MTM/VF III.H-5
4. Impacts to Groundwater Chemistry From MTM/VF III.H-6
a. Geochemical Reactions III.H-6
b. Conceptual Geochemical Model III.H-7
5. Summary of Groundwater Impacts III.H-8
6. Groundwater Quantity and Quality Conclusions III.H-9
I. OVERVIEW OF APPALACHIAN REGION COAL MINING METHODS III.I-1
1. Underground Mining Methods III.I-3
a. Underground Mine Access III.I-3

b. Room and Pillar Mining III.I-4
b.1. Conventional Room and Pillar Mining III.I-4
b.2. Continuous Room and Pillar Mining III.I-7
c. Longwall Mining III.I-8
2. Surface Mining Methods III.I-11
a. The Surface Mining Process III.I-11
a.1. The Importance of Stripping Ratios III.I-13
a.2. Approximate Original Contour III.I-14
b. Contour Mining III.I-14
c. Area Mining III.I-16
d. Mountaintop Removal Mining III.I-20
e. Highwall Mining III.I-23
3. Mountaintop Mining Complexes III.I-26
a. Shipping Point III.I-26
b. Processing Facility III.I-28
c. Coal Refuse Disposal Facility III.I-28
d. Surface Mines III.I-28
e. Underground Mines III.I-29
J. MTM/VF CHARACTERISTICS III.J-1
1. General Setting III.J-1
a. Topography III.J-1
b. Coal Reserves III.J-1
c. Transportation Access III.J-2
d. Occupied Structures III.J-2
2. General Mine Layout III.J-2
a. Permit Area Trends III.J-3
b. Support Facilities III.J-6
c. Erosion and Sedimentation Control Facilities III.J-7
d. Haul Roads III.J-9
3. Mining Equipment III.J-9
a. Production Equipment III.J-9
b. Haulage Equipment III.J-10
c. Support Equipment III.J-12
4. Operational Characteristics III.J-14
a. Working Areas III.J-14
b. Mining Progression and Backfill Configuration III.J-14
c. Coal Production and Duration III.J-17
d. Site Reclamation III.J-18
d.1. Contemporaneous Reclamation III.J-18
d.2. Topsoil Replacement/Substitution III.J-19
d.3. Revegetation Plan III.J-19
K. EXCESS SPOIL DISPOSAL III.K-1
1. Characteristics of Excess Spoil Generation and Valley Fills III.K-1
a. Swell Factor and Excess Spoil Generation III.K-3
b. Relationship of Valley Fill Construction Technique and Water Quality III.K-10
c. Valley Fill Stability III.K-10

2. Trends in Valley Fills III.K-13
   a. Regional Valley Fill Trends III.K-21
   b. Kentucky Valley Fill Trends III.K-24
   c. Tennessee Valley Fill Trends III.K-26
   d. Virginia Valley Fill Trends III.K-28
   e. West Virginia Valley Fill Trends III.K-30
3. Trends in Valley Fills Size III.K-32
   a. Regional Valley Fill Size Trends III.K-32
   b. Kentucky Valley Fill Size Trends III.K-34
   c. Tennessee Valley Fill Size Trends III.K-35
   d. Virginia Valley Fill Size Trends III.K-36
   e. West Virginia Fill Size Trends III.K-37
4. Trends in Watershed Size III.K-38
   a. Regional Watershed Trends III.K-38
   b. Kentucky Watershed Trends III.K-40
   c. Tennessee Watershed Trends III.K-42
   d. Virginia Watershed Trends III.K-44
   e. West Virginia Watershed Trends III.K-46
5. Trends on Stream Impact Under Fill Footprints III.K-47
6. Relationship of Excess Spoil Generation to Mining Method III.K-50
7. Relationship of Excess Spoil Generation to AOC Variance III.K-50
   a. Excess Spoil Generation and AOC Relationships in Kentucky III.K-50
   b. Excess Spoil Generation and AOC Relationships in Tennessee III.K-51
   c. Excess Spoil Generation and AOC Relationships in Virginia III.K-51
   d Excess Spoil Generation and AOC Relationships in West Virginia III.K-51

L. MINE FEASIBILITY EVALUATION AND PLANNING III.L-1
1. General Considerations III.L-1
   a. Property Ownership III.L-1
   b. Capital Investment III.L-3
   c. Reclamation Bonding III.L-3
   d. Coal Market Conditions III.L-5
   e. Permitting Requirements III.L-6
2. Site-Specific Considerations III.L-6
   a. Geological III.L-6
   b. Topographical - Geographical III.L-7
   c. Operational III.L-8
3. MTM/VF Mine Economic Analysis III.L-8
   a. Capital Investment III.L-8
   b. Employment III.L-13
   c. Costs and Earnings III.L-13
   d. Taxes III.L-13
4. Mining Method Considerations III.L-17
   a. Mine Method Selection Factors III.L-17

M. COAL DISTRIBUTION AND MARKETS III.M-1
1. Coal Uses and Distribution III.M-1
2. Productivity and Price Trends III.M-3
3. Coal Demand and Production Projections III.M-5
4. Structure of the Coal Industry III.M-6
N. PAST AND CURRENT MINING IN THE STUDY AREA III.N-1
1. Kentucky III.N-5
2. Tennessee III.N-5
3. Virginia III.N-6
4. West Virginia III.N-6
O. THE SCOPE OF REMAINING SURFACE-MINABLE COAL IN THE STUDY AREA III.O-1
1. Demonstrated Coal Reserves III.O-1
2. Remaining Extent of Major Surface Minable Coal Seams III.O-1
a. Introduction III.O-1
b. Methodology III.O-2
3. Geologic Extent of Remaining Mountaintop-Minable Coal in the EIS Study Area III.O-3
P. DEMOGRAPHIC CONDITIONS III.P-1
1. Population III.P-1
2. Education Levels III.P-1
3. Income and Poverty Levels III.P-1
4. Analysis of Census Statistics for Select Communities III.P-2
a. Introduction III.P-2
b. Total Population Growth Trends III.P-2
c. Age Group Composition III.P-3
d. Racial Composition III.P-5
e. Poverty Levels and Unemployment Rates III.P-6
5. Environmental Justice Populations III.P-6
a. Regulatory Background III.P-6
b. Demographic Data Pertinent to Environmental Justice Populations III.P-7
b.1. Poverty Levels III.P-8
b.2. Per Capita Income III.P-9
b.3. Minority Populations III.P-9
Q. ECONOMIC CONDITIONS III.Q-1
1. Recent Trends in Unemployment Rates and Employment III.Q-1
2. The Economic Role of Coal Mining III.Q-1
a. Coal Mining Employment III.Q-1
b. Economic Multiplier Impacts of Coal Mining III.Q-6
c. Mining-Related Tax Revenues III.Q-9
c.1. Kentucky III.Q-9
c.2. Virginia III.Q-10
c.3. West Virginia III.Q-10
d. The Economic Role of Surface Coal Mining III.Q-11
3. Economic Projections III.Q-13
a. Central Appalachia Baseline Coal Economy Projections

from EIA and University of Kentucky III.Q-13
b. Marshall University Study for the West Virginia Senate Finance Committee III.Q-14
c. Statewide Overall Economic Forecasts III.Q-14
R. LAND USE AND POTENTIAL DEVELOPMENT III.R-1
1. Historical and Current Land Uses III.R-1
a. Current Land Uses, Study Area Overall III.R-1
b. Current Land Uses, West Virginia Study Area III.R-1
c. Patterns of Land Use Changes, West Virginia Study Area . III.R-1
2. The Role of Land and Mineral Ownership III.R-3
3. Land Use and Economic Development Planning III.R-3
a. Appalachian Regional Commission (ARC) III.R-4
b. Kentucky III.R-4
c. Virginia III.R-4
d. West Virginia III.R-4
4. Land Use Needs and Development Potentials III.R-5
a. Intensive Human Use III.R-5
b. Recreation III.R-6
c. Commercial Forestry III.R-6
d. Future Land Use Needs III.R-6
S. HISTORIC AND ARCHAEOLOGICAL RESOURCES III.S-1
T. ECONOMIC IMPORTANCE OF EXISTING LANDSCAPE AND ENVIRONMENTAL QUALITY III.T-1
1. Outdoor Recreation and Tourism III.T-1
a. Kentucky III.T-2
b. Tennessee III.T-2
c. Virginia III.T-3
d. West Virginia III.T-4
2. Non-traditional Forest Products III.T-6
U. SOCIAL AND CULTURAL CONNECTIONS TO COAL MINING AND THE NATURAL ENVIRONMENT III.U-1
1. Company Town Social Environment III.U-1
2. Evolution of Unions in the Coal Mining Industry III.U-3
3. Mechanization of the Coal Mining Industry III.U-3
4. Local Culture and Ties to the Natural Environment III.U-4
V. RELATIONSHIP OF SURFACE MINING AND AIR QUALITY III.V-1
1. Discussion of Study Area Air Quality III.V-1
2. Effects of Blasting on Air Quality III.V-1
3. Effects of Hauling on Air Quality III.V-2
a. On-site Heavy Equipment III.V-2
b. Dust and Other Pollutants along Transport Roads III.V-2
4. Effects of Mining on Air Quality III.V-2
a. Particulates Released During Mining III.V-2
b. Crystalline Silica III.V-2
5. State Implementation Plans III.V-3
6. Regulatory Standards and Guidelines III.V-3
7. Potential Health Risks III.V-5

a. Fugitive Dusts/Particulate Matter III.V-5
b. Fumes Released During Blasting III.V-6
W. BLASTING AND THE LOCAL COMMUNITY III.W-1
1. Trends Associated With Blasting at Mountaintop Mining Sites . . III.W-1
2. Studies Relating to the Impact of Blasting on the Community . . III.W-1
3. Regulatory Standards and Guidelines III.W-3
4. Recent Program Improvements III.W-4
5. Conclusions III.W-6

IV. ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES ANALYZED IV.A-1
A. INTRODUCTION IV.A-1
1. Cumulative Effects IV.A-2
2. Irreversible and Irretrievable Commitment of Resources IV.A-3
B. AQUATIC RESOURCES IV.B-1
1. Consequences Common to the No Action Alternative and Alternatives 1, 2, and 3 . . . . . IV.B-1
a. Direct Stream Loss from MTM/VF IV.B-1
b. Indirect Stream Impacts IV.B-4
c. Stream Hydrology IV.B-6
d. Fill Minimization IV.B-6
e. Mitigation IV.B-8
f. Stream Segment Definitions IV.B-11
g. Bonding and Inspection IV.B-11
2. Consequences Common to Alternatives 1, 2 and 3 . . . . . IV.B-11
3. Consequences Unique to Alternative 1 . . . . . IV.B-14
4. Consequences Unique to Alternative 2 . . . . . IV.B-15
5. Consequences Unique to Alternative 3 . . . . . IV.B-16
C. SOILS & VEGETATION IV.C-1
1. Consequences Common to the No Action Alternative and Alternatives 1, 2, and 3 . . . . . IV.C-5
2. Consequences Common to Alternatives 1, 2, and 3 . . . . . IV.C-7
D. FISH &WILDLIFE IV.D-1
1. Consequences Common to the No Action Alternative and Alternatives 1, 2 and 3 . . . . . IV.D-1
a. Terrestrial Habitat IV.D-2
b. Wildlife Populations IV.D-2
c. Aquatic/Terrestrial Interface IV.D-4
d. Fish Populations IV.D-5
e. Threatened and Endangered Species IV.D-5
2. Consequences Common to Alternatives 1, 2, and 3 . . . . . IV.D-6
E. AIR QUALITY IV.E-1
1. Consequences of the No Action and Action Alternatives IV.E-1
a. Fugitive Dust IV.E-1
b. Respirable Dust IV.E-2
c. Blasting Fumes IV.E-2
2. Consequences Common to Alternatives 1, 2, and 3 . . . . . IV.E-3

F. ENERGY, NATURAL, OR DEPLETABLE RESOURCE REQUIREMENTS IV.F-1
G. CULTURAL, HISTORIC, AND VISUAL RESOURCES IV.G-1
1. Consequences Common to the No Action and Alternatives 1, 2 and 3 . . . . . IV.G-2
H. SOCIAL CONDITIONS IV.H-1
1. Impacts Common to the No Action and Alternatives 1, 2 and 3 . . . IV.H-2
2. Impacts Common to Alternatives 1, 2, and 3 . . . . . IV.H-3
I. ECONOMIC CONDITIONS IV.I-1
1. The Role of Coal in the Economy IV.I-1
2. Economic Effects of Smaller Valley Fills or Alternatives to Fills . . IV.I-2
3. Economic Consequences of the No Action Alternative IV.I-5
a. Government Efficiency and Coordinated Decision Making IV.I-5
b. Data Collection and Analysis IV.I-5
c. Consistent Definitions IV.I-5
d. Mitigation IV.I-6
e. Flooding IV.I-6
4. Economic Consequences Common to the No Action and Alternatives 1, 2, and 3 . . . . . IV.I-7
a. Fill Minimization IV.I-7
b. Data Collection and Analysis IV.I-11
c. Mitigation IV.I-12
d. Deforestation IV.I-13
5. Economic Consequences Common to Alternatives 1, 2, and 3 . . . . IV.I-14
a. Government Efficiency and Coordinated Decision Making IV.I-14
b. Consistent Definitions IV.I-16
c. Data Collection and Analysis IV.I-16
c.1. Economic Consequences of Data Collection and Analysis Unique to Alternative 1 . . . . . IV.I-17
c.2. Economic Consequences of Data Collection and Analysis Unique to Alternative 2 . . . . . IV.I-19
c.3. Economic Consequences of Data Collection and Analysis Unique to Alternative 3 . . . . . IV.I-20
d. Mitigation IV.I-20
e. Flooding IV.I-21
f. Deforestation IV.I-22
g. Air Quality IV.I-23
J. RECREATION IV.J-1
1. Consequences Common to the No Action and Action Alternatives IV.J-1
K. ENVIRONMENTAL JUSTICE IV.K-1

V. REFERENCES V-1
VI. LIST OF PREPARERS VI-1
VII. DISTRIBUTION LIST VII-1

VIII. GLOSSARY VIII-1
IX. INDEX OF KEY TERMS IX-1

List of Tables

Table ES-1 Mountaintop Mining / Valley Fill EIS Alternative Summary ES-2
Table II.A-1 MTM/VF EIS Technical Studies II.A-3
Table II.B-1 Mountaintop Mining/Valley Fill EIS Alternatives Summary II.B-3
Table II.B-2 Distinctions Among MTM/VF EIS Alternatives II.B-19
Table II.C-1 Summary of the Alternatives Carried Forward II.C-1
Table II.D-1 Valley Fill Watershed Sizes (1985-2001) II.D-5
Table III.B-1 Summary of Major Soil Associations in the Study Area III.B-7
Table III.B-2 The Effects of Reclamation Technique on White Pine Productivity and Stand Value at 30 Years III.B-14
Table III.B-3 The Relative Effect of Site Quality on Appalachian Oak Harvest Volumes and Stumpage Value at Age 60 . . . . . III.B-15
Table III.E-1 Estimates of Post-SMCRA CMD Sites for States in the Study Area III.E-7
Table III.E-2 CMD Flow and Loading Estimates for Post-SMCRA Mine Sites in Study Area States III.E-8
Table III.F-1 Areas of Different Forest Cover Types in the West Virginia Portion of the Study Area III.F-2
Table III.G-1 Comparison of HEC-HMS and SEDCAD 4 Models Peak Flow Results III.G-5
Table III.J-1 Typical MTM/VF Mine Reclamation Herbaceous Species III.J-22
Table III.J-2 Typical MTM/VF Mine Reclamation Woody Species III.J-23
Table III.K-1 Valley Fills Approved in States and Region III.K-22
Table III.K-2 Yearly Data For Total Valley Fill Footprints Approved, Valley Fill Average Sizes, and the Range of Valley Fill Sizes for the States Within the Study Area III.K-33
Table III.K-3 Watershed Impacts by States III.K-39
Table III.K-4 Distribution of Watershed Sizes for Valley Fills in Kentucky . . . III.K-41
Table III.K-5 Distribution of Watershed Sizes for Valley Fills in Tennessee . . . III.K-43
Table III.K-6 Distribution of Watershed Sizes for Valley Fills in Virginia III.K-45
Table III.K-7 Distribution of Watershed Sizes for Valley Fills in West Virginia III.K-47
Table III.K-8 Yearly Totals by States for Impacts to Streams Under Valley Fill Footprints III.K-49
Table III.L-1 Example MTM/VF Mine Operational Statistics III.L-9
Table III.L-2 Example MTM/VF Mine Economic Analysis Capital Budget - Life of Mine HEAVY EQUIPMENT III.L-10
Table III.L-3 Example MTM/VF Mine Economic Analysis Capital Budget - Life of Mine SUPPORT EQUIPMENT III.L-11
Table III.L-4 Example MTM/VF Mine Economic Analysis Capital Budget - Life of Mine CAPITAL DEVELOPMENT III.L-12
Table III.L-5 Example MTM/VF Mine Economic Analysis MANPOWER TABLE III.L-14

Table III.L-6 Example MTM/VF Mine Economic Analysis of Earnings Before Interest and Taxes III.L-15
Table III.L-7 Example MTM/VF Mine Economic Analysis CAPITAL INVESTMENT STATISTICS III.L-16
Table III.L-8 Individual Taxes By Total Mine Life Cost and Cost Per Ton of Coal III.L-17
Table III.L-9 Summary of Mine Method Selection Factors III.L-18
Table III.M-1 Coal Distribution, 1998 (million short tons) III.M-2
Table III.M-2 Coal Mining Productivity (short tons per miner per hour) III.M-3
Table III.M-3 Average Mine Price ($ per short ton) III.M-4
Table III.N-1 Coal Production Trends by State, Region, and U.S. (Thousand Short Tons) III.N-1
Table III.N-2 Coal Production and Number of Mines by State, County, and Mine Type, 1998 (thousand short tons) III.N-3
Table III.O-1 Coal Reserves and Remaining Production Life III.O-1
Table III. P-1 ARC Distressed Counties by State, 1980 and 1990 . . . . . III.P-8
Table III.Q-1 Coal Mining Employment by County III.Q-3
Table III.Q-2 Coal Mining Employment and Earnings Percentages III.Q-7
Table III.Q-3 West Virginia Severance Tax Receipts, 1997-2003 . . . . . III.Q-11
Table III.Q-4 Average Number of Coal Miners III.Q-12
Table III.Q-5 West Virginia Surface Mining Employment, 1998 . . . . . III.Q-13
Table IV.B-1 Study Area Stream Miles Under Valley Fill Footprint IV.B-2
Table IV.C-1 Estimated Terrestrial Impacts: Kentucky Portion of the Study Area IV.C-3
Table IV.C-2 Estimated Terrestrial Impacts: Tennessee Portion of the Study Area IV.C-3
Table IV.C-3 Estimated Terrestrial Impacts: Virginia Portion of the Study Area . IV.C-4
Table IV.C-4 Estimated Terrestrial Impacts: West Virginia Portion of the Study Area IV.C-4
Table IV.I-1 Comparison of SMCRA Agency and COE District Permitting Programs IV.I-14

List of Figures

Figure I.E-1 Study Area I-5
Figure III.A-1 Study Area III.A-1
Figure III.A-2 Major Rivers III.A-3
Figure III.A-3 Ecological Subregion Sections III.A-6
Figure III.B-1 Physiogeographic Provinces III.B-1
Figure III.B-2 Elevation III.B-21
Figure III.C-1 Energy Resource Categories and Invertebrate Classifications in River Ecosystems III.C-6
Figure III.C-2 Diagrammatic Representation of the River Continuum Shown as a Single Stream of Increasing Order III.C-8
Figure III.C-3 Major Links in the Food Web of Littoral Zones — Prey Comprising at Least 10% of the Diet of Predators — Statistically Significant Depletion of Prey Populations in Enclosure Experiments III.C-18
Figure III.F-1 Anderson Level Land Use/Cover in the Project Study Area III.F-1
Figure III.F-2 Number of Species of Terrestrial Vertebrates from the

	Appalachian Plateau Province	III.F-6
Figure III.F-3	Relationship Between Patch Shape/Size and Interior Forest Habitat	III.F-10
Figure III.F-4	Relationship Between Species Richness and Patch or Island Area	III.F-14
Figure III.F-5	Corridors Connect Patches in a Fragmented Environment	III.F-15
Figure III.I-	Basic Options for Underground Mine Access	III.I-5
Figure III.I-2	Typical Room and Pillar Mine Plan	III.I-6
Figure III.I-3	Typical Continuous Mining Machine	III.I-8
Figure III.I-4	Longwall Cutting Head with Shields	III.I-9
Figure III.I-5	Typical Longwall Mine Plan	III.I-10
Figure III.I-6	Typical View of a Contour Mine Cut	III.I-15
Figure III.I-7	Multiple Seam Surface Mining Sequence - Dragline, Shovel/Truck, and Loader/Truck Operation	III.I-17
Figure III.I-8	Multiple Seam Surface Mining Sequence - Shovel/Truck, Loader/Truck, and Cast Blasting/Dozer Operation	III.I-18
Figure III.I-9	Typical View of Area Mine Progression	III.I-19
Figure III.I-10	Typical Mountaintop Removal Mining Sequence	III.I-21
Figure III.I-11	Typical Auger System Components	III.I-24
Figure III.I-12	Typical Continuous Highwall Miner System Components	III.I-25
Figure III.I-13	Typical Mining Complex Components	III.I-27
Figure III.J-1	Typical MTR Mine Site Layout	III.J-3
Figure III.J-2	Trends in Kentucky Permit Application Areas	III.J-4
Figure III.J-3	Trends in Tennessee Permit Application Areas	III.J-5
Figure III.J-4	Trends in Virginia Permit Application Areas	III.J-5
Figure III.J-5	Trends in West Virginia Permit Application Areas	III.J-6
Figure III.J-6	Typical Valley Fill Toe Sediment Pond	III.J-8
Figure III.J-7	Typical MTM/VF Mine Production Equipment	III.J-11
Figure III.J-8	Typical Drilling and Shot Hole Preparation on Bench	III.J-12
Figure III.J-9	Typical Coal Preparation and Loading in the Pit	III.J-13
Figure III.J-10	Typical MTR Mine Plan Layout	III.J-15
Figure III.J-11	Typical MTR Mine Phase Layout	III.J-16
Figure III.J-12	Typical MTR Mine Regrading Profile	III.J-18
Figure III.J-13	Examples of Progressive Contemporaneous Reclamation	III.J-20
Figure III.K-1	Typical Profile Section of a Valley Fill Toe	III.K-4
Figure III.K-2	View of Typical Center Drains and Groin Ditches	III.K-5
Figure III.K-3	Center Drain Durable Rock Valley Fill Construction Sequence	III.K-6
Figure III.K-4	Durable Rock Valley Fill Photographs	III.K-7
Figure III.K-5	Example of Swell, Shrinkage, and Bulking Factors in Overburden Excavation and Spoil Backfilling	III.K-8
Figure III.K-6	Example of Excess Spoil Generation on a Steep-Slope Mine Site	III.K-9
Figure III.K-7	Overview of the Valley Fill Inventory Study Area	III.K-16
Figure III.K-8	Kentucky Fill Inventory Study Area	III.K-17
Figure III.K-9	Tennessee Fill Inventory Study Area	III.K-18
Figure III.K-10	Virginia Fill Inventory Study Area	III.K-19
Figure III.K-11	West Virginia Fill Inventory Study Area	III.K-20
Figure III.K-12	Total Number of Valley Fills Approved in States and Regions	III.K-21
Figure III.K-13	Trends in Valley Fills Constructed or Proposed to be Constructed by States and Region	III.K-23

Figure III.K-14 Total Number of Fills Approved in Kentucky III.K-24
Figure III.K-15 Trends in Valley Fills Constructed or Proposed to be Constructed in Kentucky III.K-25
Figure III.K-16 Total Number of Valley Fills Approved in Tennessee III.K-26
Figure III.K-17 Trends in Valley Fills Constructed or Proposed to be Constructed in Tennessee III.K-27
Figure III.K-18 Total Number of Fills Approved in Virginia III.K-28
Figure III.K-19 Trends in Valley Fills Constructed or Proposed to be Constructed in Virginia III.K-29
Figure III.K-20 Total Number of Valley Fills Approved in West Virginia III.K-30
Figure III.K-21 Trends in Valley Fills Constructed or Proposed to be Constructed in West Virginia III.K-31
Figure III.K-22 Trends in Valley Fill Acreage in States and Regions III.K-32
Figure III.K-23 Trends in Valley Fill Acreage in Kentucky III.K-34
Figure III.K-24 Trends in Valley Fill Acreage in Tennessee III.K-35
Figure III.K-25 Trends in Valley Fill Acreage in Virginia III.K-36
Figure III.K-26 Trends in Valley Fill Acreage in West Virginia III.K-37
Figure III.K-27 Trends in Watershed Acreage in States and Regions III.K-38
Figure III.K-28 Trends in Watershed Acreage in Kentucky III.K-40
Figure III.K-29 Trends in Watershed Acreage in Tennessee III.K-42
Figure III.K-30 Trends in Watershed Acreage in Virginia III.K-44
Figure III.K-31 Trends in Watershed Acreage in West Virginia III.K-46
Figure III.K-32 Trends in 30-Acre Synthetic Stream Impacts in States and Region III.K-48
Figure III.L-1 Overall Mine Development Decision Process III.L-2
Figure III.M-1 Electricity and Other Coal Consumption, 1970-2020 . . . . . III.M-1
Figure III.M-2 Coal Distribution, 1998 . . . . . III.M-2
Figure III.M-3 Coal Mining Labor Productivity by Region, 1990-2020 . . III.M-4
Figure III.M-4 Average Minemouth Price of Coal by Region, 1990-2020 . III.M-5
Figure III.N-1 Coal Production, 1998. . . . . III.N-2
Figure III.O-1 Extent of Potential Mountaintop-Minable Coal III.O-4
Figure III.P-1 Total Population Growth Trends III.P-3
Figure III.P-2 Population Composition Trends - School Age Groups III.P-4
Figure III.P-3 Population Composition Trends - Senior Age Groups III.P-4
Figure III.P-4 Median Age Trends for Case Study Community Counties III.P-5
Figure III.P-5 Black/African American Population Compositions III.P-5
Figure III.P-6 Unemployment Rate Trends III.P-6
Figure III.R-1 Land Use Characteristics for the West Virginia Study Area III.R-2
Figure III.T-1 West Virginia Food Services and Accommodations Sales Per Capita, 1997 . . . . . III.T-5
Figure IV.I-1 AOC+ Results in Additional Spoil Returned to the Mined Area and Not in Streams IV.I-10
Figure IV.I-2 Illustration of General Results of AOC+ on Length of Stream Impact IV.I-10
Figure IV.I-3 Illustration of Original Fill Toe Location (At Teal Colored "Xs"); and After AOC + Process (At Gold Lines) IV.I-11

APPENDICES

Appendix A Ideas for Government Action

Appendix B	Programmatic Reviews of Statutes and Regulations, Statute and Executive Order Summaries, Regulatory Process Flowcharts, and Stream Definitions
Appendix C	Regional Setting Supporting Information
Appendix D	Aquatic Technical Studies
Appendix E	Terrestrial Technical Studies
Appendix F	T & E Species Table
Appendix G	Socioeconomic Technical Studies
Appendix H	Engineering Technical Studies
Appendix I	Cumulative Impact Study
Appendix J	AOC+ policy
Appendix K	Flooding Analysis Guidelines
Appendix L	Cumulative Guidance

EXECUTIVE SUMMARY

Introduction

This Draft Programmatic Environmental Impact Statement (EIS) was prepared by the U.S. Army Corps of Engineers (COE), the U.S. Environmental Protection Agency (EPA), the U.S. Department of Interior's Office of Surface Mining (OSM) and Fish and Wildlife Service (FWS), and the West Virginia Department of Environmental Protection (WVDEP) ("the agencies"). The purpose of this EIS is to evaluate options for improving agency programs under the Clean Water Act (CWA), Surface Mining Control and Reclamation Act (SMCRA) and the Endangered Species Act (ESA) that will contribute to reducing the adverse environmental impacts of mountaintop mining operations and excess spoil valley fills (MTM/VF) in Appalachia. Preparation of this EIS involved substantial information gathering over the past four years, and it describes relevant historical data, details several possible alternative policy frameworks, and contains the results of over 30 scientific and technical studies conducted as a part of this effort. The agencies identified a preferred alternative that incorporates programmatic improvements at the state and Federal levels intended to provide enhanced environmental protection and agency coordination during permit reviews under SMCRA and CWA consistent with the primary goal of minimizing adverse environmental effects.

This document is organized into major sections that describe relevant historical information on Appalachian MTM/VF practices: permitting; policy and regulatory approaches pertinent to the action alternatives presented; and potential impacts of such approaches, including the results of studies that evaluated various aspects of MTM/VF. The agencies now seek comment from the public on the information presented here, in particular on the proposed course of action described as the preferred alternative (Alternative 2).

Origin, Background, and Scope

On February 5, 1999, the COE, EPA, OSM, FWS, and WVDEP published a Notice of Intent in the Federal Register [64 FR5778] to develop an EIS with the following stated purpose:

> *"… to consider developing agency policies, guidance, and coordinated agency decision-making processes to minimize, to the maximum extent practicable, the adverse environmental effects to waters of the United States and to fish and wildlife resources affected by mountaintop mining operations, and to environmental resources that could be affected by the size and location of excess spoil disposal sites in valley fills."*

The agreement to prepare the Draft EIS is contained in a settlement agreement that resolved the Federal claims of the coal mining court case known as *Bragg v. Robertson*, Civ. No. 2:98-0636 (S.D. W.V.). This is a "programmatic" EIS consistent with the National Environmental Policy Act (NEPA) in that it evaluates broad Federal actions such as the adoption of new or revised agency program guidance, policies, or regulations. "Mountaintop mining" refers to coal mining by surface methods (e.g., contour mining, area mining, and mountaintop removal mining) in the steep terrain of the central Appalachian coalfields. The additional volume of broken rock that is often generated as a result of this mining, but cannot be returned to the locations from which it

was removed, is known as "excess spoil" and is typically placed in valleys adjacent to the surface mine, resulting in "valley fills." Background on the NEPA process, issues analyzed as part of this EIS, and relevant historical information can be found in Chapter I.

The geographic focus of this study involves approximately 12 million acres, encompassing most of eastern Kentucky, southern West Virginia, western Virginia, and scattered areas of eastern Tennessee. The study area contains about 59,000 miles of streams. Some of the streams flow all year, some flow part of the year, and some flow only briefly after a rainstorm or snow melt. Most of the streams discussed in this EIS are considered headwater streams. Headwater streams are generally important ecologically because they contain not only diverse invertebrate assemblages, but some unique aquatic species. Headwater streams also provide organic energy that is critical to fish and other aquatic species throughout an entire river. Ecologically, the study area is valuable because of its rich plant life and because it is a suitable habitat for diverse populations of migratory songbirds, mammals, and amphibians. The environment affected by MTM/VF is described in Chapter III.

The U.S. Department of Energy (DOE) estimated in 1998 that 28.5 billion tons of high quality coal (i.e., high heating value, low sulfur content) remain in the study area. DOE reported about 280 million tons of coal were extracted by surface and underground mining from the study area in 1998. Coal produced from the study area continues to provide an important part of the energy needs of the nation. Regionally, coal mining is a key component of the economy providing jobs and tax revenue. Almost all of the electricity generated in the area comes from coal-fired power plants. Although coal production remains high, productivity gains and new technology have reduced the need for coal miners. Unemployment, poverty, and out migration in the study area are well above the national average. Mining methods, demographics and economics are also discussed in Chapter III.

The Surface Mining Reclamation and Control Act (SMCRA) was enacted by Congress in 1977 to provide a comprehensive program to regulate surface coal mining and reclamation operations, including MTM/VF. A variety of Clean Water Act (CWA) programs apply to MTM/VF activities where these activities may impact the chemical, physical, and biological integrity of the nation's waters. Section 404 of the CWA regulates the discharge of dredged or fill material into waters of the U.S. Section 402 regulates all other point source discharges of pollutants into waters of the U.S. Technology based effluent limits for the NPDES program are established by EPA to restrict the concentration of particular pollutants associated with a particular industry (e.g., iron for coal mining discharges). Section 401 provides states with the authority to review and either deny or grant certification for any activities requiring a Federal permit or license, to ensure that they will not violate applicable state water quality standards. CWA and SMCRA regulatory agencies must either consult or coordinate with the FWS, as appropriate to ensure the protection of endangered and threatened species and their critical habitats as determined under the Endangered Species Act (ESA). Relevant features of the SMCRA, CWA, ESA, and Clean Air Act (CAA) programs are discussed throughout the document, but are described in some detail under the No Action Alternative in Chapter II and in Appendix B.

As a critical part of the scoping process for this EIS, the agencies met with the public and solicited comments regarding their concerns. Over 1,000 people attended the public meetings, over 640 people provided verbal statements, and 95 people submitted written comments.

Concerns were expressed at the meetings about the changing regulatory climate and its impact on the livelihood of coal miners, as well as various adverse environmental impacts from mountaintop mining, including the loss of forested mountains, and the direct and indirect impacts of MTM/VF construction in headwater streams. The agencies funded studies and reviewed respective regulatory programs to determine if program improvements could be made to address the concerns. As study results were available, the agencies held workshops, symposia, and meetings to receive additional comments and stakeholder input as part of this NEPA process.

Technical Studies

The agencies conducted or funded over 30 studies of the impacts of mountaintop mining and associated excess spoil disposal valley fills. The findings of these studies, along with the joint agency review of the existing regulatory environment, form the basis upon which the significance of each issue was evaluated. The results of these studies, compilation of previously published research, and information from various experts regarding the effects of mountaintop mining are in the appendices or are cited in the reference sections.

Individuals and agencies outside of the EIS development process conducted some studies. Opinions and views expressed by the authors of the studies were not altered. Their opinions and views in the studies do not necessarily reflect the position or view of the agencies preparing this EIS. These studies are grouped into four appendices based on these categories: aquatic; terrestrial; socio-economic; and engineering. The studies were summarized at the beginning of these four appendices. These appendix cover sheets are provided as an aid to the reader and do not necessarily reflect the opinions and views of the EIS agencies. The studies noted the following:

- Of the largely forested study area, approximately 6.8 % has been or may be affected by recent and future (1992-2012) mountaintop mining [USEPA, 2002]. In the past, reclamation focused primarily on erosion prevention and backfill stability and not reclamation with trees. Compacted backfill material hindered tree establishment and growth; reclaimed soils were more conducive for growing grass; and grasses, which out-competed tree seedlings, were often planted as a quick growing vegetative cover. As a result, natural succession by trees and woody plants on reclaimed mined land (with intended post-mining land uses other than forest) was slowed. Better reclamation techniques for growing trees on mined lands now exist and are being promoted.

- More species of interior forest songbirds occur in forest unaffected by mining than forest edge adjacent to reclaimed mined land. Grassland bird species are more predominant on reclaimed mines. Similarly, amphibians (salamanders) dominate unaffected forest, whereas reptiles (snakes) occupy the reclaimed mined lands. Small mammals and raptors appear to inhabit both habitats.

- Approximately 1200 miles of headwater streams (or 2% of the streams in the study area) were directly impacted by MTM/VF features including coal removal areas, valley fills,

roads, and ponds between 1992 and 2002. An estimated 724 stream miles (1.2 % of streams) were covered by valley fills from 1985 to 2001. Certain watersheds were more impacted by MTM/VF than others.

- Based upon the study of 37 stream segments, intermittent streams and perennial streams begin in very small watersheds, with a median of 14 and 41 acres respectively.

- Streams in watersheds where MTM/VFs exist are characterized by an increase of minerals in the water as well as less diverse and more pollutant-tolerant macroinvertebrates and fish species. Questions still remain regarding the correlation of impacts to the age, size, and number of valley fills in a watershed, and effects on genetic diversity. Some streams below fills showed biological assemblages and water quality of good quality comparable to reference streams.

- Streams in watersheds below valley fills tend to have greater base flow. These flows are more persistent than comparable unmined watersheds. Streams with fills are generally less prone to higher runoff than unmined areas during most low-frequency storm events; however, this phenomenon appears to reverse itself during larger rainfall events.

- Wetlands are, at times inadvertently and other times intentionally, created by mining via erosion and sediment control structures. These wetlands provide some aquatic functions, but are generally not of high quality.

- Valley fills are generally stable, as evidenced by fewer than 20 reported slope movements out of more than 6800 fills constructed since 1985.

- The extraction of coal reserves in the study area could be substantially impacted if fills are restricted to small watersheds. The severity of impact to coal recovery correlates with the magnitude of the fill limitations and site-specific and operational factors.

Actions and Alternatives

In Chapter II, the EIS identifies a number of proposed actions, presented in three action alternatives in addition to the No Action Alternative, to improve agency decision making and minimize the adverse effects from MTM/VF. The objective of the coordinated program improvements considered is to integrate application of the CWA and SMCRA to enhance environmental protection associated with MTM/VF operations. The CWA/SMCRA program improvements envisioned include more detailed mine planning and reclamation; clear and common regulatory definitions; development of impact thresholds where feasible; guidance on best management practices; comprehensive baseline data collection; careful predictive impact and alternative analyses, including avoidance and minimization; and appropriate mitigation to offset unavoidable aquatic impacts. The EPA, COE, and OSM propose to promulgate regulations and develop policies or guidance as necessary to establish an integrated surface coal mining regulatory program to minimize environmental impacts from MTM/VF.

The No Action alternative describes the SMCRA and CWA programs as currently implemented in 2003. This alternative is the baseline from which to compare all other alternatives.

Alternative 1 provides for the COE, on a case-by-case basis, to make the initial determination of the size, number, and location of valley fills in waters of the U.S. Under this alternative, all MTM/VF projects that would involve proposed valley fills in waters of the U.S. would initially be handled as individual permits (IP) under CWA Section 404. The SMCRA and other permitting agencies would rely, to the extent practicable, on the COE decisions regarding fill placement in waters of the U.S.

Alternative 2 is the preferred alternative because of the improved efficiency, collaboration, division of labor, benefits to the public and applicants, and the recognition that some proposals will likely be suited for IPs, and others best processed as Nationwide Permit (NWP) 21. This alternative is unlike the other two action alternatives in that it integrates the features of SMCRA and CWA programs into a coordinated regulatory process to determine the size, number, and location of valley fills in waters of the U.S. The COE would determine whether an IP under CWA Section 404 is appropriate, relying in part on the SMCRA information provided by the applicant as part of a joint permit application. If so, CWA Section 404(b)(1) and NEPA compliance determinations would be made, similar to that discussed in Alternative 1. If a general permit, such as Nationwide Permit (NWP) 21, is appropriate, the COE would process the application following the SMCRA review similar to the description in Alternative3. COE NWP 21 decisions would rely, to the greatest extent possible and consistent with legal requirements, on the information and conclusions from the relevant SMCRA review.

Alternative 3 provides for the SMCRA authority to assume the primary role in determining the size, number, and location of valley fills in waters of the U.S. This alternative is based on a procedural presumption by the COE that most MTM/VF applications would be processed as general permits under NWP 21 because the SMCRA review would be the functional equivalent of a CWA Section 404 IP. SMCRA programs would be enhanced through rulemaking to satisfy the informational and review requirements of the CWA Section 404 program, consistent with SMCRA authority. Under this alternative, any off-site mitigation would continue to be assured by the COE under CWA authorization.

The alternative summary table below briefly describes how agency actions would create a coordinated regulatory process for MTM/VF. Following the table are the highlights of the actions proposed to implement the complementary CWA/SMCRA programs.

Table ES-1. Mountaintop Mining/Valley Fill EIS Alternatives Summary *

No Action	Maintains the regulatory programs, policies, and coordination processes that exist in 2003.
Action Alternative 1	The COE CWA Section 404 program would be the primary regulatory program for determining (on a case-by-case basis) whether and how large valley fills from MTM/VF would be authorized in waters of the U.S. The COE would presume that most projects would require the CWA Section 404 IP process, and general permit NWP 21 authorization would be applicable only in limited circumstances. The COE would perform requisite public interest review as well as appropriate NEPA analysis. As part of the IP process, the COE would

Table ES-1. Mountaintop Mining/Valley Fill EIS Alternatives Summary *	
	largely rely on SMCRA reviews that adequately address terrestrial and community impact issues arising as part of public participation. COE would require mitigation of unavoidable aquatic impacts either through on-site replacement of aquatic functions or by in-kind, off-site watershed improvement projects within the cumulative impact area. The COE would be the lead agency for ESA consultation on aquatic resources and the SMCRA agencies would coordinate with FWS on aquatic and terrestrial species. All other regulatory programs would defer to, or condition decisions on attaining, the requisite CWA Section 404 approval. OSM would consider rulemaking so that the stream buffer zone would be inapplicable to excess spoil disposal in waters of the U.S. OSM would finalize excess spoil provisions to include minimization and alternative analysis more consistent with those under the CWA. Cross-program actions include rulemaking; continued research on MTM/VF impacts, improved data collection, sharing, and analysis; development of Best Management Practices (BMP) and Advance Identification (ADID) evaluations; and agency coordination memorialized by such mechanisms as Memoranda of Agreement. These actions would serve to further minimize the adverse effects on aquatic and terrestrial resources and protect the public.
Action Alternative 2 (Preferred)	The agencies would develop enhanced coordination of regulatory actions, while maintaining independent review and decision making by each agency. The size, location and number of valley fills allowed in waters of the U.S. would be cooperatively determined by CWA and SMCRA agencies based on a joint application and under procedures spelled out in such mechanisms as Memoranda of Agreement. OSM would apply functional stream assessments to determine onsite mitigation. OSM rules would be finalized to make the stream buffer zone more consistent with SMCRA and CWA. OSM excess spoil rules would be finalized to provide for fill minimization and alternatives analysis, similar to CWA Section 404(b)(1) Guidelines. The COE would make case-by-case decisions as to NWP or IP processing. Public interest review and NEPA compliance by the COE would occur for IPs and would be informed, to the extent possible, by the SMCRA permit. Mitigation of unavoidable aquatic impacts would be required to the appropriate level. ESA evaluations for IPs would be similar to those in Alternative 1; the SMCRA agency would take the lead for ESA coordination for NWP 21. FWS would retain the ability to consult on unresolved ESA issues for all CWA Section 404 applications. Cross-program actions include rulemaking; improved data collection, sharing and analysis; development of a joint application, harmonized public participation procedures, BMP and ADID evaluations; and close interagency coordination. These actions would serve to further minimize the adverse effects on aquatic and terrestrial resources and protect the public.
Action Alternative3	The COE would begin processing most MTM/VF projects as NWP 21 and few projects would require IP processing. The SMCRA program would be enhanced as described in Alternative 2 and the SMCRA regulatory authority would assume the primary role of joint application review. The COE, or a state through a programmatic general permit from the COE, would base CWA authorizations largely on the SMCRA review with the addition of adequate off-site mitigation. The COE would require the IP process if its review found an application inadequate due to lack of data, alternatives considered, or mitigation. Satisfaction of ESA would be identical to Alternative 1 and 2. The cross-program actions are identical to Alternative 2 with the exception that no ADIDs would be developed. These actions would serve to further minimize the adverse effects on aquatic and terrestrial resources and protect the public.

* Complete descriptions of the alternatives are in Chapter II.C.; acronyms can be found on page 1 of this EIS.

As described in more detail in the Draft EIS, the Federal and/or state agencies cooperatively would:

- develop guidance, policies, or institute rulemaking for consistent definitions of stream characteristics, as well as field methods for delineating those characteristics.
- continue to evaluate the effects of mountaintop mining on stream chemistry and biology.
- continue to work with states to further refine the uniform, science-based protocols for assessing ecological function, making permit decisions and establishing mitigation requirements.
- continue to assess aquatic ecosystem restoration and mitigation methods for mined lands and promote demonstration sites.
- incorporate mitigation/compensation monitoring plans into SMCRA/NPDES permit inspection schedules and coordinate SMCRA and CWA requirements to establish financial liability (e.g., bonding sureties) to ensure that reclamation and compensatory mitigation projects are completed successfully.
- work with interested stakeholders to develop a best management practices (BMPs) manual for restoration/replacement of aquatic resources.
- evaluate and coordinate current programs for controlling fugitive dust and blasting fumes from mountaintop MTM/VF operations, and develop BMPs and/or additional regulatory controls to minimize adverse effects, as appropriate.
- develop guidelines for calculating peak discharges for design precipitation events and evaluating flooding risk. In addition, the guidelines would recommend engineering techniques useful in minimizing the risk of flooding.
- based on the outcome of ongoing informal consultation, identify and implement program changes, as necessary and appropriate, to ensure that MTM/VF is carried out in full compliance with the Endangered Species Act.
- in Alternatives 1 and 2, EPA and the COE would consider designating areas generally unsuitable for fill, referred to as Advanced Identification of Disposal Sites (ADID).
- in Alternatives 2 and 3, the agencies would develop a joint MTM/VF application form.

The COE would:

- continue to refine and calibrate the stream assessment protocol for each COE District where MTM/VF operations are conducted to assess stream conditions and to determine mitigation requirements as part of the permitting process.
- compile data collected through application of the assessment protocol along with PHC, CHIA, antidegradation, NPDES, TMDLs, mitigation projects, and other information into a GIS database.
- use these data to evaluate whether programmatic “bright-line” thresholds, rather than case-by-case minimal individual and cumulative impact determinations, are feasible for CWA Section 404 MTM/VF permits.

The OSM and/or the state SMCRA regulatory authorities would:

- continue rule making to clarify the stream buffer zone rule and require fill minimization and alternatives analysis.
- in conjunction with the PHC, CHIA, and hydrologic reclamation plan, apply the COE stream assessment protocol to consider the required level of onsite mitigation for MTM/VF.
- develop guidelines identifying state-of-the-science BMPs for selecting appropriate growth media, reclamation techniques, revegetation species, and success measurement techniques for accomplishing post-mining land uses involving trees.
- if legislative authority is established by Congress or the states, require reclamation with trees as the post mining land use.

The EPA would:

- develop and propose, as appropriate, criteria for additional chemicals or other parameters (e.g., biological indicators) that would support a modification of existing state water quality standards.

The FWS would:

- continue to work with Federal and state SMCRA and fish and wildlife agencies to implement the 1996 Biological Opinion and streamline the coordination process.
- work with agencies to develop species-specific measures to minimize incidental takes of T&E species.

Environmental and Process Benefits

The alternatives and actions were developed with the objective that each would satisfy the requirements of the CWA and SMCRA. Each proposed alternative would enhance environmental protection and better coordinate implementation of CWA and SMCRA, as compared to the No Action Alternative. The No Action Alternative contains a number of CWA and SMCRA provisions for programmatic changes which occurred during development of this EIS to enhance environmental protection. These changes include, but are not limited to: finalization of rule-making by EPA and the COE to define “fill” material; reauthorization by the COE of NWP 21, requiring case-by-case evaluations and compensatory mitigation; increased focus on enhanced baseline data collection and monitoring of biological and chemical aspects of aquatic resources by the agencies; implementation of state policies regarding approximate original contour that maximizes backfill and minimizes excess spoil; development of stream delineation policy, commercial forestry regulations, surface water runoff analysis and blasting

regulations by WVDEP; promotion of reforestation by OSM and the states; and development of a post mining land use policy by OSM.

In addition, pursuant to the *Bragg* settlement agreement, the agencies implemented an interim permit process, including the general condition that fills in watersheds of more than 250 acres would require IP processing in West Virginia. Based, in part, on the interim 250-acre watershed threshold, CWA NWP 21 renewal requirements, program changes by SMCRA resource agencies, and coal market influences, there has been a reduction in the size and number of valley fills that have been permitted annually since the initiation of this EIS in 1998. The experience of the agencies resulting from the increased permit scrutiny and interagency review has been utilized in the development of this EIS.

Each proposed action alternative would enhance environmental protection and better coordinate implementation of CWA and SMCRA, as compared to the No Action Alternative. Alternatives 1, 2 and 3 build upon existing "best science" methods for characterizing aquatic resources. The goal is to bring stakeholders, as well as state and Federal agencies, together to establish common criteria and science-based methods for determining baselines, impacts, and mitigation requirements. Monitoring information could be used to identify and evaluate T&E listed species habitats; stream reaches supporting naturally diverse and high quality aquatic populations; sole or principal drinking water source aquifers; or other specially-protected areas.

Better stream protection from direct and indirect effects would result from improved characterization of aquatic resources; operations designed to avoid and minimize adverse effects and restore aquatic functions; and compensatory mitigation plans with improved design, inspection, and enforcement. With better characterization of these resources, excess spoil fills can be placed in locations that may minimize adverse environmental effects and may reduce direct impacts.

All three action alternatives would result in reduced environmental impacts from excess spoil disposal. Even the No Action Alternative requires a demonstration to the COE prior to CWA Section 404 authorization that impact avoidance ("upland" options) and minimization (least direct impacts practicable) have occurred. Use of the CWA Section 404(b)(1) Guidelines and/or COE functional stream assessment protocol for CWA Section 404 permits would identify high-functioning streams and favor fill locations where impaired streams exist, due to CWA avoidance provisions and lower mitigation costs. The proposed changes or development of regulations, policies, and/or guidelines will result in operations that avoid, minimize, or mitigate, to the maximum extent practicable, significant adverse impacts to the waters of the U.S. and prevent material damage outside the permit area. It is anticipated that these actions would further minimize direct stream loss.

The data mandated by different regulatory programs results in some duplication of collection and analysis, typically only assessed for particular program requirements. Compiling similar data from varied sources could serve multiple program goals and objectives. The use of GIS to

compile other relevant resource, ecosystem, or community information is a logical augmentation to the aquatic data for use in COE NEPA compliance. Use of information technology to collect, compile, screen, and update aquatic and other resource information in GIS, linked to various databases, would provide for better informed and timely permit decisions regarding aquatic impacts and a reference library to assist in future decisions. Evaluation of these data could result in establishment of individual or cumulative impact CWA thresholds for NWP 21, if feasible.

Enhanced assessments would reduce the cumulative adverse impacts of MTM/VF through more environmentally-protective designs; enhanced compensatory mitigation that emphasizes onsite reclamation and restoration of degraded streams within a watershed; identifying and developing best management practices for restoring aquatic functions impacted by mining; and inclusion of improved techniques to grow trees and more quickly restore mined land to better terrestrial habitat. Agencies would continue to identify better practices to reduce fugitive dust and fumes from mining, and thus, reduce impacts to adjacent communities. Flooding would be reduced by improved mining design, flood analysis, and, in the longer term, restoring the post mining land use to trees.

Common data elements in a joint application form could lead to more efficient analytical approaches among the agencies. Reliance on these analytical results could facilitate agreements among agencies and provide a basis for one agency to confidently rely on the findings of another agency. The Memorandum of Agreement (MOA) and Field Operating Procedures (FOP) proposed by the action alternatives should improve consistency, permit coordination, and reduce the processing time with a logical, concurrent process.

Improved communications, through pre-permit application meetings and the use of a designated regulatory authority as a focal point for initial data collection, should result in better cataloguing of T&E species, cultural, and historic properties, as well as addressing these issues at the earliest possible stages of permit review.

An MOA would be developed under Alternatives 1, 2, and 3 to clearly define and commit to writing the roles and responsibilities of each agency for permitting, monitoring/inspection, and bonding of mitigation projects. This would provide the agencies with the opportunity to coordinate these activities in order to increase certainty that all mitigation requirements are being implemented and minimize identified inefficiencies associated with duplicate systems. By incorporating all mitigation construction plans/specifications, time lines, and success criteria into each issued permit, an inspector will have all the information needed to ensure the mitigation projects are properly completed.

The proposed alternatives and actions would better inform the public and provide more meaningful participation, in part because plans would more thoroughly address impacts to environmental resources. Many of the actions are designed to facilitate methodical, sequenced review processes while improving environmental protection. A coordinated review process could reduce processing times and costs of permit applications, which may offset some of the

increased costs and times associated with the additional data collection and analysis requirements of the actions. Each action alternative would support efficient, environmentally responsible production of energy resources, and would help clarify environmental performance standards for stakeholders and regulators. Likewise, each action alternative would lead to more complete permit information as a better basis for regulatory decisions.

In summary, joint evaluations of MTM/VF proposals would result in more expansive considerations of both environmental impacts and effective treatments to mitigate those impacts. This coordinated process would also facilitate selection, implementation and monitoring of mitigation projects. The coordinated process and actions that make up the action alternatives could minimize adverse environmental effects by enhancing the following:

- identification of the environmental resources;
- prediction of environmental impacts;
- avoidance of special/high-value environmental resources;
- development of operation plans that mitigate (i.e. avoid, minimize, avoid, and compensate) adverse environmental impacts;
- consideration of the least damaging practicable alternative in fill placement;
- minimization of excess spoil material;
- consideration of adverse cumulative environmental effects;
- coordination of data sharing and analyses among key regulatory agencies to provide more informed decisions under the respective programs;
- technology transfer to identify the best practices reclamation techniques available to avoid or minimize adverse environmental impacts; and,
- communication among stakeholders and regulators.

The environmental and programmatic benefits of the alternatives are summarized in Chapter II. The consequences (environmental, economic, administrative, and environmental justice impacts) of implementing programmatic actions under the various alternatives are presented in Chapter IV. The consequences of implementing any of the three action alternatives would have impacts similar to those of the No Action Alternative on the social conditions, cultural, historic and visual resources, and environmental justice populations in the EIS study area. Implementation of the proposed actions carry economic consequences to the regulated community and administrative costs to the agencies. In particular, data collection and analysis, fill minimization and avoidance, and mitigation present the major cost considerations for industry. Administrative costs to the agencies stem from the necessity of additional staff to evaluate applications that include increased data, alternatives analyses, impact predictions, and mitigation measures. The relative costs of these actions are discussed in Chapter IV.

EPA is in the process of writing a Biological Assessment (BA) that would identify any T&E species likely to be adversely affected by the proposed action. Measures to avoid adversely

affecting the listed species would be considered in the BA. Information about the findings of the BA and the informal consultation will be in the Final EIS.

Public Comment Sought

The agencies now seek public comments on this Draft EIS. Following consideration of the comments, a Final EIS will be published.

This EIS, a comprehensive document developed through an extraordinary inter-agency effort, is designed to inform more environmentally sound decision making for future permitting of MTM/VF. To this end, this EIS includes a substantial amount of environmental and economic data associated with MTM/VF collected and analyzed by these agencies. We have cooperatively evaluated our various programs and believe this EIS includes much valuable information that will assist our respective agencies to better coordinate the review necessary under each agency's mandates. We believe this document will contribute to more efficient decision-making by coordinating data collection and environmental analyses by the respective agencies, resulting in better permit decisions on a watershed basis.

LIST OF ACRONYMS

ACSI	Appalachian Clean Streams Initiative
ADID	Advanced Identification Designation
AMD	Acidic Mine Drainage
AMLs	Abandoned Mine Lands
AMLIS	Abandoned Mine Land Inventory System
AOC	Approximate Original Contour
ARNI	Aquatic Resource of National Importance
BMP	Best Management Practices
BO	Biological Opinion
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CHIA	Cumulative Hydrologic Impact Assessment
CIA	Cumulative Impact Area
CLI	Cultural Landscape Inventory
CMD	Coal Mine Drainage
COE	U.S. Army Corps of Engineers
CWA	Clean Water Act
dBA	Decibels (A-weighted sound pressure level measurement)
EA	Environmental Assessment
EIA	Energy Information Administration
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act of 1973
EPA	United States Environmental Protection Agency
FHBM	Flood Hazard Boundary Map
FIRE	Fire, Insurance, and Real Estate
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
FOP	Field Operating Procedures
FPM	Floodplain Management
FR	Federal Register
FWCA	Fish and Wildlife Coordination Act
FWPCA	Federal Water Pollution Control Act
FWS	United States Fish and Wildlife Service (U.S. Department of the Interior)
gpm	gallons per minute
gr/dscf	grains per dry standard cubic foot
H_2S	Hydrogen Sulfide
HSA	Health Systems Agency
IDT	Interdisciplinary Team
IMCC	Interstate Mining Compact Commission
IP	Individual Permit
LA	Load Allocations
JPP	Joint Permit Processing
KFTC	Kentuckians for the Commonwealth
KYDSMRE	Kentucky Department for Surface Mining Reclamation and Enforcement
mg/L	milligram per Liter

mg/Kg	milligram per Kilogram
mgd	million gallons per day
MM	million short tons
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MTM	Mountaintop Mining
MTM/VF	Mountaintop Mining/Valley Fill
MTR	Mountaintop Removal
NAAQS	National Ambient Air Quality Standards
NACD	National Association of Conservation Districts
NAD	North American Datum
NAMD	Neutral/Alkaline Mine Drainage
NEPA	National Environmental Policy Act of 1969, P.L. 91-190
NFIP	National Flood Insurance Program
NHPA	National Historic Preservation Act of 1966
NOAA	National Oceanic and Atmospheric Administration (US Department of Commerce)
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRHP	National Register of Historic Places
NSPP	New Source Permit Program
NSPS	New Source Performance Standards
NWP	Nationwide Permit
OSM	United States Office of Surface Mining (U.S. Department of the Interior)
PCN	Pre-construction Notification
PHC	Probable Hydrologic Consequences
PIR	Public Interest Review
P.L.	Public Law (of the United States)
PMLU	Postmining Land Use
ppm	parts per million
ppt	parts per trillion
PSD	Prevention of Significant Deterioration
RGP	Regional General Permit
SBZ	Stream Buffer Zone
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan (CAA)
SMCRA	Surface Mining Control and Reclamation Act of 1977
SOP	Standard Operating Procedure
SPGP	State Programmatic General Permits
T&E	Threatened and Endangered (plants and animals)
TMDL	Total Maximum Daily Loads
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
USBLM	United States Bureau of Land Management (U.S. Department of the Interior)
USBM	United States Bureau of Mines
USBOR	United States Bureau of Outdoor Recreation, now the Heritage Conservation and Recreation Service (U.S. Department of the Interior)

USC	United States Code
USDA	United States Department of Agriculture
USDOE	United States Department of Energy
USEIA	United States Energy Information Agency
USERDA	United States Energy Research and Development Administration
USFmHA	United States Farmers Home Association
USFS	United States Forest Service (U.S. Department of Agriculture)
USGAO	United States Government Accounting Office
USGS	United States Geological Survey (U.S. Department of the Interior)
USHCRS	United States Heritage Conservation and Recreation Service (U.S. Department of the Interior)
USHUD	United States Department of Housing and Urban Development
USICC	United States Interstate Commerce Commission
USMSHA	United States Mining Safety and Health Administration
USOTA	United States Congress Office of Technology Assessment
VA	Veterans Administration
VADMLR	Virginia Division of Mined Land Reclamation
vmt	vehicle miles traveled
WLA	Waste Load Allocations
WQS	Water Quality Standard
WV	West Virginia
WVAPCC	West Virginia Air Pollution Control Commission
WVDC	West Virginia Department of Commerce
WVDCH	West Virginia Department of Culture and History
WVDE	West Virginia Department of Education
WVDEP	West Virginia Department of Environmental Protection
WVDES	West Virginia Department of Employment Security
WVDH	West Virginia Department of Highways
WVDM	West Virginia Department of Mines
WVDNR	West Virginia Department of Natural Resources
WVGES	West Virginia Geological and Economic Survey; Divisions include: WVGES-Archaeology Section WVGS (West Virginia Geological Survey)
WVGOECD	West Virginia Governor's Office of Economic and Community Development
WVGOSFR	West Virginia Governor's Office of State-Federal Relations
WVHDF	West Virginia Housing Development Fund
WVPSC	West Virginia Public Service Commission
WVRMA	West Virginia Railroad Maintenance Authority
WVSCI	West Virginia Stream Condition Index
WVSCMRA	West Virginia Surface Coal Mining and Reclamation Act
WVSHSP	West Virginia Statewide Health Systems Plan, 1979
WVURD	West Virginia University Office of Research and Development

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AMLs	Abandoned Mine Lands
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mg/Kg	milligram per Kilogram
mgd	million gallons per day
MM	million short tons
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MOU	Memorandum of Understanding
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NRHP	National Register of Historic Places
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NSPS	New Source Performance Standards
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PCN	Pre-construction Notification
PHC	Probable Hydrologic Consequences
PIR	Public Interest Review
P.L.	Public Law (of the United States)
PMLU	Postmining Land Use
ppm	parts per million
ppt	parts per trillion
PSD	Prevention of Significant Deterioration
RGP	Regional General Permit
SBZ	Stream Buffer Zone
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan (CAA)
SMCRA	Surface Mining Control and Reclamation Act of 1977
SOP	Standard Operating Procedure
SPGP	State Programmatic General Permits
T&E	Threatened and Endangered (plants and animals)
TMDL	Total Maximum Daily Loads

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TSS	Total Suspended Solids
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USBM	United States Bureau of Mines
USBOR	United States Bureau of Outdoor Recreation, now the Heritage Conservation and Recreation Service (U.S. Department of the Interior)
USC	United States Code
USDA	United States Department of Agriculture
USDOE	United States Department of Energy
USEIA	United States Energy Information Agency
USERDA	United States Energy Research and Development Administration
USFmHA	United States Farmers Home Association
USFS	United States Forest Service (U.S. Department of Agriculture)
USGAO	United States Government Accounting Office
USGS	United States Geological Survey (U.S. Department of the Interior)
USHCRS	United States Heritage Conservation and Recreation Service (U.S. Department of the Interior)
USHUD	United States Department of Housing and Urban Development
USICC	United States Interstate Commerce Commission
USMSHA	United States Mining Safety and Health Administration
USOTA	United States Congress Office of Technology Assessment
VA	Veterans Administration
VADMLR	Virginia Division of Mined Land Reclamation
vmt	vehicle miles traveled
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WVDM	West Virginia Department of Mines
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WVGOSFR	West Virginia Governor's Office of State-Federal Relations
WVHDF	West Virginia Housing Development Fund

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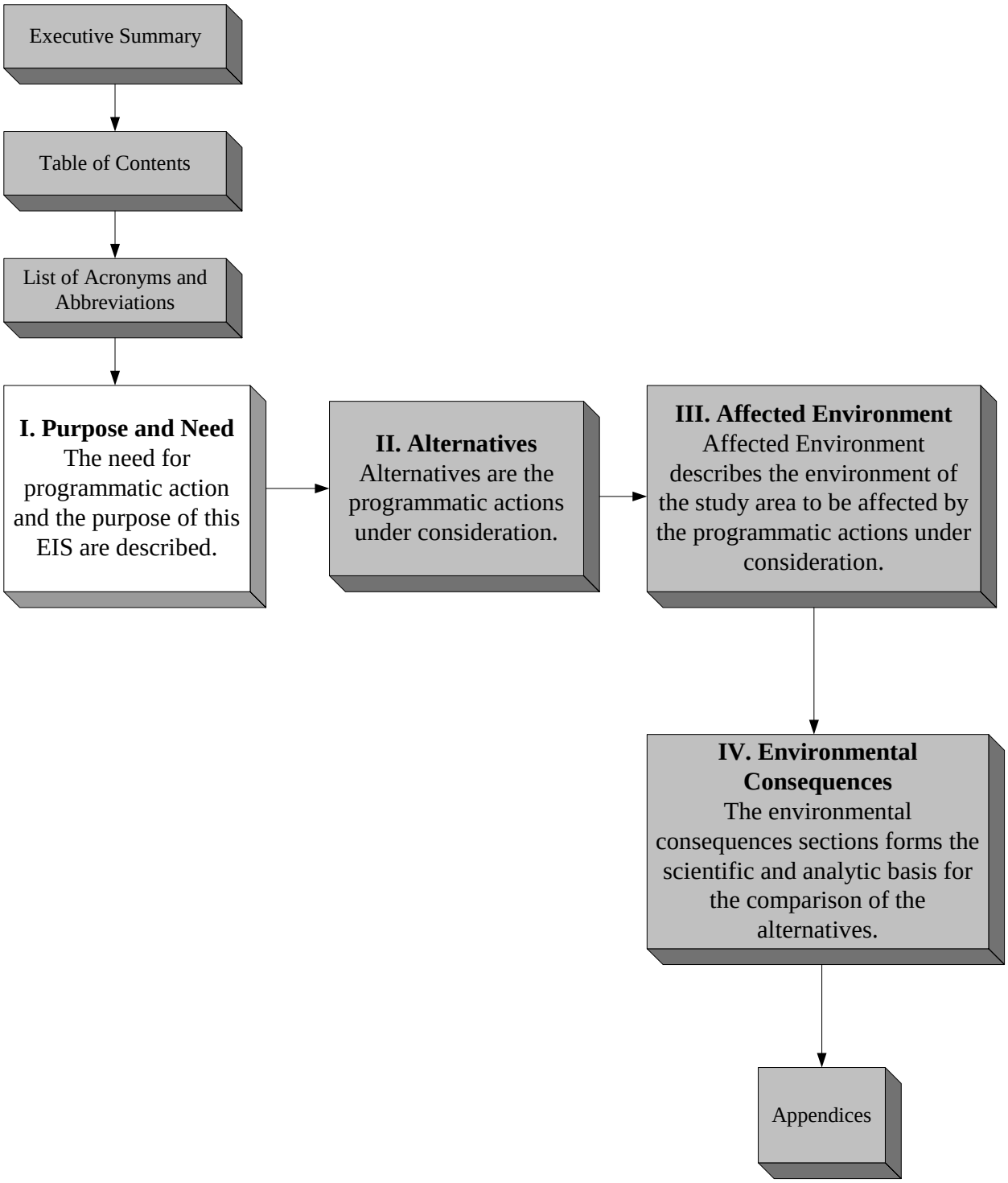
Chapter I. Purpose and Need



I. PURPOSE AND NEED

A. INTRODUCTION

Surface coal mining in the Appalachian coalfield states of Kentucky, Tennessee, Virginia, and West Virginia is conducted by a variety of mining methods and in different topographic settings. For the purposes of this EIS, "mountaintop mining" considers all types of surface coal mining (mountaintop removal, contour, area, etc.) in the steep terrain of the central Appalachian coalfields. Removal of overburden and interburden (rock above and between coal seams, respectively) during mountaintop mining / valley fills (MTM/VF) operations results in generation of excess spoil, because the broken rock will not all fit back into the mining pit. The excess spoil must be placed in disposal sites adjacent to the mining pits in order to allow for efficient and economical coal extraction. Typical locations for excess spoil disposal sites are valleys, also known as heads-of-hollows or uppermost (headwater) stream reaches. The usual method of disposing of this excess spoil is to place it in engineered earthen and rock structures known as excess spoil disposal areas or colloquially known as head-of-hollow fills, hollow fills or valley fills. Detailed information on the environmental resources in the EIS study area and coal mining methods is contained in Chapter III.

A number of Federal and state agencies regulate MTM/VF under the authority of several different statutes. An explanation of these programs and description of the requirements of applicable laws and regulations can be found in the No Action Alternative discussion under each issue in Chapters II.B and II.C. and Appendix B.

The Office of Surface Mining (OSM) is responsible for the national administration of SMCRA and has delegated this authority to states in the EIS study area except Tennessee. Delegation of SMCRA authority occurs when states assume primacy for regulating surface coal mining and reclamation by adopting statutes and regulations no less effective than the Federal counterparts. Subsequent changes in the Federal SMCRA program may result in changes to states' SMCRA provisions when required in order to retain primacy. The U.S. Army Corps of Engineers (COE) and the U.S. Environmental Protection Agency (EPA) share responsibility for implementing different portions of the Clean Water Act (CWA). The COE has the principal authority to regulate the placement of fills into waters of the U.S. under CWA Section 404 while EPA maintains oversight authority. The COE authorizes such fills by General Permit (GPs), such as Nationwide Permit (NWPs), for projects that individually or cumulatively have only minimal adverse effects on the aquatic environment or by an individual permit (IP) for projects that have more than minimal adverse effects.

The states in the EIS study area, through programs approved by EPA, implement the National Pollutant Discharge Elimination System (NPDES) established under CWA Section 402. The states also certify that Federally-authorized CWA Section 404 projects do not violate state water quality standards (CWA Section 401). As a signatory to the December 1998 settlement agreement, West Virginia (through the West Virginia Department of Environmental Protection (WVDEP)) is participating with the Federal agencies as a co-lead agency in the preparation of this EIS. WVDEP administers the SMCRA, CWA Section 401, and CWA Section 402 responsibilities within West Virginia.

The Endangered Species Act (ESA) is administered by the U.S. Fish and Wildlife Service (FWS) through consultation on actions by Federal agencies and coordination with state agencies. In addition, the Fish and Wildlife Coordination Act (FWCA) pertains to Federally-controlled water development projects and land development projects that affect any water body. Whenever OSM, COE, or EPA authorizes an action within the scope of the FWCA, they consult with the FWS and counterpart state agencies to obtain recommendations on ways to mitigate adverse effects on fish and wildlife resources.

B. PROPOSED ACTION

The COE, EPA, and the OSM propose to establish an integrated surface coal mining regulatory program in steep slope Appalachia. The objective of the coordinated program improvements considered by this EIS is consonant application of the Clean Water Act (CWA) and the Surface Mining Control and Reclamation Act (SMCRA) to improve the regulatory process and effect better environmental protection for mountaintop mining and valley fill (MTM/VF) operations.

To effect this integrated regulatory program, the COE, EPA, and OSM would amend their policies, guidance, procedures, or regulations as necessary. These amendments would result in MTM/VF operations that avoid, minimize, or mitigate, to the maximum extent practicable, significant adverse impacts to the waters of the U.S. and prevent material damage to water resources outside the permit area; would streamline the permitting process; and would coordinate the agencies' respective programs. Coordinating these regulatory programs would aid in balancing the nation's need for energy with the need to conserve environmental resources that could be adversely affected by MTM/VF operations in the steep slope Appalachian coalfields. The joint CWA and SMCRA program changes envisioned would address the following, as applicable:

- More detailed and consistent mine planning and reclamation;
- Clearer regulatory definitions;
- Guidance on best management practices;
- Comprehensive baseline data collection;
- Data analysis to determine feasibility of impact thresholds;
- Standards for alternative analyses, impact predictions, and impact avoidance and minimization considerations; and
- Suitable levels of compensatory mitigation for unavoidable impacts.

C. PURPOSE OF THE EIS

The Notice of Intent to prepare this Draft EIS was published in the Federal Register, dated February 5, 1999 and posted on EPA's mountaintop mining web page [64 FR 5778; http://www.epa.gov/region3/mtntop/documents/html]. As stated in this Notice, the purpose of this EIS is "to consider developing agency policies, guidance, and coordinated agency decision-making processes to minimize, to the maximum extent practicable, the adverse environmental effects to waters of the Unites States and to fish and wildlife resources affected by mountaintop mining operations, and to environmental resources that could be affected by the size and location of excess spoil disposal sites in valley fills."

This EIS focuses on steep-slope Appalachian surface coal mining and excess spoil disposal, although waters of the U.S. in other parts of the country are also filled by mining activities, including underground coal mining practices such as "face-up" fills, waste rock fills, and coal mine waste from coal preparation (embankments and impoundments). Coal mining activities involve temporarily or permanently diverting waters of the U.S. into engineered channels for various reasons, including mining coal beneath streams. As discussed in section I.F., litigation, NEPA scoping, and agency experiences emphasized the critical need to evaluate these matters for Appalachian steep slope mining. The agencies assumed, for the purposes of this Draft EIS, that impacts in the study area would probably be at least as significant as impacts in other areas, and that the measures to address these impacts for the study area would be adequate for other areas as well. Following the conclusion of the NEPA process for the issues addressed, the need for additional evaluation would be assessed relative to other coal mining activities affecting jurisdictional streams.

A further purpose of this EIS to evaluate the various laws, regulations, policies, guidelines, and processes to determine if gaps in implementation and data exist or more protective requirements are needed. This EIS evaluates environmental impacts associated with these operations on water quality, streams, aquatic and terrestrial habitat, habitat fragmentation, the hydrological balance, and other individual and cumulative effects. Federal and state agencies initiated a number of studies as part of this EIS to address gaps in data regarding MTM/VF.

Other results of this EIS include the following. The EIS provides information that would help the agencies improve the permitting process to protect water quality and minimize impacts on other environmental resources. The EIS also examined the coordination and implementation of the regulations of the agencies. The EIS considers information on the following: the cumulative environmental impacts of mountaintop mining; the efficacy of stream restoration; the viability of reclaimed streams compared to natural waters; the impact that mining and associated fills have on aquatic life, wildlife and nearby residents; biological and habitat analyses that should be done before mining begins; practicable alternatives for in-stream placement of excess overburden; measures to minimize stream filling to the maximum extent practicable; and the effectiveness of mitigation and reclamation measures.

D. NEED FOR PROPOSED ACTION

Interagency evaluations of regulatory program requirements, issues raised in litigation, technical study results, and concerns expressed by stakeholders during scoping, all of which are described in this and subsequent sections, support the need for government action to improve the MTM/VF regulatory process and minimize impacts of MTM/VF operations. A number of issues related to interpretation, coordination, consistency, and areas of overlap were found in permitting, reclamation, and oversight programs being implemented by the CWA and SMCRA agencies. For example:

- COE, EPA, and judicial interpretations of whether proposed activities would result in a "discharge of fill material" demonstrated the need for national consistency. While this issue is related to and discussed in this EIS, the COE and EPA proposed and finalized a rule independent of the EIS to promote clearer understanding and application of the CWA regulatory program. [65 FR 21294–95 and 67 FR 31129-43].

- OSM has not viewed, applied, or enforced the stream buffer zone (SBZ) regulation to prohibit mining activities within the buffer zone, if those activities would have less than a significant effect on the overall chemistry and biology of streams, i.e., the overall watershed or stream below the activity. While some have interpreted the SBZ rule to prohibit excess spoil fill construction in intermittent and perennial streams, to do so would counter other SMCRA provisions recognizing the necessity of excess spoil fills. These polarized interpretations illustrate needed clarification of the OSM SBZ rule.

- The typical sequence and timing between issuance of the SMCRA permit, the CWA Section 401 Certification, and CWA Section 402/404 permits are described in Chapter II.C.1.a. Sequence and timing issues for these different permits are of concern to applicants, the agencies, and other stakeholders. Under NWP 21, COE Districts receive MTM/VF mining applications after the company has obtained the necessary SMCRA permit. The case-by-case determinations by the COE on the applicability of the NWP could result in redesign of the MTM/VF project and require re-submission of revisions to the SMCRA authority. This independent treatment of the applicant by different agencies characterizes the opportunity for closer coordination to better integrate the regulatory programs, maximize environmental protection, minimize review time and lessen the need for project revision and multiple reviews by any agency.

- The CWA, SMCRA, and selected state stream definitions, protocols, and monitoring requirements take different approaches to evaluate headwater streams, aquatic resources, and related functions. The programs employ certain analyses and protections based, in part, on the type and character of a stream segment. Also, the fact that each program typically requires a field visit and stream reconnaissance for applying these varied approaches illustrates the potential for duplication of effort by the regulatory agencies, applicants, and stakeholders. Use of many approaches may lead to confusion, uncertainty, and duplication of effort for regulation of headwater streams. This indicates the need for Federal and state authorities, working with stakeholders, to establish science-based methods for definition and delineation of stream characteristics and impacts.

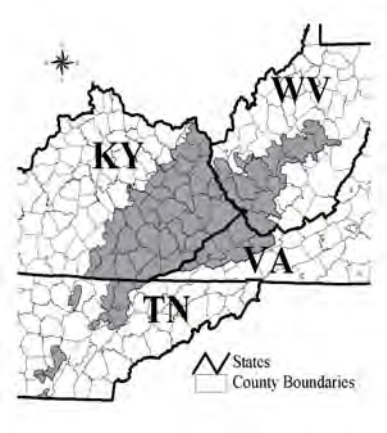
- A variety of CWA criteria and programs operate to maintain and restore water quality and aquatic resources. Collection of background aquatic data, impact predictions, and monitoring are fundamental to accomplishing CWA program goals. SMCRA is similar in this regard and, along with data generated in CWA implementation, these programs provide extensive information useful for impact determinations. Because these data are collected by different agencies using different methods for different purposes, the information is not usually viewed in an integrated fashion. With automated data processing and geographic information systems, data integration is feasible and could lead to a clearinghouse for use in satisfying multiple program goals by applicants, the public, and regulatory agencies.

- There are many models, equations, and procedures for assessing peak runoff that are dependent on site-specific factors such as geology, hydrology, topography and

precipitation. A standardized methodology addressing flooding potential has not been identified by the COE or OSM as applicable for CWA or SMCRA applicants. However, guidelines on calculating peak discharge, evaluating flooding potential, and minimizing flood potential would benefit applicants, regulatory authorities, and improve flooding analysis and reduce potential for impacts to residents and property downstream of MTM/VF.

These brief descriptions of issues support the need for better coordination in implementation of the CWA and SMCRA in permitting of MTM/VF. The issues are discussed in detail in Chapter II.C.

E. STUDY AREA



The study area is located within the Appalachian Coalfield Region of the Appalachian Plateau physiographic province and Bituminous Coal Basin. Consistent with the EIS purpose, the study area boundary within this region was established to include watersheds where excess spoil fills, otherwise known as valley fills, have been constructed or are likely to be constructed in the future. The resulting study area boundary encompasses approximately 12 million acres and extends over portions of West Virginia, Kentucky, Virginia, and Tennessee [Figure I.E]. The study area is described in detail in Chapter III.A.

Figure I-E Study Area

F. CHRONOLOGY OF ISSUES

1. 1997-1999 Chronology

Increased public and government agency concern about MTM/VF operations emerged in 1997 and 1998. It appeared that the number of these types of operations had increased in recent years in Appalachia, and that more and more valley fills were being proposed/built. However, based on information contained in the Fill Inventory conducted for this EIS [Chapter III.K.] there were an average of 558 valley fills per year approved in the EIS study area for the five-year period of 1985-1989; an average of 399 valley fills/year approved during the period 1990-1994 (a 28% reduction from the 1985-1989 period); and, an average of 315 fills/year approved in the four year period (1995-1998) before the start of preparation of this EIS in early 1999 (a 44% reduction from the 1985-1989 period and a 21% reduction from the 1990-1994 period). However, while the average number of fills per year had decreased, a comparison of the fills constructed in the period 1985-1989 with those constructed in 1995-1998 showed that the average fill increased in size by 72 percent, and the average length of stream impacted per fill increased by 224 percent.

a. Federal Activities

Concerned about impacts to fish and wildlife habitats, the FWS initiated an informal inventory in 1997 of stream impacts resulting from valley fills and sediment ponds in West Virginia, Virginia, and Kentucky. Also in 1997, EPA, COE, OSM, and FWS began meeting to discuss MTM/VF through an EPA Region III forum called the Federal Regulatory Operations Group. In November 1998, the agencies signed a "Statement of Mutual Intent," agreeing to study the impacts from and regulatory controls on MTM/VF. This evaluation plan stated the following:

> *"1. Assessing and documenting the cumulative environmental impacts of fills since the permanent regulatory program under the Surface Mining Control and Reclamation Act was implemented in each state, and estimate the extent of future impacts. This assessment will consider effects on water quantity and quality, and aquatic and terrestrial habitats–both under the footprint of the fill and downstream. The assessment will also consider final reclamation results and the success of any mitigation requirements, both on and off site.*
>
> *2. Assess the individual and cumulative effects of valley fills and the associated mining disturbance on downstream flooding potential;*
>
> *3. Review mitigation practices utilized in various States;*
>
> *4. Assess long-term stability of fills with emphasis on safety issues; and*
>
> *5. Document existing federal and state laws and regulations and current regulatory practices. This will include relevant provisions of the Clean Water Act, as well as consideration of the utilization of the provisions of the Surface Mining Control and Reclamation Act requiring operators to complete a probable hydrologic consequences determination, and the state regulatory agency to complete a cumulative hydrologic impact assessment."*

As a result, plans for a fill inventory; stream impact study; flooding study; mitigation practices study; fill stability study; and a review of the interplay of federal laws and regulations were developed. In addition, OSM initiated an oversight evaluation in 1998 of how the SMCRA delegated programs in Kentucky, Virginia, and West Virginia were approving coal mines that proposed to not restore to approximate original contour (AOC), a practice that can result in more numerous and larger valley fills. The oversight studies, including the findings and action plans can be found at http://www.osmre.gov/mtindex.htm.

b. WV Governor's Study

In June 1998, West Virginia's then-Governor Cecil Underwood created the "Task Force on Mountaintop Mining and Related Practices" to study the effects of MTM/VF. The task force was organized into three committees: 1) Impact to the Economy; 2) Impact on the Environment; and 3) Impact on the People. The findings of the task force were published in December 1998. The Task Force recommendations included the following:

- The need for more research on the environmental and economic effects of MTM/VF;
- Establishment of a state office to regulate the impact of mountaintop removal mining on people;
- Establishment of a nationwide stream mitigation policy;
- Discontinuation of "fish and wildlife habitat" as a post-mining land use (PMLU);
- Development of commercial forest land as a preferred PMLU;
- Rigorous enforcement of existing regulatory requirements, including water quality and approximate original contour (AOC) guidelines; and,
- Examination by the legislature of whether public values compel restrictions on the degree of alteration of the landscape and the environment with regard to large-scale MTM/VF operations.

c. Litigation

c.1. *Bragg v. Robertson*

In July 1998, the West Virginia Highlands Conservancy and several citizens filed a lawsuit against the West Virginia Department of Environmental Protection (WVDEP) and the COE (*Bragg v. Robertson*., Civ. No. 2:98-0636 S.D. W. Va), alleging that valley fills associated with surface coal mining operations resulted in the loss and degradation of West Virginia streams, and that CWA and SMCRA were being improperly applied.

c.2. Clean Water Act Allegations

Specifically, plaintiffs contended that CWA Section 402 rather than CWA Section 404 was the regulatory program governing disposal of excess spoil, largely over confusion resulting from differing definitions of "fill" in EPA and COE regulations. See Appendix B for a more detailed explanation of the CWA Section 402 and Section 404 programs. The plaintiffs also argued that if the CWA Section 404 did apply, then valley fills both individually and cumulatively caused more than a minimal impact to "waters of the U.S.," and consequently were not eligible for COE authorization via a NWP. In addition, the plaintiffs alleged that the COE violated the National Environmental Policy Act (NEPA) by failing to analyze the adverse and cumulative environmental impacts of valley fills and surface mining activities in West Virginia.

c.3. SMCRA Allegations

Several *Bragg* counts centered around the alleged failure of WVDEP to satisfy requirements of its SMCRA program including the following:

- enforcement of the stream buffer zone downstream of valley fills and sediment control structures;
- measurable demonstrations that approximate original contour (AOC) were attained, minimizing excess spoil and stream impacts;
- specific findings in permits on AOC variances and other areas involving post-mining land uses (particularly establishing commercial forestry standards; allowing donation of reclaimed "homesteading" tracts; and disapproval of undeveloped recreational uses to justify AOC variances);

- hydrologic reclamation plan;
- contemporaneous reclamation provisions;
- establishing a quality control advisory committee to evaluate application approvals; and,
- securing certain technical disciplines as staff for permit application evaluation.

The plaintiffs in *Bragg* also contended that the practice of valley filling violates the SMCRA "stream buffer zone rule" [30 CFR 816.57], which restricts surface mining operations within 100 feet of an intermittent or perennial stream.

c.4. *Bragg* 1998 Settlement

In December 1998, the plaintiffs, Federal agencies, and WVDEP agreed to settle the CWA portion of the case, based on a general agreement that the CWA Section 404 regulatory framework was the appropriate regulatory control for authorization of valley fill construction in West Virginia. The settlement agreement required the agencies to:

> "enter into an agreement to prepare an Environmental Impact Statement ("EIS") on a proposal to consider developing agency policies, guidance, and coordinated agency decision-making processes to minimize, to the maximum extent practicable, the adverse environmental effects to waters of the United States and to fish and wildlife resources affected by mountaintop mining operations, and to environmental resources that could be affected by the size and location of excess spoil disposal sites in valley fills."

The settlement agreement established interim guidelines (pending completion of this EIS) for the evaluation of MTM/VF permit applications in West Virginia, and required the agencies to enter into a Memorandum of Understanding (MOU) to establish an interagency coordination process "to ensure compliance with all applicable Federal and state laws and guidance, improve the permit process, and minimize any adverse environmental effects associated with excess spoil created by mountaintop mining operations in West Virginia," thereby accomplishing a stated goal of "coordinated permit decisions that minimize adverse environmental effects." The evaluation and resultant study plans developed under the 1998 Statement of Mutual Intent subsequently became part of the effort to prepare this EIS [Chapter I.C.2.b.]. These efforts were assimilated by the Federal agencies into the initial NEPA process for this EIS beginning in early 1999 to describe the affected environment and identify areas where programmatic improvements and better coordination could occur, ultimately resulting in enhanced environmental protection under the Federal laws.

The *Bragg* settlement thus described a CWA Section 404 framework for mining proposals in West Virginia, establishing, as a general matter, a minimal impact threshold where valley fills are located in watersheds less than 250 acres. The COE can exercise its discretion (based on site-specific aquatic conditions) to require an individual permit (IP) on any project in watersheds less than 250 acres or authorize valley fills in watersheds greater than 250 acres under Nationwide Permit 21 (NWP 21). NWP 21 is a general permit authorizing fills in waters of the U.S. associated with surface coal mining and reclamation operations, provided the coal mining activities are authorized by OSM or states with approved programs. The COE also evaluates whether multiple valley fills on a project, or multiple mining proposals in a particular watershed, exceed the minimal impact

threshold and thus require an IP review. IPs are more extensively-reviewed CWA Section 404 permits that require NEPA, public interest, cumulative and secondary impact analysis as well as broader interagency consultation and public participation.

As mentioned above, to aid in the objective of increased scrutiny of permits, the Federal agencies, and WVDEP signed a Memorandum of Understanding (MOU) for the "Purpose of Providing Effective Coordination in the Evaluation of Surface Coal Mining Operations Resulting in Placement of Excess Spoil Fills in the Waters of the United States" which established a process for improving coordination in the review of permit applications. The signatory agencies entered into the agreement with the goals of enhancing cooperation and communication in order to ensure compliance with all applicable Federal and state laws, improving time lines and predictability of the permit process, and minimizing adverse environmental impacts from surface coal mining operations resulting in placement of excess spoil fills in the waters of the U. S. The experience of the agencies resulting from the increased permit scrutiny have been considered in the development of this EIS. Many of the efforts in this so-called "interim permitting" period identified areas where the agencies, the regulated community, and the environment would benefit from coordinated or clarified procedures, better baseline data collection, improved analysis of potential impacts, and a different sequence of processes.

c.5. 1999 Consent Decree

In 1999, WVDEP entered into a Consent Decree following discussions with the plaintiffs on issues in the Bragg counts regarding the state implementation of the delegated SMCRA program. The stream buffer zone violation was not addressed as part of either the 1998 settlement agreement or WVDEP Consent Decree and was subsequently briefed by parties and reviewed by the Federal district court.

c.6. 1999 *Bragg* decision

In October 1999, the southern Federal District Court in West Virginia ruled on the disposition of the SMCRA-related count concerning stream buffer zones. The court ruled that valley fills could not be located in intermittent or perennial stream segments without violating the OSM stream buffer zone regulation at 30 CFR 816.57 [Bragg, et al. v. Robertson, Civ. No. 2:98-0636 S.D. W. Va.]. The decision was appealed to the 4th Circuit by the Federal government and West Virginia. The outcome of the appeal is described below in I.F.3.b.1.

3. 2000-2003 Chronology

Following the permitting changes instituted pursuant to the *Bragg* settlement agreement and other unrelated factors, the average number of fills/year approved in the EIS study area declined from the average of 396 fills/year (1985-1998) to 217 fills/year (1999-2001). Average stream impacts also decreased to 0.137 miles/fill during the three-year period (1999-2001) after the Bragg settlement compared with the 0.207 stream miles/fill for the four-year period before the settlement agreement. The cumulative change following implementation of the interim permitting process was a reduction by half of the total stream miles of impacts approved during 1999-2001 (30 miles) versus the average number of miles approved in the previous four years (1995-1998, 63 miles). Similarly, 3,016 acres of fill in 26,570 acres of watershed were approved between 1999 and 2001, while 5,168

acres of fill in 15,733 watershed acres were approved between 1995 and 1998. These data are derived from the valley fill inventory prepared for this EIS [Chapter III.K].

a. Revision to Definition of "Fill Material" under CWA Section 404 and Issuance of Revised NWPs

Some of the legal arguments on CWA applicability to valley fills occur because the EPA and COE historically defined "fill" (i.e., materials to be placed in waters of the United States that are under CWA 404 jurisdiction) differently. The COE applied a "primary purpose test," that is, material was considered to be fill when it was placed in waters of the U.S. for a purpose, such as to create dry land for a construction site. The EPA considered the "effects test" to determine CWA Section 404 jurisdiction, i.e., if fill had the "effect" of creating dry land or changing the bottom elevation of a stream. The differences in the "fill" definitions that arose in *Bragg* and other COE/EPA litigation unrelated to coal mining were resolved through joint rule making started in 2000. EPA and the COE proposed a rule that would harmonize these definitions with the EPA "effects test." This rule was finalized in May 2002, clearly specifying that "overburden from mining"is fill regulated by CWA Section 404 [67 FR 31129-31143]. While this regulatory action is related to issues analyzed by this EIS, the rule making was independent of this EIS development.

As discussed briefly above, under the CWA Section 404 program, the COE can consider issuing permits to convert portions of waters of the U.S. to dry land, provided that the proposal is in compliance with the Section 404(b)(1) Guidelines. There are several types of permitting actions available to the COE to authorize these activities. The COE may use a general permit review process (such as regional or NWP) or a more-involved IP process. The NWP process is reviewed and revised as necessary by the COE every five years. In February 2002, the COE re-issued all NWPs [67 FR 2020-95]. NWP 21, applicable to coal mining activities authorized by a SMCRA permit, was revised to address some of the interim permitting issues identified. The new NWP 21 requires a case-by-case evaluation of valley fill impacts to determine which CWA Section 404 permitting process is most appropriate, and provides for mitigation of unavoidable aquatic impacts to assure that significant degradation will not occur.

b. Litigation

b.1. *Bragg v. Robertson*

The *Bragg* settlement agreement resulted in an MOU for agency collaboration on SMCRA and CWA application review where mining proposals included valley fills. The Federal agencies and WVDEP began concurrently evaluating mining proposals, both informally before application and formally after application. WVDEP required additional information in the application and performed reviews similar to those required by the CWA Section 404(b)(1) Guidelines in order to make SBZ findings required under SMCRA. OSM provided additional technical staff to assist WVDEP in application review. The COE based CWA Section 404 reviews on the SMCRA application and any additional data necessary to satisfy the NWP or mitigation requirements.

WVDEP implemented the terms of the *Bragg* consent decree, preparing guidelines, policies and regulations to address the issues presented above. In 2001, the Fourth Circuit Court of Appeals held that claims by the plaintiffs against West Virginia were barred by the Eleventh Amendment of the

U.S. Constitution. [248 F.3d 275 (4th Cir. 2001)]. The Circuit Court found that the stream buffer zone rule, like all requirements adopted by West Virginia under its authorized SMCRA program, become requirements of state law. The Fourth Circuit vacated the district court's decision in this case and plaintiff's claims were accordingly dismissed by the district court. From 2000 to the present, preparation of this EIS continued as provided in the *Bragg* litigation settlement as described above.

b.2. *KFTC v. Rivenburgh*

A case filed in 2002 by Kentuckians for the Commonwealth (KFTC) against the COE, also in the southern Federal district court in West Virginia, focused on CWA issues similar to those in *Bragg* (*KFTC v. Rivenburgh*, Civil Action No. 2:01-0770 (S.D. W.Va. 2002)). The court held that the COE lacked statutory authority under the CWA to issue Section 404 permits for waste material (*KFTC v. Rivenburgh*, 204 F. Supp. 2d 927, enjoined modified (S.D. W.Va. 2001)). The District Court stated that the joint COE/EPA final "fill rule" was ultra vires, beyond the authority of the COE under the CWA. The court enjoined the COE from issuing CWA Section 404 permits within the Huntington (WV) District where any fills proposed in waters of the U.S. had no "constructive purpose." This injunction, which applied prospectively, generally limited COE authorization of MTM/VF in southern West Virginia and eastern Kentucky. The court ruling had no effect on MTM/VF CWA Section 404 permits in the rest of Kentucky, Tennessee or Virginia. The government appealed the decision to the Fourth Circuit Court.

On January 29, 2003, the Fourth Circuit vacated the district court's decision in *KFTC*, in part, on the grounds that the injunction was overly broad. While the plaintiffs made allegations only with respect to a particular mine, the district court's injunction broadly applied to any coal mining or other fill activities throughout the Huntington District of the COE, which covers parts of five states. In addition, because the agencies' revised joint definition of fill material of 2002 was never before the district court, the court of appeals also vacated the district court's declaration that the agencies' regulation exceeded the agencies' authority under the CWA. According to the court of appeals, the sole issue was whether the COE authorization of the Martin County Coal Mine valley fills was valid under its 1977 regulations and the statute. The court of appeals found that regulating valley fills was consistent with both the regulation and the statute, rejected the district court's conclusion that the statute only authorized issuance of permits under CWA Section 404 for "beneficial" fills, and held that neither the statute nor the 1977 regulation prohibited the COE from authorizing valley fills for waste disposal purposes under CWA Section 404.

G. SCOPING AND PUBLIC INVOLVEMENT

1. Public Participation

Public participation was actively sought in the development of this EIS. The Notice of Intent for the EIS was published in the Federal Register, dated February 5, 1999 [64 FR 5778] and posted on the MTM/VF web site. The agencies invited comments and suggestions on the scope of the analysis, including the regulatory issues and significant environmental effects to be addressed in the EIS. Public meetings as well as meetings with citizen groups and mining industry groups were held to engage the stakeholders and other interested parties.

a. Public Meetings

Scoping meetings were held in Summersville, Charleston, and Logan, West Virginia, on February 23, 24, and 25, 1999, respectively. Many people took advantage of the opportunity to participate in these public meetings. The public was also invited to provide written comments. Verbal statements were made by 641 individuals at the public meetings while 95 provided written comment letters.

Concerns expressed in these public scoping meetings described economic and social impact issues, policy and regulatory review issues, EIS process questions, and a broad range of environmental impacts associated with MTM/VF operations. A summary of the concerns and issues expressed during the scoping process is presented in the MTM/VF EIS Bulletin 1, dated May 1999. This bulletin, and other information on the EIS, can be reviewed by accessing the Mountaintop Mining homepage at www.epa.gov/region03/mtntop/.

b. Meetings with Citizen Groups

A meeting was held December 13, 1999 at the WVDEP Office in Nitro, West Virginia. Invited citizen groups included the West Virginia Highlands Conservancy, Ohio Valley Environmental Coalition, West Virginia Organizing Project, Citizen's Action Group, West Virginia Environmental Council, and Mountain State Justice.

A meeting with citizen groups was held December 15, 1999 at the Kentucky DNREP Office in Prestonsburg, Kentucky. Invited citizen groups included the Kentucky Resource Council, Kentuckians for the Commonwealth, and Citizen's Coal Council.

c. Meetings with Coal Mining Industry Groups

A meeting with mining industry groups was held January 6, 2000 at the Kentucky DNREP Office in Prestonsburg, Kentucky. Invited mining industry groups included Kentucky Coal Association, Small Coal Operators Advisory Board, Coal Operators and Associates, and Knott/Perry/Letcher Coal Operators Association.

A meeting with mining industry groups was held December 14, 1999 at the WVDEP Office in Nitro, West Virginia. Invited mining industry groups included the West Virginia Mining and Reclamation Association and the West Virginia Coal Association.

2. Issues Raised During the Scoping Process

Issues of concern expressed during the scoping process have been summarized and organized into the following aquatic, terrestrial, and community impact issues.

a. Direct Stream Loss

Comments expressed concerns related to stream loss and associated secondary or cumulative effects. The following are excerpts from a aquatic resource-related comments.

"The EIS should determine the immediate, long term and cumulative effect of stream losses due to valley fills and watershed vegetational alterations to aquatic ecosystems. In addition, the study should determine how energy budgets, water quality, and water quality downstream of buried streams compare to a stream that has no headwaters filled."

"Sufficient biological data are not presently available to characterize the importance of headwater streams. In addition, the data that is available is unreliable. New biological studies are needed to generate this data."

"Already we have lost hundreds of miles of streams to valley fills."

b. Stream Impairment

Other comments expressed concerns related to water quality and associated biotic effects. The following are excerpts from aquatic resource-related comments.

"Research should be conducted on the ecological function of head-of-hollow streams, and their role and significance in preserving the quality and quantity of water downstream."

"What are the regulatory limitations on valley fills in terms of state water quality standards? How can valley fills be consistent with anti-degradation requirements under the Clean Water Act?"

"What are the short- and long-term effects of sediment runoff downstream from mountaintop removal operations?"

"Not only is the chemical quality of the water affected by the condition of the headwater areas, but the complex food webs and life cycles of stream organisms are dependent on use of these critical areas."

"Seasonal benthic surveys should be conducted to determine potential immediate and long-term, and cumulative impacts of valley fills, caused by area mines, mountaintop removal or other surface mine activities."

c. Fill Minimization

Statements provided during scoping of this EIS express concern related to fill minimization. The following are excerpts from comments received.

"There is a need for clear and concise rules on maintaining the Approximate Original Contour (AOC) at both the permitting and reclamation state of mine operations. I urge tighter regulations on AOC, that assures binding long term compliance by states. There is tremendous variability in the West Virginia program, which requires more oversight by Federal agencies responsible for implementation of the Surface Mine Control an Reclamation Act (SMCRA)."

> *"An EIS should determine the viability of other alternatives of disposal of 'overburden' in valleys where mountaintop removal and area mining is conducted."*

d. Assessing and Mitigating Stream Habitat and Aquatic Functions

Statements provided during scoping of this EIS indicate that wetland habitats and functions are being created on reclaimed mine sites either purposely or as the result of the construction of erosion and sediment controls. This issue addresses the ability of reclamation practices to restore stream habitat and aquatic functions impacted by MTM/VF and the effectiveness of mitigation. The following are excerpts from comments received.

> *"Cattail wetlands have an important place in mine reclamation. But they are just one type of wetland. There are other types that should be encouraged on backstacked areas to increase productivity, water quality, and biodiversity."*

> *"I request the EIS address the following concerns/issues…the likelihood of reclaiming mined sites to their original ecology."*

Comments indicated that valley fills increase base flow to streams. The following are excerpts.

> *"From what I have seen in my 28 years of mining experience, the valley fills created due to surface mining makes the downstream more productive for aquatic life because the valley fills act as water reservoirs and provides a reliable stream of water downstream - without valley fill the stream might dry up in extremely dry weather."*

> *"The experience of the industry is that once valley fills are completed and hydrologic balances reach equilibrium, peak flows after large storm events are reduced and base flows actually increase even over extended periods of dry weather. The net effect is that stream segments that were once ephemeral and that supported only sporadic benthic life before mining, now flow perennially and support benthic life throughout the year."*

Comments made during the public scoping process addressed the effectiveness of compensatory mitigation. Comments ranged from suggesting that there is no way to mitigate for or replace the streams or habitat lost to suggesting that significant aquatic resource benefits have resulted from compensatory mitigation projects. This issue evaluates the effectiveness of compensatory mitigation projects to make up for loss of stream habitat and aquatic functions. The following are excerpts.

> *"It is our observation that many cumulative miles of streams have been covered/destroyed without any mitigation."*

> *"Mitigation measures may be more public relations than substance."*

> *"It seems highly improbable that proper mitigation has been conducted..information should include whether or not the mitigation occurred on or off-site and whether or not mitigation was appropriate and compensatory. This study should also determine*

how much follow-up activity occurs to see whether or not mitigation has been successful."

"Eliminate the arbitrary 200 acre mitigation requirement for valley fills. Watersheds as small as 20 acres contain valuable water dependent ecosystems, and should be considered for mitigation."

e. Cumulative Impacts

Statements provided during scoping of this EIS express concern regarding cumulative effects from MTM/VF activities. The following excerpts are provided. The analysis of cumulative impacts covers both aquatic and terrestrial resources.

"Mountaintop mining and valley fill permits should no longer be issued on an individual basis without first considering the cumulative impacts on the watershed. Coal companies should be required to conduct pre-mine environmental habitat assessments for each permit in relation to the impacts of the mine project on the biota of the individual watershed . Habitat Assessments would include qualitative and quantitative information on aquatic and terrestrial resources."

"How does mountaintop removal affect biodiversity of terrestrial plants and animals in the region?"

"The EIS should quantify the current cumulative losses and future potential losses of acres of terrestrial habitat as a result of mountaintop mining, area mines and other surface mining activity as well as the actual losses of miles of streams caused by valley fills."

"The full impact of valley fills, both on the micro scale and on the macro or landscape/ecosystem scale, must be studied and known....We need to look at the overall picture for the area at risk. This requires identification of where any MTR mining might be expected for the present and for the future. It means looking beyond the confines of a given permit application. We need to understand the long-term cumulative impact if 30-40% of the mountains in some areas are stripped and leveled."

f. Deforestation

Statements provided during scoping of this EIS express concern over deforestation or forest fragmentation and its effect on plants and wildlife. The following are excerpts.

"The EIS should determine the extent to which WV's valuable hardwood forests are becoming fragmented and what immediate, long-term and cumulative impacts fragmentation has upon fauna."

"West Virginia has remained a strong hold for species like: Cerulean warbler, Worm-eating warbler and Scarlet tanager because of large areas of relatively unbroken forest where a diverse ecosystem survives. Mountain top removal as a

mining practice is not compatible with the maintenance of healthy habitats for wildlife!"

"Latta and Baltz (1997) indicate that fragmentation of breeding bird habitat can have profound effects on reproductive success of avian species. They further state that fragmentation can cause insularization effects, increased nest predation, increased nest parasitism by Brown-headed Cowbirds, and decreased pairing success. In many cases, these effects may be sufficient to cause local declines in bird populations. Other species, such as salamanders, may be heavily impacted by forest removal and fragmentation due to their requirements for moist habitats."

"Robinson (1998) presents a concise overview of the linkage between neotropical migrants and forest fragmentation. Villard (1998) addressed the subject of forest-interior species and area-sensitive species. The importance of contiguous forest land has been directly studies for a variety of avian species. Recent examples include the Scarlet Tanager (Roberts and Norment, 1999) and Wood Thrush (Weinberg and Roth, 1998). It would seem imperative, given the wealth of evidence on the detrimental effect of forest fragmentation on avian species that the environmental impact of mountaintop removal be thoroughly examined. Baseline data on the occurrence of breeding neotropical migrants at specific sites should be collected to assess possible impacts."

g. Blasting

The following are excerpts from comments related to blasting made during the EIS scoping process. The issue is the effects of MTM/VF on communities, homes, water wells, and quality of life.

"Objective research into the effects of mountaintop mining blasting on groundwater hydrology and quality is needed. The evaluation of effects is complicated by the fact that many of the mining areas are underlain with extensive old mine works. A study must be done on the effects of blasting on structures such as houses, churches, farms, water, and sewer lines, etc. Minimum distances from property and wells should be based on science and standards should be set for the adequate prevention of damage."

"Many residents whose homes are near proposed or active surface mining sites opt to move or are bought out by the coal companies. Those that refuse to leave are subjected to noise, dangerous fly-rock, potential harm to health from breathing dust, and structural damage to their homes and water wells."

"We have watched and lived through this mining process. As a result we have seen a large number of changes in our overall quality of life…This has caused a major destruction of community structure. It has caused low enrollment in our schools, which resulted in the closure of our high school and our children being bused, and the near future closure of our grade school."

"The communities, families, and homes in the area where mountaintop removal is done have suffered hugely. The impact on the human and social environment must be considered."

h. Air Quality

The potential health risks of airborne dust and fumes from blasting and other mining operations were cited. During the EIS scoping process, comments were received from people living near mountaintop mines describing constant dust on their property and health concerns associated with mining. The following are excerpts from the comments.

"The company has washed our houses frequently, but the dust still prevails. Some of our people have bad irritating and aggravating sinus infections."

"One important aspect of the EIS should be to determine acute and chronic impacts on human health, focusing especially on respiratory illnesses of on-site workers as well as community residents. EPA should request photos and/or videos of dust events from citizens living in communities impacted by large area mines and mountaintop removal sites and conduct health impact studies on citizens who live or formerly lived in these communities. In addition, EPA should conduct monitoring for PM10 and PM2.5 to help determine exposure on and off-site of the mines."

"Air quality monitoring programs need to be developed for MTR operations. Significant particulate matter and other airborne pollutants are produced by barren windblown surfaces and blasting operations at MTR sites, that in many cases exceed 1000 acres. More monitoring is needed at MTR sites to quantify the type, amount and toxicity of pollutants, including their contribution to the regional air quality problem."

"One important aspect of the EIS should be to determine acute and chronic impacts on human health, focusing especially on respiratory illnesses of on-site workers as well as community residents."

i. Flooding

Statements provided during scoping of this EIS indicate concern that MTM/VF could increase flooding. The following are comment excerpts.

"What has been the extent of flooding as a result of forest removal and mining activities?"

"The potential for increased flood danger, because of removal of forest cover and smoothing of contours, as well as the risk of failure of built valley fills, must be assessed."

"Flattening a mountaintop and filling a valley will cause unknown changes to the hydrologic cycle. We don't know if valley fills cause increased flooding or increased

drought. No one knows if a filled valley will recharge groundwater at the same rate than if it's left with its original topography and plant cover."

"A growing number of hydro-geologists and scientists believe these cumulative effects may cause flash flooding and loss of life and/or property to the residents of the coal fields."

j. Land Use

Statements express the desire that mined lands are reclaimed to viable economic post-mining land uses, so that coal communities will continue long after coal resources are depleted. This issue addresses the ability of reclaimed mined land to provide an economic, social, or environmental benefit to coal field communities. The following are examples of comments received regarding concerns related to post mining land use.

"Development issues need to be thoroughly examined. What happens to a mountaintop removal site after mining? How have the economics of a human community been affected once mining activity ceases?"

"MTR will ruin WV's only renewable resource- its timber, as planting trees on MTR sites is like planting trees in concrete."

"It is quite obvious that land and environmental qualities often are increased after mining. there is diversity in the environment in that land exists which can be used by humans for something other than to look at, timber, or ride 4-wheelers."

"…the reclaimed land is much more useful to the landowner…The current permitting process includes the landowner in the decision-making process relative to his land and how it will be reclaimed."

k. Threatened and Endangered Species

Statements provided during scoping of this EIS express concern about the evaluation potential adverse impacts to threatened and endangered species. The following are excerpts from the comments.

"Immediate, long-term and cumulative impacts on endangered species or species of special concern should be conducted. Green and Pauley (1987) noted 62 records of different species of amphibians and reptiles in the southern portion of the Allegheny Plateau Region of West Virginia."

"There may be a loss of P.Clava and Club Shell Mussels buried in loose sand in Elkwater Drainage shed. Such watersheds which have endangered species of mussels must be identified."

l. Scenery and Culturally Significant Landscapes

Statements provided during scoping of this EIS indicate a concern regarding the effects of mining on scenery. Also, statements were made indicating that the mountains have cultural significance. The following are comment excerpts.

> *"The loss of scenic value should be considered site-by-site."*
>
> *"I request the EIS address the visual aesthetic impact of post mined sites."*
>
> *"Visual resources, as experienced from many units of the National Park Service, are a key part of the visitor expectation when visiting National parks. It is important that the EIS factor in potential degradation of the visual landscape, especially when operations are proposed near units of the NPS. Scars from historic surface mining upon the Appalachian landscape are prevalent. We believe it is important that the EIS examine how past mining disturbance and new mining proposals will further affect the viewshed not only post operations, but during what can often be lengthy mining operations as well."*
>
> *"This used to be beautiful land. Tall majestic mountains. Heavily forested. Streams fed by spring water you could drink, animals and plant life everywhere. The old settlers called this the land of milk and honey, a place of peace and security. Not so today."*

m. Exotic and Invasive Species

Statements provided during scoping of this EIS indicate a concern over the introduction of exotic or invasive plant species through MTM/VF activities or reclamation practices. The following are comment excerpts.

> *"Future MTR reclamation plans should be modified to address the recently signed Presidential Executive Order on Invasive Species. This order signed on February 3, 1999, states that, '...to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological and human health impacts that invasive species cause..' The implementation of this order shall eliminate the use of exotic species on MTR reclamation operations."*
>
> *"They are planting pine, locust and a grass that nothing can eat, and this is to cover up their damage to our mountains. they are planting Autumn Olive which is not permitted in West Virginia except here in our southern counties where nothing else will grow."*
>
> *"I would like the EIS to determine whether native plants and trees of all types grow and reproduce prolifically on all reclaimed MTR sites. This should include a count of the native species by type and abundance. After mining, coal companies should be required to return native species to pre-mining populations. Coal companies should be held responsible until at least 90% of native trees and plants reach maturity."*

n. Valley Fill Stability

Statements provided during scoping of this EIS indicate a concern over the long term stability of valley fills. The following are comment excerpts.

> *"Human communities are often situated below valley fills. What is the long-term stability of these structures?"*
>
> *"The risk of failure of built valley fills, must be assessed."*
>
> *"I am concerned that coal companies will be making their valley fills too short for maximum stability."*

o. Economics

Letters and verbal comments were received during scoping expressing concern over the potential for job loss if permitting or regulatory changes were implemented. Comments stated the positive economic impacts of MTM/VF on the local communities, the state, and the nation. Statements were made during scoping that local governments depend on revenues and taxes from the coal industry in order to provide police and fire protection, ambulance service, and for education. The following are comment excerpts .

> *"Local governments depend on revenues and taxes from this industry in order to provide police and fire protection, ambulance service, and for education."*
>
> *"The EIS needs to analysis the environmental and economic costs caused by mountaintop removal operation to regional and local efforts to build and expand their sustainable economic base. As one example of these efforts, herbal cooperatives are working to sustain population of native ginseng, a high-priced herb in demand world-wide for medicinal uses that is found in undisturbed mountain habitats of Appalachia."*
>
> *"An economic evaluation should be conducted within the counties most effected by MTR. this study would evaluate the long-term economic impacts of: removed mountaintops; the filling-in of hundreds of mile of stream; elimination of productive timberlands; degraded aquifers; altered scenic values and the associated loss of tourism dollars; etc."*
>
> *"The notice in the Federal Register indicates that impacts of valley fills on nearby residents are going to be addressed. If this means that socio-economic impacts are to be included, then a detailed assessment of the positive economic impacts of mountaintop mining on local communities, the state, and the nation must be included as well. If the intent of the EIS is to study the overall impacts, then annual payrolls, severance taxes, property taxes, sales taxes, indirect jobs and medical benefits of workers should be evaluated to determine the net impacts."*

"There will be no jobs for the miners in West Virginia, these people will be out of their jobs, layed off. And they won't be able to support their families. This will cause them to fall back on unemployment and eventually welfare."

p. Environmental Justice

Statements provided during scoping of this EIS indicate concerns regarding environmental justice issues. The following are comment excerpts.

"Is it any wonder what has happened in the coalfields of West Virginia? Is it any wonder that significant infrastructure development, education and school performance, improved standards of health or alternative business development are so minimal in the West Virginia coalfields compared to the rest of the country? Is it any wonder that our status as poorly educated, lacking in economic diversity, and suffering from comparable poor health relative tho the rest of the country persist today despite record coal production of some $4.4 billion dollars just last year? From the coal industry perspective, this is good business. Keep the people totally dependent on one and only one industry. Keep the people poorly educated. Keep them vulnerable to health concerns. Drive away talented young, who might effectively challenge coal practices or develop other businesses which could erode almighty coal's dominance. Keep the people desperate. That's just good business."

q. Government Efficiency

Statements provided during scoping of this EIS indicate concerns over process issues. The following are comment excerpts organized by process topics. Comments were received regarding compliance with existing laws.

"Coal companies in West Virginia have worked very hard to follow the stringent environmental regulations that EPA has established. Now, without prior notice of any kind, no permits are being issued. EPA has announced at least twice a unified Federal position and yet we still have not seen such a decision or any signed documents implementing the same".

"Need to Resolve Regulatory Inconsistencies (ie- Stream Definitions)"

"MTR is only cheap because we collectively do not write definitive enough laws or enforce uniformly and completely those laws we do have to govern the industry."

Comments were presented concerning a perceived lack of consistency of Federal requirements from state to state.

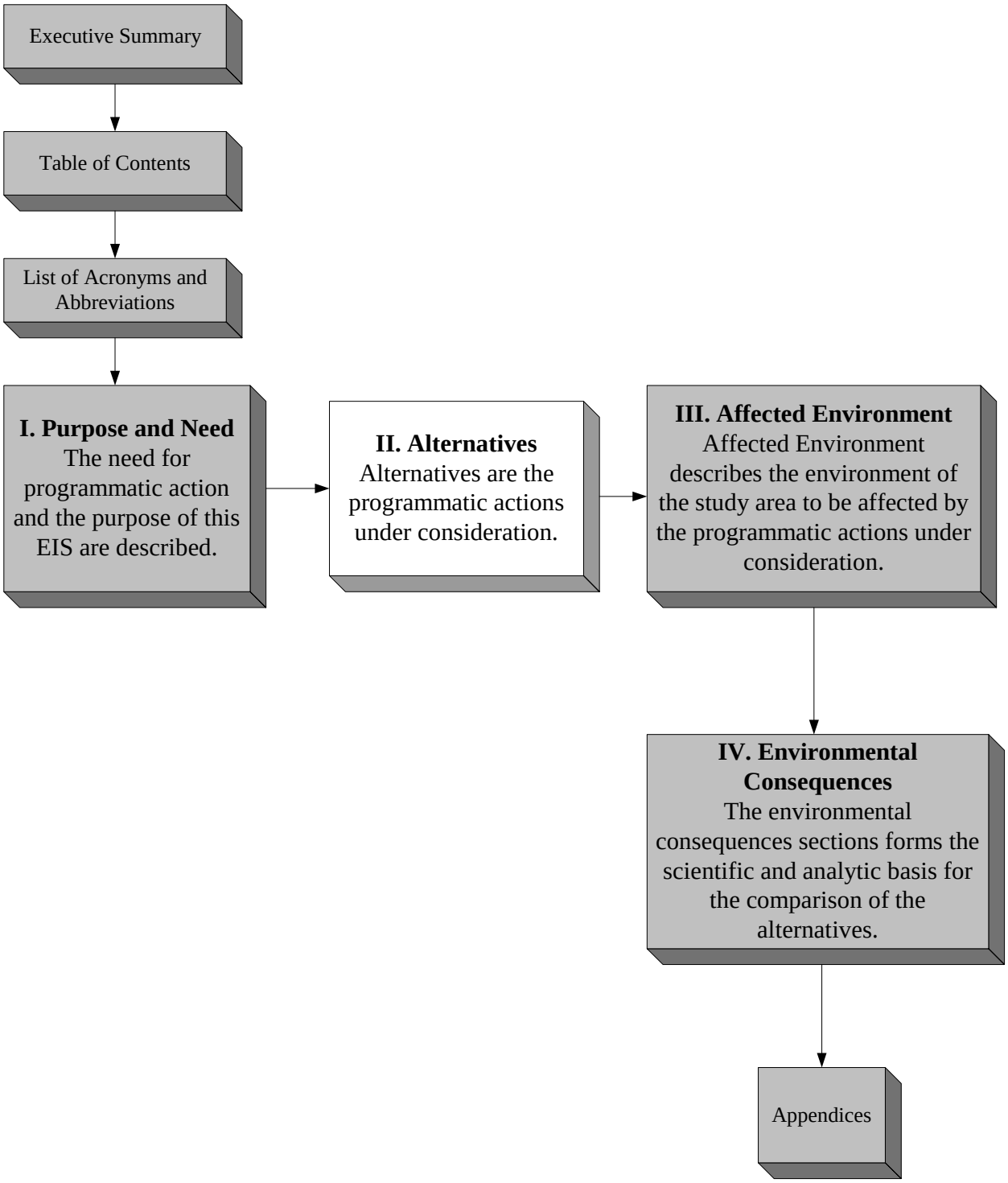
"Consistency of Valley fills with Antidegradation Policy"

"OSM should be the lead federal agency for the EIS"

"*Open the process to the public via a web site*"

The issues, including the excerpts provided above and raised in public and written comments, were analyzed and considered in scoping this EIS. Issues deemed "significant" in the NEPA context, and analyzed in detail in other sections of this EIS, are discussed in Chapter II.A.3.

Chapter II. Alternatives



II. ALTERNATIVES

A. ACTIONS CONSIDERED TO ADDRESS ISSUES IDENTIFIED IN SCOPING

Consistent with the National Environmental Policy Act (NEPA), issues identified in the scoping process were evaluated to determine the proper focus of the EIS. The NEPA regulations at 40 CFR 1501.7(a) provide that "significant" issues be identified and analyzed in depth while eliminating from detailed discussion issues which are not "significant." The focus of this EIS is therefore directed toward those issues that relate to the purpose and need of the EIS and are truly "significant" or important. The term "significant issues" is different from the criteria for significance of impacts, and refers to those issues that truly contribute to environmental impacts associated with the actions proposed in the EIS. Simply stated, the significant issues should be important to the decisions to be made. [Environmental Planning Strategies, Inc., 1998.]

The issues identified in scoping and set out in Chapter I.D.2, as well as the additional issues identified and discussed in Chapter I.E., were jointly evaluated. In evaluating the issues, the agencies reviewed their existing statutory and regulatory controls, policies, guidance and decision-making process to determine if the existing regulatory environment provided the mechanisms necessary to accomplish the purposes of this EIS. The purpose of this EIS is:

> "...to consider developing agency policies, guidance, and coordinated agency decision-making processes to minimize, to the maximum extent practicable, the adverse environmental effects to waters of the Unites States and to fish and wildlife resources affected by mountaintop mining operations, and to environmental resources that could be affected by the size and location of excess spoil disposal sites in valley fills." [64 FR 5778]

A description of the applicable statutes and regulations along with reviews of the requirements related to the EIS issues are in Appendix B.

1. Programmatic Review

During the programmatic reviews, the agencies considered the issues raised by the public and interested parties during scoping and "brainstormed" actions the government might take to better coordinate the programs to minimize impacts of mountaintop mining and valley fills. The "significant issues" were then identified in the scoping process, potential actions to address these issues were developed, reviewed, and prioritized in order to determine which actions would be effective and practicable for purposes of this EIS. Each issue raised in the scoping process [Chapter I] was considered to determine if actions could be taken to better coordinate the regulatory programs and to minimize environmental impacts of mountaintop mining and valley fills. The over 400 ideas for potential actions resulting from this process were organized and consolidated into approximately 130 ideas for government actions. In December 1999, these ideas were compiled in an outreach document and posted on the EPA Region III web site [http://www.epa.gov/region03/mtntop/documents.htm] as well as distributed to hundreds of stakeholders throughout the EIS study area [Appendix A].

Stakeholders provided reviews and comments on the 130 ideas; ranked the various ideas as high, medium, or low priority; and provided additional ideas. Ideas similar in nature were combined into common categories. Some ideas and comments were not developed into potential actions because they:

- were not related directly to the purpose and need of this EIS;
- were adequately covered by existing regulatory programs;
- would not be feasible under existing agency authorities and unlikely to be authorized by Congress in light of existing case law, statutes, or constitutional guarantees such as individual property right protections;
- were beyond the scope of the EIS because they would affect regulatory areas outside of the steep slope mountaintop coal mining focus of this EIS and could not be properly considered or analyzed; or
- were too vague or general to be analyzed, or would not provide substantial improvement in addressing the "significant issues" as required by NEPA.

Other suggestions were initially included for analysis but were ultimately not supported by the findings of the various technical studies, symposia, and existing literature reviews.

The result of this outreach effort was that the 130 ideas for government actions were further consolidated into approximately 60 actions, which were then assessed for appropriate inclusion in the EIS alternatives. Each of the actions was reviewed to select those that could significantly improve existing regulatory programs and realize greater environmental benefit regarding environmental impacts of mountaintop mining and valley fills in the study area. The 60 actions were then categorized into the following four topics: coordinated decision making, improved aquatic habitat protection, improved terrestrial habitat protection, and enhanced land uses.

The 60 suggested actions were evaluated, prioritized, and described. The final actions discussed in this EIS, which may be groups of suggested actions, were considered in various combinations in formulating the alternatives. As a result of this effort, 17 actions and three alternatives were developed and carried forward for analysis in this EIS. These actions and alternatives are described and evaluated in Section II.C of this chapter.

2. Technical Studies

To assist in the review of the existing regulatory environment, the agencies conducted or commissioned over 30 studies of the impacts of mountaintop mining and associated excess spoil disposal valley fills. The findings of these studies, along with the joint agency review of the existing regulatory environment, form the basis upon which the significance of each issue was evaluated. Many of the study findings are contained in Appendices D, E, G and H or referenced as to availability of information through other agencies or authors. Some studies were conducted by individuals and agencies outside of the EIS development process. Opinions and views expressed by the individual authors of these studies were not altered. Their opinions and views do not necessarily reflect the position or view of the agencies preparing this EIS. These studies are grouped into four general categories (aquatic, terrestrial, socio-economic and engineering). Cover sheets to summarize the studies were developed for each of the four appendices. These cover sheets are an aid to the reader and do not necessarily reflect the opinions and views of the EIS agencies.

Table II.A-1
MTM/VF EIS Technical Studies

Category	Study Short Title (preparer)	Date/Availability
Streams/Aquatic Information	WV-Macroinvertebrate (EPA)	November 2000; Appendix D
	WV Benthic Survey (OSM)	November 2002; Appendix D
	WV-Chemistry (EPA)	April 2002; Appendix D
	KY-Macroinvertebrate (EPA)	October 2001; Appendix D
	Fisheries (Penn State)	October 2002; Appendix D
	Statistical Analysis (EPA)	April 2002; Appendix D
	Ephemeral, Intermittent, Perennial Segments (USGS)	May 2003; Appendix D
	Wetlands	November 2001; Appendix D
	Headwater Streams Workshop	April 2000; Appendix D
	Aquatic Ecosystem Enhancement Symposium	May 2000; Appendix D CD of proceedings; available from DOE–NETL
Terrestrial, Soils Information	Birds, Small Mammals, Herptiles (WVU)	September 2002; Appendix E
	Birds along Forest Edge (Concord College)	May 2002; Appendix E
	Natural Succession/Plants (Rutgers)	October 2002; Appendix E
	Soil & Forest Productivity (OSM)	October 2002; Chapter III.B.4
	Mine soils (WVU)	January 2001; Appendix E

Category	Study Short Title (preparer)	Date/Availability
Extent of Potentially Surface- Minable Coal Resources	Extent of Surface-minable Coal Resources above the Coalburg Horizon in West Virginia (WVGES)	April 2000; Chapter III.O.
	Extent of Surface-minable Coal Resources in Three Eastern Kentucky Horizons (KGS)	July 2000; Chapter III.O.
	Extent of Surface-minable Coal Resources in Five Horizons in Southwestern Virginia (VPI)	July 2000; Chapter III.O.
Fill Stability	Fill Stability (OSM)	March 2002; Appendix H
Mining Reclamation Technology	Symposium	January 2000; Appendix H CD of Proceedings available from DOE--NETL
	Mine Tech Team Ephemeral Fill Restriction	July 2000 CD; Appendix G
Flooding/Fill Hydrology	Post-2001 WV Flood Analysis (USGS)	USGS draft Publication dated 2003; Appendix H
	COE/OSM Modeling	April 2001; Appendix H
	Ballard Fork Rainfall/runoff Model (USGS)	USGS draft Publication dated 2003; Appendix H
	Stream Geomorphology, Substrate, Flow, Temperature Survey (USGS)	USGS Publication IR 01-4092 dated 2001; available from USGS; Appendix D
Post Mining Land Use	Clarke Urban Growth Model land development potential and GIS analysis(WVU)	February 2002; Appendix G
Cumulative Impact Study	GIS modeling (EPA/Gannett Fleming Inc.)	December 2002; Appendix I
Blasting	Mine Dust/Blast Fumes (WVU)	October 2001; Appendix G

Category	Study Short Title (preparer)	Date/Availability
	Citizen Complaint Survey (OSM)	July 2002; Appendix G
	Non-Traditional Structures (OSM)	April 2002; Executive summary in Appendix G
	Wells (OSM)	June 2002; Executive Summary in Appendix G
Economics	Phase I-RTC	March 2002; Appendix G
	Phase II and Sensitivity Analysis-Hill & Associates	December 2001 and January 2003; Appendix G
	Community Impact/Demographic Changes (Gannett Fleming/EPA)	August 2002; AppendixG

3. Disposition of the Issues

The issues identified during the scoping process were evaluated and assigned to one of two categories. The first category contains those issues that were determined to be "significant issues" and actions were proposed to address them. The proposed actions addressing these Category 1 issues are described and evaluated in Chapter II.C. The consequences of these actions are analyzed in Chapter IV.

The "significant issues" in Category 1 are the following:

- Government Efficiency
- Direct Stream Loss
- Stream Impairment
- Fill Minimization
- Assessing and Mitigating Stream Habitat and Aquatic Functions
- Cumulative Impacts
- Deforestation
- Air Quality
- Flooding
- Threatened and Endangered Species

The second category contains issues that were considered not to be "significant issues", or that were considered significant but were already addressed by existing programs, regulations or laws. These issues do not have proposed actions and were not evaluated as part of the alternatives. The Category 2 issues (see Chapter I.D.2) are addressed as follows:

a. Blasting

Public comment during scoping indicated that MTM/VF blasting could impact individual homes, residents, and quality of life The agencies reviewed existing CWA and SMCRA regulatory requirements relevant to evaluation of the impacts that MTM/VF blasting operations. Studies related to these issues were also commissioned. Study topics included blasting vibrations and air concussion, well impacts, and a citizen complaint review. The complaint review consisted of an examination of the portion of a national blasting complaint survey that pertained to the EIS study area.

The regulatory review and study conclusions confirmed that existing regulatory controls provide adequate protections from coal mining-related blasting impacts on public safety and structures including wells. Findings further indicate the existing regulatory programs are intended to ensure public safety and prevent damage rather than eliminate nuisances from coal mine blasting activities. Some blasting within legal limits may still constitute a nuisance to people in the general area. As with all nuisances, the affected persons may have legal recourse regarding blasting nuisances through civil action. Consequently, blasting is not considered a "significant issue" and no actions are considered in this EIS. Existing blasting controls are discussed in Chapter III and Appendix B; study findings are in Appendix G.

b. Land Use

Concerns for viable post-mining land uses were expressed during the scoping. The agencies reviewed existing COE and SMCRA regulatory requirements relevant to evaluation of post-mining reclamation and potential use of mountaintop mine sites following reclamation. A study was commissioned related to this issue (Appendix G: Post Mining Land Use Assessment–Mountaintop Mining in West Virginia). The regulatory review and study indicate that existing regulatory controls are adequate to address this issue. Certain program controls relative to post mining land uses are discussed in Chapter II.C.

c. Scenery and Culturally Significant Landscapes

Statements provided during scoping indicated concerns about the effects of MTM/VF on scenery and culturally significant resources. Moreover, NEPA Section 102(2)(B) requires Federal agencies to "insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making." [42 U.S.C. 4321] Existing regulatory programs afford the opportunity to address this issue either independently or through public comment. For example, SMCRA regulatory requirements and procedures provide the option for designation of lands unsuitable for mining on the basis of these values. COE actions can also include NEPA and public interest reviews that consider this issue [33 CFR 325.3(c)]. Another example of SMCRA protections requires that potential impacts to public parks, designated scenic rivers, and historic/cultural sites listed on or eligible for listing on the National Historic Register be considered and appropriate measures taken to prevent impacts to these resources [30 U.S.C. 1271]. In addition, the National Historic Preservation Act includes considerations of this issue [16 U.S.C. 470 et seq.]. Statutory and regulatory controls exist that address this issue. Moreover, actions contemplated within this EIS could reduce landscape impacts (e.g., address reforestation, fill minimization and cumulative impacts).

Exotic or Invasive Species – Commenters expressed concern that exotic and invasive species pose a threat to the natural ecosystem as they may out-compete and displace native species, reduce available food and habitat for wildlife, and change natural areas in terms of composition, structure, or ecosystem function. On February 3, 1999, Executive Order 13112 (E.O.) was issued to discourage the introduction of invasive species and provide for their control to minimize the economic, ecological, and human health impacts that invasive species cause [http://www.invasivespecies.gov/laws/execorder.shtml]. E.O. 13112 requires each Federal agency whose action may affect the status of invasive species to the extent practicable and permitted by law to undertake the following:

- identify such actions;
- subject to available appropriations and budgetary limits, use relevant programs and authorities to:
  - prevent the introduction of invasive species;
  - detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner;
  - monitor invasive species;
  - provide for restoration of native species and habitat conditions in the ecosystem that have been invaded;
  - conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control; and
  - promote public education on invasive species and means to address them; and
- not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species unless the benefits of the actions clearly outweigh the potential harm caused by the invasive species.

The SMCRA regulations require that mine sites be reclaimed with vegetation that is diverse, effective, and permanent [30 CFR 816.111] . This vegetation can be comprised of native species or introduced species where desirable and necessary to achieve the approved post-mining land use. In addition to a review of the existing COE and SMCRA regulatory requirements and procedures relevant to the use and potential spread of exotic and invasive species associated with reclamation of mountaintop mine sites, the EIS action agencies commissioned a study [Appendix E: Terrestrial Plant (Spring Herbs, Woody Plants) Populations of Forested and Reclaimed Sites]. This study included a review of the use and occurrence of introduced invasive species on reclaimed mountaintop mining sites. The study also indicated the following: 1) species that may be considered exotic may be introduced in mining reclamation but their spread to other areas may be limited by surrounding forests and remoteness from other disturbed lands; and 2) the remoteness of MTM/VF sites typically limits the spread of invasive species to these sites.

Based on the review of this study and applicable SMCRA regulations, it was concluded that this was not a "significant issue" as related to MTM/VF. No additional actions are warranted. However, actions contemplated within this EIS could reduce the likelihood of the introduction of exotic and invasive species.

d. Valley Fill Stability

Some comments received during scoping indicated a concern over the long term stability of valley fills. OSM, in cooperation with the state SMCRA authorities in Kentucky, Virginia, and West Virginia, undertook a study to identify valley fills in the EIS study area and determine if stability of fills within this area was a "significant issue". The fill stability study is presented in Appendix H and discussed in Chapter III.K.1.C. This study concluded that no systemic evidence of area wide fill stability problems existed. The study identified very low occurrences of stability failures, and those identified failures were generally minor in nature and posed no risk to public safety.

e. Economics

The agencies commissioned studies to address economic impacts of MTM/VF in the EIS study area based on comments received during scoping. The economic studies are summarized in Appendix G (Phase I and Phase II Economic Studies). The studies indicate that the economic relationships existing among the coal industry, income, employment, taxes, electricity costs, and coal prices can be significant issues in the EIS study area. The actions proposed could affect the cost of mining application preparation, review, reclamation, and mitigation, and the cost of coal and electricity, due to the increased cost of mining. The actions and alternatives could have economic implications for the budgets of the regulatory agencies because of the need to add staff qualified to perform additional review and inspection functions. Economics are not analyzed as a separate issue in this EIS, but rather as consequences of the proposed alternatives in Chapter IV, consistent with NEPA.

f. Environmental Justice

Public comments received during scoping raised concerns of the impacts of MTM/VF on the local communities. E.O. 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,"[http://www.fs.fed.us/land/envjust.html] requires Federal agencies to identify and address, to the extent practical and appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, or activities on minority or low-income populations. The agencies evaluated effects of existing regulatory programs, policies, and activities related to mountaintop mining and valley fills and commissioned studies on the issues of environmental, socio-economic, and quality-of-life impacts of mountaintop mining. The agency reviews and studies confirmed that these issues are significant as they contribute to the impacts associated with the proposal and are therefore important to the agencies decisions.

Under NEPA, if such effects are identified, agencies should give appropriate consideration to alternatives, mitigation measures, monitoring needs, and preferences expressed by the affected communities or populations [http://ceq.eh.doe.gov/nepa/regs/ej/ej.pdf]. Environmental justice is discussed in Chapter IV.

B. SUMMARY OF ALTERNATIVES CARRIED FORWARD

This section provides brief explanations of the four alternatives in the EIS, highlights proposals analyzed in the action alternatives, and discusses environmental and regulatory benefits of the alternatives. Also included are tables comparing and illustrating the major differences of the alternatives [Tables II-1, II-2]. Section II.C includes a detailed analysis, by issue, of the proposed actions, together with an overview of how the regulatory programs work today (i.e., the No Action Alternative) and how they would work under each of the other action alternatives.

The following alternatives, in conformance with the stated EIS purpose and need, include actions to improve and integrate regulatory programs dealing with MTM/VF. Each proposed alternative would improve environmental protection and better coordinate implementation of CWA and SMCRA, as compared to the No Action Alternative. Environmental benefits similar to those anticipated from the proposed alternatives, discussed below and in Chapter IV, were partially achieved through recent regulatory changes in West Virginia and changes by the COE to NWP 21. Under the proposed action alternatives, benefits similar but more expansive than those in the No Action Alternative would accrue in Kentucky, Tennessee, and Virginia. This would occur because implementation of the Federal programs would be more consistent across all states in the EIS study area. All three proposed action alternatives would better achieve the administrative mandate of the agencies to minimize duplication among the various Federal regulatory programs [30 U.S.C. 1211(c)(12), 30 U.S.C. 1292(c), 30 U.S.C. 1303(a), and 33 CFR 322.2(f)(2)].

The alternatives were developed with the objective that each would satisfy the requirements of the CWA and SMCRA. Overall, the fundamental regulatory framework of these statutory and regulatory objectives share many similarities. Both statutes require an applicant to:

- identify the environmental resources on the proposed site;
- predict the project impacts on those resources;
- avoid and minimize impacts to high-quality environmental resources;
- develop a compensatory mitigation plan to offset unavoidable aquatic impacts;
- demonstrate that the proposal is the least damaging, practicable option; and
- develop a plan that meets design and performance standards.

The regulatory authorities review the above information and analyses provided by the applicant and approve the plan if it meets the performance standards of SMCRA and CWA. Following approval, the applicant must perform certain monitoring obligations during mining and reclamation to verify that operations are conducted in accordance with performance standards and permit conditions. Monitoring by the applicant and inspection by the regulatory authorities reveal if impacts exceed predicted levels and documents that reclamation/mitigation are successful. The regulatory processes provide for public participation and appeal of decisions during all stages of application, operation, and reclamation. Various checks and balances also exist for interagency oversight, coordination, and consultation. Interaction and oversight responsibilities, coupled with the inspection and enforcement process, are important components in an effective regulatory structure.

Each proposed action, explained in Chapter II.C, is related to the various components of the regulatory process just described. The following are examples of the benefits of the proposed actions:

- Improved environmental protection through better information and analysis and collaborate government regulation.

- Improved government efficiency in implementing programs to achieve coordinated data collection/sharing and application processing that fulfill these objectives:
  - assure adherence to performance standards;
  - eliminate duplication; and
  - provide for public participation.

- Improved data collection to accomplish the following:
  - identify environmental resources;
  - monitor impacts based on changes from baseline condition; and
  - demonstrate compliance and/or reclamation/mitigation success.

- Improved prediction of impacts based on better data and analysis.

- Clarified regulatory concepts in the regulation of surface mining operations that accomplish these goals:
  - provide clear expectations to stakeholders for making decisions;
  - improve environmental protection; and
  - assure public safety.

- Expanded best management practices in mining, reclamation, and mitigation practices.

The proposed alternatives considered would better inform the public and provide more meaningful participation in part because plans would more thoroughly address impacts to environmental resources. The applicants would benefit from integrated regulatory programs under Federal environmental statutes for several reasons. Many of the actions are designed to facilitate streamlined, sequenced review processes while improving environmental protection. A coordinated review process could reduce processing times and costs of permit applications which may offset some of the increased costs and times associated with the additional data collection and analysis requirements of the actions. These actions also consider the program costs of Federally- versus state-administered application reviews, inspection, and enforcement. Each alternative would support efficient, environmentally responsible production of energy resources, and would help clarify environmental performance standards for stakeholders and regulators. Likewise, each action alternative would lead to more complete permit information as a better basis for regulatory decisions.

Table II.B-1
Mountaintop Mining/Valley Fill EIS Alternatives Summary

"No Action" Alternative	Maintains the regulatory programs, policies, and coordination processes that exist in 2003.
Alternative 1	The COE CWA Section 404 program will be the primary regulatory program for determining (on a case-by-case basis) whether and how large valley fills from MTM/VF would be allowed in waters of the U.S. The COE would procedurally presume that most projects would require the CWA Section 404 IP process and NWP 21 authorization would be applicable in limited circumstances. The COE would perform requisite public interest review as well as appropriate NEPA analysis. As part of the IP process, the COE would largely rely on SMCRA reviews that adequately address terrestrial and community impact issues arising as part of public participation. COE authority for mitigation of unavoidable aquatic impacts will be required to less than significant levels, either by on-site replacement of aquatic functions or by in-kind, off-site watershed improvement projects within the cumulative impact area. The COE would be the lead agency for ESA consultation on aquatic resources and the SMCRA agencies would coordinate with FWS on aquatic and terrestrial species. All other regulatory programs would defer to or condition decisions on attaining the requisite CWA Section 404 approvals. OSM would consider rule-making so the stream buffer zone is inapplicable to excess spoil disposal in waters of the U.S. OSM would finalize excess spoil provisions to include minimization and alternative analysis more consistent with CWA. Cross-program actions include rule-making; continued research on MTM/VF impacts, improved data collection, sharing, and analysis; development of BMPs and ADIDs; and agency coordination established by an MOA and FOP (no joint application). These actions would serve to further minimize the adverse effects on aquatic and terrestrial resources and protect the public.
Alternative 2	This is the preferred alternative. The agencies would develop enhanced coordination of regulatory actions, while maintaining independent review and decision making by each agency. The size, location and number of valley fills allowed in waters of the U.S. would be cooperatively determined by CWA and SMCRA agencies based on a joint application and under procedures spelled out in an MOA, JPP, and FOP. OSM would apply functional stream assessments to determine onsite mitigation. OSM rules would be finalized to make the stream buffer zone more consistent with SMCRA and CWA. OSM excess spoil rules would be finalized to provide for fill minimization and alternatives analysis, similar to CWA Section 404(b)(1) Guidelines. The COE would make case-by-case decisions as to NWP or IP processing. Public interest review and NEPA compliance by the COE would occur for IPs and would be assisted, to the extent possible, by the SMCRA permit. Mitigation of unavoidable aquatic impacts would be required to the appropriate level. ESA evaluations for IPs mirror Alternative 1; the SMCRA agency would take the lead for ESA coordination for NWP 21. FWS retains the ability to consult on unresolved ESA issues for all CWA Section 404 applications. Cross-program actions include rule-making; improved data collection, sharing and analysis; development of a joint application, harmonized public participation procedures, BMPs, and ADIDs; and close interagency coordination. These actions would serve to further minimize the adverse effects on aquatic and terrestrial resources and protect the public.
Alternative 3	The COE would begin processing most MTM/VF projects as NWP 21 and few projects would require IP processing. The SMCRA program would be enhanced as described in Alternative 2 and the SMCRA regulatory authority would assume the primary role of joint application review. The COE, or a state through an SPGP, would base CWA authorizations largely on the SMCRA review with the addition of adequate offsite mitigation. The COE would require the IP process if its review found an application inadequate because of data collected, alternatives considered, or mitigation. Satisfaction of ESA would be identical to Alternative 1 and 2 descriptions relative to IP and NWP 21/SMCRA processing. The cross-program actions are identical to Alternative 2 with the exception of no ADID development.

1. Overview of the Alternatives

The features of the alternatives for this EIS are summarized below. Detailed explanations of these alternatives and actions are provided in Chapter II.C

a. No Action Alternative: The Regulatory Program Today

The No Action alternative, describing the SMCRA and CWA programs as implemented in 2003, is the baseline from which to compare all other alternatives. A more detailed description of the current regulatory program features can be found in Chapter II.C. Under this alternative, the agencies would continue to operate in West Virginia in a coordinated fashion using the interim permitting process required by the *Bragg* settlement agreement. The COE agreed in the *Bragg* settlement to establish the general condition in West Virginia that valley fills in watersheds less than 250 acres could be authorized by NWP 21. However, this threshold would eventually be replaced in West Virginia by the COE stream assessment protocol establishing chemical, biological, and physical characteristics for case-by-case determinations by the COE District Engineer whether to process CWA Section 404 applications as a NWP 21 or an IP. Processing an MTM/VF application as an IP for valley fills is subject to NEPA, and the COE prepares either an EA/FONSI or EIS. OSM is the SMCRA authority in Tennessee and, since SMCRA permitting in that state is a Federal action, NEPA requirements apply and are coordinated with the COE.

The interim permitting process resulted in a methodical evaluation of the SMCRA and CWA permit processes in relation to MTM/VF in West Virginia. The agencies developed flow charts, listed issues to address, and attempted to eliminate duplication where possible, emphasizing early interagency pre-application reviews and discussion. In addition, the agencies coordinated decisions in the most logical manner allowed under the existing program requirements. Federal and state teams developed guidance documents to address analysis of flooding potential, mitigation, NEPA compliance, etc.

The No Action Alternative does not foster the consistent, coordinated review process outside of West Virginia [see existing program coordination features in Chapter II.C.1.a]. However, the West Virginia interim permitting activity encouraged some level of Federal/state agency coordination in other states where MTM/VF occurs. For instance, workgroups of Federal and state regulatory agencies, as well as mining industry and environmental stakeholders, were formed in Kentucky and Virginia. Even though fully-coordinated review processes do not exist in all states, the COE performs case-by-case minimal impact determinations and mitigation for unavoidable aquatic resource impacts in all states [Chapter II.C.1.a, II.C.6.a.1]. Inter-district COE consistency is a result of the revised NWP 21, in effect since January 2002. In addition, COE Headquarters developed regulatory guidance addressing consistency for data collection, and impact analysis in all Districts reviewing MTM/VF applications.

Under the No Action Alternative, the SMCRA permit is typically processed first and issued relatively concurrent with the NPDES CWA Section 402 authorization by the states. COE issuance of the CWA Section 404 permit under NWP 21 and the state issuance of a CWA Section 401 water quality certification occurs following SMCRA approvals. A few permit applications have been processed as IPs, which requires the COE to perform a public interest review, alternative analysis and prepare detailed NEPA compliance documents. If an EIS is required, extensive review by the public and Federal and state agencies occurs. SMCRA application information about the terrestrial environment and control of other human-related impacts (e.g., blasting, embankment stability, roads,

hydrologic impact to water quantity or quality, etc.) is useful to the COE for both NEPA and the public interest review.

There have been no major programmatic changes from 1998 to the present for compliance with ESA, CWA Sections 401 and 402, NHPA, and other applicable laws and regulatory provisions. EPA and OSM oversight of CWA and SMCRA programs is a common feature of all alternatives considered by this EIS, including the No Action Alternative. The COE is responsible for requesting comments and consulting with the FWS and state fish and wildlife agencies in regards to Federally-listed T&E species and critical habitat in the aquatic environment. State SMCRA agencies will further consider potential upland impacts from MTM/VF on T&E species and habitat [Chapter II.C.11.a.]. Under all four alternatives, the FWS is responsible for reviewing and providing timely comments and suggestions to the COE and the appropriate SMCRA agency regarding the protection of Federally-listed T&E species.

A number of significant program improvements included in the No Action Alternative, accomplished while the draft EIS has been under development, are described below.

a.1. COE CWA Section 404 Program

The interim permitting process implemented following the *Bragg* settlement in West Virginia led the COE to take steps to consistently apply CWA Section 404 to MTM/VF project proposals in all COE Districts with jurisdiction over steep-slope Appalachia (Louisville, KY; Nashville, TN; Norfolk, VA; and Huntington, WV) [see Chapter II.C.6.a.1]. COE inter-District meetings to discuss the MTM/VF permitting process assisted in this regard. The COE agreed in the *Bragg* settlement to establish the general condition in West Virginia that valley fills in watersheds less than 250 acres could be authorized by NWP 21. Consequently, as of July, 2002, 81 proposals were eligible for NWP 21 in West Virginia and 5 were processed as IPs. The COE Huntington District has processed more than 160 NWP 21 permitting actions involving fills in West Virginia and Kentucky since the start of 1999. These CWA Section 404 permit numbers also partially reflect that, between mid-2002 and early 2003, the COE Huntington District was enjoined from approving fills without a "constructive purpose."

The COE/EPA promulgation of a final fill rule in May, 2002 eliminated discrepancies between EPA and COE definitions of "fill" [67 FR 31129-31143]. The COE renewed NWPs, including NWP 21, in January, 2002 [67 FR 2020-2094]. The COE District Engineer must make a specific determination on a case-by-case basis that proposed activity complies with the terms and conditions of the NWP 21 and that adverse effects to the aquatic environment are minimal, individually and cumulatively, after considering mitigation. In addition, the COE Louisville District began developing and validating a protocol for quantifying functions for stream segments where impacts are proposed.

The COE Louisville District collaborated with EPA Region IV, and the Kentucky state water quality agency to assemble the procedures for data collection and analysis to evaluate activities filling waters of the U.S. Use of the Louisville District protocol provides a numerical "score" for stream segments based on physical, chemical, and macro-invertebrate data collection. In addition to helping to determine the size, number and location of valley fills, the stream score is used to evaluate whether mitigation projects can offset unavoidable impacts by recreating stream functions on site

or improving stream functions off-site within the same watershed. The protocol is also a tool which can be used by the COE to determine whether a project is in compliance with the CWA Section 404(b)(1) Guidelines. This protocol is currently in use by the Louisville, Huntington, and Nashville districts in Kentucky and Tennessee. Calibration for West Virginia by the Huntington District and for Virginia by the Norfolk District is underway. Upon final validation, the protocol will be used in all COE Districts and become a standard tool for determining the size, number and location of valley fills and whether MTM/VF proposals can be processed under a NWP 21 or require an IP.

a.2. EPA CWA Section 402/404 Programs

The EPA, working with the other Federal and state CWA/SMCRA agencies, developed baseline data protocols for chemistry and biological monitoring in 1999-2000 [see Chapter II.C.4.a.]. These protocols were formalized for use in both Regions III and IV of EPA for mining proposals within the EIS study area. CWA program activities regarding development of total maximum daily loads (TMDLs) for impaired streams are widespread in the study area, as are development of state water quality criteria for anti-degradation, identification of impaired and high quality streams, and other provisions that will affect the ultimate approval of any "discharge of fill" in waters of the U.S. New mining impacts proposed in impaired streams undergo additional scrutiny as to the ability to improve existing water quality and other stream characteristics related to the overall integrity of a watershed. EPA and OSM, working with the states, established best management practices (BMPs) that would encourage remining and result in overall watershed improvements. The BMPs are discussed in the EPA rule-making on new effluent guidelines to reclaim abandoned mine sites. [http://www.epa.gov/ost/guide/coal/fsdec2001.html]

a.3. SMCRA Programs

Following OSM oversight review of state implementation of SMCRA requirements for AOC and post-mining land use in Kentucky, Virginia, and West Virginia, [http://osmre.gov/mtindex/htm]; and after WVDEP entered into the 1999 consent decree with *Bragg* plaintiffs, state SMCRA regulatory authorities began developing guidelines or policies for assuring that MTM excess spoil was demonstrably surplus of that needed for mine site reclamation. Most notably, WVDEP, with OSM assistance, developed the "AOC+ policy," requiring volumetric calculations and an engineering process to assure that excess spoil disposal resulted in the least stream impacts possible to conduct the project. Virginia, Kentucky, and the OSM Tennessee programs developed similar policies to minimize excess spoil, thus limiting valley fills. [Chapter II.C.5.a.2]

OSM issued a post-mining land use policy in June, 2000 clarifying the criteria for mine sites to qualify for non-AOC reclamation. This emphasis by OSM and the state SMCRA agencies on AOC requirements leads applicants to avoid streams and seek upland locations for spoil placement. The number and size of valley fills has been reduced due to this and other factors.

In 2002, OSM developed and issued guidance documents for managing hydrologic data that will aid in developing PHCs and CHIAs. Also during 2002, OSM held a workshop on PHC and CHIA requirements for states to share processes and improvements to enhance hydrologic data collection and analyses. OSM conducted oversight and research regarding blasting impacts and controls. Development of improved guidance manuals and advanced training on proper blasting design and evaluation is nearing completion. To encourage reforestation, OSM held a policy outreach

symposium in January, 1999 and technical interactive forums in March, 1999 and May, 2002. These efforts were intended to illustrate the benefits of reclaiming with trees, to identify regulatory impediments, incentives, and state-of-the-art soil handling and commercial forestry reclamation techniques.

OSM initiated a SMCRA regulatory program enhancement to amend and clarify the stream buffer zone (SBZ) rules at 30 CFR 816.57 and 817.57. The amended SBZ rule would more closely align with the principal statutory basis for the rule [30 U.S.C. 1265(b)(10) and (b)(24)]. As a complementary rule change, the excess spoil regulations will be changed to ensure that the volume of excess spoil is minimized and that excess spoil fills are constructed in a manner and location to cause the least environmental harm after the consideration of alternative designs and locations [Chapter II.C.5., Action 7].

WVDEP, working in a team with the COE and OSM, developed guidelines for consistent evaluation of flooding potential that are used in West Virginia. The FWS and OSM developed a training course for Federal and state staff to explain how to satisfy the coordination requirements under the FWS 1996 BO related to the protection of T&E species under the ESA. FWS retains consultation procedures regarding appropriate T&E species-specific protection plans with COE under Section 7 of the ESA. [Chapter II.C.11.]

b. Summary of Alternative 1: The Number, Size, and Location of Valley Fills in Waters of the U.S. would be Determined by the COE CWA Section 404 Permit Process.

The COE District Engineer would procedurally presume in Alternative 1 that most CWA Section 404 MTM/VF applications would be processed as IPs. The COE, on a case-by-case basis, would make the initial determination of the size, number, and location of valley fills in waters of the U.S. Under this alternative, all MTM/VF projects proposed in waters of the U.S. would initially be processed by the COE as an IP, rather than as a general permit, such as NWP 21. Following this initial determination, the applicant would commence the SMCRA and other requisite application processes (NPDES, MSHA, etc.). ESA concerns would initially be addressed by the COE. Alternative 1 would involve the COE evaluating these IPs with a 404(b)(1) Guidelines review, secondary and cumulative impact review, and the public interest review. [Chapter II.C.1.b, Action 1.1.] This alternative contrasts with the No Action Alternative as well as Alternative 3, under which most valley fills have been and would be authorized by NWP 21.

Alternative 1 would continue the OSM rulemaking currently underway to make the regulatory program more consistent with SMCRA and CWA provisions [Chapter II.C.5.a.2, Action 7]. OSM would also consider revising the SBZ rule at 30 CFR 816.57 as inapplicable to excess spoil disposal in waters of the U.S., based on deference to the COE analyses of the aquatic resource impacts [Chapter II.C.3.a.2, Action 3.1]. The SMCRA regulatory authority would retain its overall responsibility for regulating other SMCRA environmental and public safety aspects of mining operations. The result of this alternative would be a series of consecutive, coordinated reviews and decisions, formalized through an MOA and FOP, lead by COE with the appropriate SMCRA agency [Chapter II.C.1.b, Action 1.1]. EPA and FWS responsibilities for commenting on IP applications and EPA oversight authorities are unchanged.

Alternative 1 also contains a number of programmatic actions under CWA and SMCRA that would result in added environmental protection of streams, fish, wildlife, and other environmental values. These actions include development of Best Management Practices (BMP) manuals covering topics such as mitigation, fugitive dust and blasting fumes, flooding, and reforestation. The COE and EPA would also consider identifying high quality watersheds for special consideration. This alternative proposes to continue evaluating the effects of MTM/VF on stream chemistry and biology and further refine science-based protocols for assessing ecological function, making permit decisions, establishing mitigation requirements and, if necessary, developing water quality criteria. The T&E consultation and coordination process would be adjusted, if necessary to assure ESA compliance. The agencies would work together to: coordinate permit processing, mitigation project bonding, and inspection; develop consistent definitions of stream characteristics and delineations; and collect and analyze data to assess the feasibility of individual and cumulative impact thresholds. [Chapter II.C.1-11.]

c. Alternative 2: (Preferred Alternative) The Size, Number, and Location of Valley Fills in Waters of the U.S. would be Determined by a Coordinated Regulatory Process

Alternative 2 is unlike the other two action alternatives in that it integrates the SMCRA and CWA programs into a coordinated regulatory process to determine the placement of MTM/VF in waters of the U.S., while maintaining independent decision making authority among the agencies. The COE would initially decide the applicability of the IP process (in partial reliance on the SMCRA information provided by the applicant as part of a joint permit application); and determine CWA Section 404(b)(1) Guidelines and NEPA compliance for those applications determined to warrant IP processing (as described in Alternative 1). The COE would make case-by-case evaluations of site-specific impacts to determine the appropriate CWA Section 404 review process, in accordance with any NWP 21 regional conditions. Any regional conditions, such as an interim 250-acre minimal impact threshold for specific geographic areas, would continue to be implemented under this alternative until revoked or replaced. These regional conditions are described in the No Action Alternative [Chapter II.C.1.a.1.]. If the coordinated COE/SMCRA review process determined that an application could likely receive NWP 21 authorization, the COE would process the application following the SMCRA review (as described in Alternative 3). COE NWP 21 decisions would rely, to the greatest extent possible, on the SMCRA review. [Chapter II.C.1.c, Action 1.2.]

Selection of Alternative 2 could result in the resource agencies conducting more joint site visits to gather site-specific resource information and impact prediction to allow the COE to make a more informed decision regarding the use of discretionary authority. OSM would retain SMCRA authorities, including oversight of state agencies implementing SMCRA. In addition, OSM would continue rule making to adopt regulations to allow data collection, impact predictions, alternative analysis, fill minimization, and on-site mitigation considerations in consonance with the CWA Section 404(b)(1) Guidelines [Chapter II.C.3.a.2, Action 3.1; Chapter II.C.5.a.2, Action 7]. EPA and FWS responsibilities for commenting on IP applications and EPA oversight authorities are unchanged [Chapter II.B.1.a.]. ESA evaluations for IPs mirror Alternative 1; the SMCRA agency would take the lead for ESA coordination for NWP 21 as described in Alternative 3. FWS retains the ability to consult on unresolved ESA issues for all CWA Section 404 applications [Chapter II.C.1.c, Action 1.2].

The regulatory framework and process for this alternative would be embodied in an interagency Memorandum of Agreement (MOA) among the regulatory agencies with authorities under the SMCRA or CWA and their respective implementing regulations [Chapter II.C.1.c]. The MOA could set forth the joint permit process (JPP) in general, explain responsibilities and authorities of each agency in the process, frame the interagency decision making and dispute resolution procedures, and require the development of joint CWA/SMCRA Field Operating Procedures (FOP). A FOP could serve as the guidelines manual implementing the MOA and provide administrative and procedural details.

Further, the MOA could integrate and coordinate the regulatory programs under SMCRA and CWA to continue data collection to address identified gaps, to develop permit application assessment procedures and mitigation based on these data, to convene regular JPP meetings and to further refine and implement the COE stream assessment protocol in evaluating permit applications. The MOA could explain the preparation and dissemination of a public outreach brochure. The brochure would provide status reports related to the implementation of the selected alternative in this EIS and would therefore be updated as needed.

In addition, this alternative would provide for a single joint permit application for SMCRA and CWA authorization. The information submitted by the permit applicant would be distributed to the regulatory agencies according to their respective statutory authorities and responsibilities. For example, information and data relating to engineering aspects of the proposal such as slope stability, revegetation, blasting, and roads would still be reviewed principally by the SMCRA agency. Information relevant to both SMCRA and CWA authorization, such as fill minimization, upland alternatives, and compensatory mitigation would be jointly reviewed and evaluated. This would result in a streamlined application process and harmonized public participation.

Alternative 2 also contains a number of programmatic actions under CWA and SMCRA that would result in added environmental protection of streams, fish, wildlife, and other environmental values. These actions were previously described in Alternative 1 and are presented in Chapter II.C.1-11.

d. Alternative 3: The Size, Number, and Location of MTM/VF Valley Fills in Waters of the U.S. would be Determined by an Enhanced SMCRA Regulatory Program

The goal of this alternative would be to enhance the SMCRA programs to satisfy the informational and review requirements of the CWA Section 404 program in order to minimize, to the maximum extent possible, the adverse effects of MTM/VF and to create a more effective and efficient permit application review process. The principal difference between this alternative and Alternative 1 is that the enhanced SMCRA regulatory process, gained through rule-making, could provide the regulatory platform to ensure that MTM/VF in waters of the U.S. comply, to the extent allowed by the proposed rule-making, with CWA Section 404 program. This alternative differs from Alternative 2 which describes a coordinated interagency screening process to determine the type of COE CWA Section 404 permit needed for MTM/VF in waters of the U.S.

Alternative 3 is based on the concept of a procedural presumption by the COE that most MTM/VF applications would begin processing as NWP 21 because the SMCRA review is the functional equivalent of an IP, with the exception of off-site mitigation, which would be assured by the COE under CWA Section 404 review. Under this alternative, the SMCRA regulatory authority would be

the lead review agency, reducing duplication of CWA regulatory control exercised by the COE. This would meet the purpose of the general permit process envisioned by the CWA Section 404(e). However, unlike Alternative 1, ESA concerns could be addressed in the initial review under SMCRA, and that review may reduce the time required for FWS consultation with the COE on the CWA Section 404 permit as a Federal action. [Chapter II.C.1.d, Action 1.3.]

While the COE retains responsibility for authorizing CWA Section 404 permits, the information collected and analyzed by the SMCRA agency would allow the COE to process most permits under NWP 21. A state may assume control through a state programmatic general permit (SPGP) or through full assumption of the CWA Section 404 program [Chapter II.C.1.a.2]. The COE would also be responsible for mandating and retaining its jurisdiction for appropriate compensatory mitigation to offset unavoidable impacts to aquatic resources. Currently, unlike the COE, SMCRA agencies may not have the statutory basis to require off-site compensatory mitigation. Most states in the EIS study area require compensatory mitigation through either the CWA Section 401 water certification process or state water quality laws. Under this alternative, the SMCRA agency would work closely with the COE to determine the extent of on- or off-site compensatory mitigation needed to offset unavoidable adverse effects of MTM/VF to waters of the U.S.

Alternative 3 contains a number of programmatic actions under CWA and SMCRA that would result in added environmental protection of streams, fish, wildlife, and other environmental values. These actions were previously described in Alternative 1. Alternative 3 does not include development of ADIDs, but does include the development of a joint permit application, MOA, and FOP as described in Alternative 2.

2. Specific Actions Proposed by the Alternatives

a. Proposals Common to Action Alternatives 1, 2, and 3

The Federal and/or state agencies would cooperatively do the following:

- develop guidance, policies, or institute rule making for consistent definitions of stream characteristics as well as field methods for delineating those characteristics.
- continue to evaluate the effects of mountaintop mining on stream chemistry and biology.
- continue to work with states to further refine the uniform, science-based protocols for assessing ecological function, making permit decisions and establishing mitigation requirements.
- continue to assess aquatic ecosystem restoration and mitigation methods for mined lands and promote demonstration sites.
- incorporate mitigation/compensation monitoring plans into SMCRA/NPDES permit inspection schedules and coordinate SMCRA and CWA requirements to establish financial liability (e.g., bonding sureties) to ensure that reclamation and compensatory mitigation projects are completed successfully.
- work with interested stakeholders to develop a best management practices (BMPs) manual for restoration/replacement of aquatic resources.

- evaluate and coordinate current programs for controlling fugitive dust and blasting fumes from mountaintop MTM/VF operations, and develop BMPs and/or additional regulatory controls to minimize adverse effects, as appropriate.
- develop guidelines for calculating peak discharges for design precipitation events and evaluating flooding risk. In addition, the guidelines would recommend engineering techniques useful in minimizing the risk of flooding.
- based on the outcome of ongoing informal consultation, identify and implement program changes, as necessary and appropriate, to ensure that MTM/VF is carried out in full compliance with the Endangered Species Act.

The COE would:

- continue to refine and calibrate the stream assessment protocol for each COE District where MTM/VF operations are conducted to assess stream conditions and to determine mitigation requirements as part of the permitting process.
- compile data collected through application of the assessment protocol along with PHC, CHIA, antidegradation, NPDES, TMDLs, mitigation projects, and other information into a GIS database.
- use these data to evaluate whether programmatic "bright-line" thresholds, rather than case-by-case minimal individual and cumulative impact determinations, are feasible for CWA Section 404 MTM/VF permits.

The OSM and/or the state SMCRA regulatory authorities would:

- continue rule-making to clarify the stream buffer zone rule and require fill minimization and alternatives analysis.
- in conjunction with the PHC, CHIA, and hydrologic reclamation plan, apply the COE stream assessment protocol to consider the required level of onsite mitigation for MTM/VF.
- develop guidelines identifying state-of-the-science BMPs for selecting appropriate growth media, reclamation techniques, revegetation species, and success measurement techniques for accomplishing post mining land uses involving trees.
- if legislative authority is established by Congress or the states, require reclamation with trees as the post mining land use.

The EPA would:

- as appropriate, develop and propose criteria for additional chemicals or other parameters (e.g., biological indicators) that would support a modification of existing state water quality standards.

The FWS would:

- continue to work with Federal and state SMCRA and fish and wildlife agencies to implement the 1996 BO and streamline the coordination process.
- work with agencies to develop species-specific measures to minimize incidental takes of T&E species.

b. Actions Common to Alternatives 1 and 2

The Federal and/or state agencies would cooperatively:

- consider designating areas generally unsuitable for fill, referred to as Advanced Identification of Disposal Sites (ADID).

c. Actions Common to Alternatives 2 and 3

The Federal and/or state agencies would cooperatively:

- develop a joint MTM/VF application form.

The OSM would:

- continue rulemaking relative to the stream buffer zone rule and excess spoil disposal.
- consider additional rule-making to be more consistent with the CWA Section 404(b)(1) Guidelines.

d. Actions Unique to Alternative 1

The COE would:

- procedurally presume that most MTM/VF projects could be processed as IPs.
- coordinate with other agencies through an MOA and FOP.

The OSM would:

- consider revising the SBZ rule as inapplicable to excess spoil disposal in waters of the U.S., based on deference to the COE analyses of the aquatic resource impacts.

e. Actions Unique to Alternative 2

The COE would:

- make case-by-case determinations of the applicability of NWP 21 to MTM/VF projects through a coordinated interagency process.
- coordinate with other agencies through an MOA, JPP and FOP.

f. Actions Unique to Alternative 3

OSM and/or state SMCRA regulatory agencies would:

- issue permit approval prior to the CWA Section 404 authorization.

The COE would:

- presume that most MTM/VF projects begin processing as NWP 21.
- verify most projects under NWP 21, after the SMCRA permit is issued.
- coordinate with other agencies through an MOA, JPP and FOP.

3. Regulatory and Environmental Benefits of the Alternatives

The objectives of the action alternatives proposed in this EIS are to coordinate decision making to minimize regulatory duplication; improve natural resource characterization/impact predictions; improve permitting decisions to minimize, to the maximum extent practicable, the adverse environmental effects of MTM/VF; and minimize unnecessary paperwork and processing for the applicant. Some of the benefits are common to all alternatives while others may occur only with one or two of the alternatives. The environmental benefits of the three action alternatives are very similar. Similar environmental benefits are not uncommon for a programmatic EIS such as this where each alternative must conform with the CWA and SMCRA requirements.

a. Regulatory Process Benefits of All Action Alternatives

Under Alternatives 1, 2, and 3, the need to revise an issued SMCRA permit to incorporate CWA 404 concerns would be reduced as compared to the No Action Alternative. Both the CWA and SMCRA should be satisfied by the action alternatives through coordinated application reviews by the COE and SMCRA regulatory authority. For example, all projects would be required to undertake alternatives analyses demonstrating that fills in waters of the U.S. have been avoided and minimized to the maximum extent practicable. Under the No Action Alternative, SMCRA review and authorization occurs first, followed by a COE review that could require redesign of the mining plan and a modification of the SMCRA permit.

Common data elements in a joint application form could lead to more efficient analytical approaches among the agencies. Reliance on these analytical results could facilitate agreements among agencies and provide a basis for one agency to confidently rely on the findings of another agency. The MOA and FOP proposed by the action alternatives should improve consistency, permit coordination, and reduce the processing time with a logical, concurrent process.

Improved data collection resulting from the coordinated regulatory programs would lead to more descriptive identification of environmental resources. This allows inspection and monitoring of impacts based on changes from the baseline condition and facilitates demonstration of MTM/VF plan compliance and reclamation/mitigation success. More comprehensive data should improve prediction of impacts, speed regulatory processing, and decrease the number of deficiencies. Conversely, the necessity to collect data at certain times of year may delay applications and require applicants to build costly lead times into mine plan development.

Clarified regulatory concepts provide a basis for more predictable business and mine planning decisions by applicants and for other stakeholders to evaluate mining proposals. Available BMP manuals for mining controls (flooding, fugitive dust, blasting fumes), reclamation (fill minimization, revegetation), and mitigation practices would provide guidance for improved mine design and

applications that are more likely to fulfill performance standards and regulatory agency requirements.

The proposed action alternatives would better inform the public and provide for more meaningful participation. Aligning the different public comment periods is a possible outcome of agency coordination. Integrated regulatory programs and a coordinated review process could reduce processing times and costs of permit applications which may offset some of the increased costs and times associated with the additional data collection and analysis requirements of the actions. Program costs of Federally- and state-administered application reviews, inspection, and enforcement would be lower under Alternatives 2 and 3.

b. Distinguishing Process Benefits Between the Alternatives

No Action – Different process procedures occur in each state and/or COE District, or even within a state where multiple COE Districts are involved. Additional formalized processes such as the MOA, FOP, joint permit application, and numerous other guidelines are not in existence today but are proposed in Alternatives 1, 2 and 3 to improve consistency and coordination over the No Action Alternative.

Alternative 1 – Additional environmental data collection and assessments necessary to fulfill CWA Section 404(b)(1), NEPA, cumulative and secondary impact, and public interest review are required by the IP process. The IP process is very likely to add costs to the applicant. The application process would be considerably longer due to more thorough treatment of MTM/VF IP applications including more intensive COE review and NEPA analysis, and agency and public comments on the proposal. Enhanced information on aquatic resources proposed to be impacted, thorough impact predictions, and detailed plans for restoration of lost aquatic functions would improve regulatory processing and may offset some of the additional processing time associated with this alternative. Coordination between CWA and SMCRA agencies is included in this alternative, however is more difficult to implement than Alternatives 2 and 3. It is possible that state SMCRA administrative program costs could be reduced if a state chooses to rely on Federal reviews; however these state cost savings may be muted or non-existent because all MTM/VF proposals processed as IPs will still require state CWA Section 401 certification.

Alternative 2 – Coordination among the regulatory agencies would be maximized and would occur at the earliest stages of the application process under Alternative 2, resulting in more efficient and better decision making. Changes in a particular proposal affected by the review of one agency would not conflict with the mandates and policies of another. Concurrent reviews and evaluations would facilitate a comprehensive consideration of any particular proposal and result in a single set of comments and recommendations to the permit applicant. Data and information relative to a proposal could be shared by all reviewing agencies and other interested parties.

Similarly, the public and other interested parties can submit comments through a coordinated process and those agencies collaboratively evaluating the proposal can consider those comments comprehensively in the context of the entire proposal. Mitigation plans required for the proposal would be equally comprehensive, incorporating both CWA and SMCRA requirements (and likely to be considered earlier in the joint process), thereby facilitating the verification that various mitigation components of the plan are complementary. This coordinated process would also

facilitate oversight of mitigation implementation and monitoring, which would have environmental as well as process benefits.

This alternative would allow concurrent, coordinated regulatory reviews and each agency could consider the reviews of the other. Concurrent review would facilitate effective and timely regulatory decisions, including development of permit conditions, with the following consequences:

- support comprehensive consideration of environmental factors in permit actions in the CWA and SMCRA in order to enhance environmental protection;
- provide permit applicants with a unified permit application that would satisfy SMCRA and CWA Section 404 requirements, and promote efficiency by minimizing duplication; and
- furnish the public an opportunity to review and comment on a single comprehensive proposal rather than on portions of one proposal that are prepared to satisfy different regulatory authorities and that are offered for public review at different times.

Another benefit of this alternative is to ensure that agencies give adequate consideration to all other activities occurring in a watershed as they make their environmental decisions. Each agency would be responsible for maintaining a system (or database) to characterize proposed activities in a watershed relevant to its program and designate a liaison to serve as the principal contact for other agencies to expedite information exchange.

Alternative 3 – This alternative would result in a more effective and efficient regulatory process to satisfy CWA and SMCRA by using the SMCRA review as a focal point for gathering and analyzing information required by SMCRA and CWA 404. This alternative would promote a single lead agency with coal mining regulatory expertise for permitting and a framework for efficient, environmentally responsible production of energy resources. In addition, it would provide clear environmental performance targets for industry, stakeholders and regulators based on combined analyses of SMCRA and CWA performance standards, a better basis for decisions and findings by SMCRA regulators, and an improved ability for states, with more knowledge about environmental resources within their borders, local conditions, etc., to set priorities for mitigation. However, this alternative may not make the most efficient use of an integrated process which would maximize the networking of expert staff from CWA and SMCRA regulatory authorities (as in Alternative 2). Federal administrative costs of this alternative may be less than required under Alternative 1 and 2 because of the SMCRA lead role and reliance on state SMCRA regulatory authorities in Alternative 3.

c. Environmental Benefits of the No Action Alternative

The COE currently is developing guidance on assessing stream functions and quantifying mitigation to offset unavoidable aquatic impacts, similar to the guidance that would be provided under Alternatives 1-3. Individual state requirements, such as the increased emphasis on calculating peak discharges in West Virginia, would continue to apply under this alternative, as would the general emphasis on fill minimization, viable alternative post-mining land uses, and other regulatory improvements resulting from *Bragg* in West Virginia and Federal focus in the other states on similar

goals. If the No Action Alternative is selected without the additional data collection, analysis, reclamation guidance, policies, and regulations by the Federal programs envisioned under the action alternatives, the environmental benefits would not be as significant or consistent in the EIS study area.

Based, in part, on the interim 250-acre watershed threshold, CWA NWP 21 renewal requirements, and other program changes by SMCRA resource agencies (e.g., increased scrutiny of fill minimization and PMLU emphasis), there has been a reduction in the size and number of valley fills since the initiation of this EIS in 1998. The average number of fills approved in the EIS study area declined from 304 fills/year (1996-1998) to 217 fills/year (1999-2001). The average size of the fills during these two intervals also decreased 18 percent. Because of the reduction in the number and size of fills for the intervals 1996-1998 and 1999-2001, respectively, the total area directly impacted by fills decreased from 15,370 to 8,974 acres; watershed impacts decreased from 95,185 to 46,398 acres; and linear length of stream decreased from 145 to 107 miles. These data are derived from the valley fill inventory prepared for this EIS [Chapter III.K.2-5].

However, the "post-*Bragg*" regulatory environment in Appalachia was also affected by economic pressures on the industry. At times, excessive Appalachian coal supplies and reduced central Appalachian production were caused by highly-competitive coal sources. At other points in the past 4+ years, a temporary spike in the demand and commensurate price increase for Appalachian coal caused a surge in mining applications or re-activated idle permitted mines in temporary cessation. These factors and further uncertainties, due to the Rivenburgh injunction and other legal controversies, suppressed investment capital for new mines. It is difficult to apportion the influence of reduced MTM/VF environmental impacts, post-Bragg, among economic, legal, or regulatory factors.

The 250-acre threshold established in the Bragg agreement may be responsible in part for the reduction in the size and number of valley fills. Until such time as sufficient scientific data may be available to establish a specific minimal impact threshold, retaining the existing 250-acre threshold as a regional condition could provide an interim administrative basis for authorization of MTM/VF projects using NWP 21. The extension of this threshold through a regional permit condition by the COE is an independent action from this EIS. The threshold could remain in place until supplanted by a validated functional assessment protocol for case-by-case assessments of minimal impacts by the COE. This threshold is an initial NWP/IP screening tool and site-specific data may change the type of CWA Section 404 permit required (e.g., MTM/VF projects initiated as NWP may, after assessment, require IP, and vice versa). Scientific evidence, gained through the COE experience under NWP 21 and IP reviews, may warrant establishing some future type of watershed acreage, stream length, or stream flow condition that would be presumed by the COE to be a minimal impact threshold. [Chapter II.C.6-7, Actions 9 and 12].

Under this alternative, aquatic impacts from fills would continue at rates similar to those described above for the post-1999 period. However, environmental benefits from compensatory mitigation measures would increase based on changes to NWP 21 and the establishment of the COE stream functional assessment protocol. Many of the effects of program improvements of the last several years at both the Federal and state level are just now becoming evident, and those effects should increase as implementation progresses. Environmental benefits equal or greater than those expected

from the No Action Alternative would occur with the implementation of any one of the three proposed action alternatives.

d. Environmental Benefits of the Action Alternatives

Alternatives 1, 2 and 3 build upon existing "best science"methods, such as the WVSCI and the COE stream functional assessment protocol. The goal is to bring stakeholders as well as state and Federal agencies together to establish common criteria and science-based methods for determining baselines, impacts, and mitigation requirements. Monitoring information could be used to identify and evaluate T&E listed species habitats; stream reaches supporting naturally diverse and high quality aquatic populations; sole or principal drinking water source aquifers; or other specially-protected areas. This information could be a basis for considering ADIDs. By inclusion of a habitat quality evaluation, as well as the CWA Section 404(b)(1) Guidelines analysis (or its equivalent) in all three action alternatives, the least-damaging practicable alternative for the placement of fill in waters of the U.S. would be chosen.

The data mandated by different regulatory programs results in costly collection and analysis of voluminous information, typically only assessed for particular program requirements. Compiling similar data from varied sources could serve multiple program goals and objectives. The use of GIS to compile other relevant resource, ecosystem, or community information is a logical augmentation to the aquatic data for use in COE NEPA compliance. Use of information technology to collect, compile, screen, and update aquatic and other resource information in GIS, linked to various databases, would provide for better informed and timely permit decisions regarding aquatic impacts and a reference library to assist in future decisions.

Significant environmental benefits would be realized from the use of a coordinated permit process in combination with other regulatory aids and tools such as ADIDs and the COE stream assessment protocol. For example, the collaboration that would occur among the agencies in this coordinated regulatory process would facilitate the effective application of the alternatives test required by the CWA Section 404(b)(1) Guidelines. The application evaluation process would facilitate consideration of the "cost" provision in the definition of "practicable" as applied to the feasibility of MTM/VF alternatives. The institutional expertise unique to each agency could be employed in performing the CWA Section 404(b)(1) practicability test. These efforts could result in consideration of a greater range of alternatives, such as placing excess spoil in adjacent, previously-mined areas in order to avoid or substantially minimize fills in waters of the U.S.

Moreover, joint evaluations of MTM/VF proposals would result in more expansive considerations of both environmental impacts and effective treatments to mitigate those impacts. This coordinated process would also facilitate selection, implementation and monitoring of mitigation projects. The coordinated process and actions that make up the action alternatives could minimize adverse environmental effects by <u>enhancing</u> the following:

- identification of the environmental resources;
- prediction of environmental impacts;
- avoidance of special/high-value environmental resources;
- development of operation plans that mitigate (i.e. avoid, minimize, avoid, and compensate) adverse environmental impacts;

- consideration of the least damaging practicable alternative in fill placement;
- minimization of excess spoil material;
- consideration of adverse cumulative environmental effects;
- coordination of data sharing and analyses among key regulatory agencies to provide more informed decisions under the respective programs;
- technology transfer to identify the best practices reclamation techniques available to avoid or minimize adverse environmental impacts; and,
- communication among stakeholders and regulators.

Better stream protection from direct and indirect effects would result from improved characterization of aquatic resources; operations designed to avoid and minimize adverse effects and restore aquatic functions; and compensatory mitigation plans with improved design, inspection, and enforcement. Excess spoil fills would become smaller and placed in locations that minimize adverse environmental effects.

Enhanced assessments would reduce the cumulative adverse impacts of MTM/VF through more environmentally-protective designs; enhanced compensatory mitigation that emphasizes onsite reclamation and restoration of degraded streams within a watershed; identifying and developing best management practices for restoring aquatic functions impacted by mining; and inclusion of improved techniques to grow trees and more quickly restore mined land to better terrestrial habitat. Agencies would continue to identify better practices to reduce fugitive dust and fumes from mining, and thus, reduce impacts to adjacent communities. Flooding would be reduced by improved mining design, flood analysis, and, in the longer term, restoring the post mining land use to trees.

Improved communications, through pre-permit application meetings and the use of a designated regulatory authority as a focal point for initial data collection, should result in better cataloguing of T&E species, cultural, and historic properties, as well as addressing these issues at the earliest possible stages of permit review.

Table II.B-2 Distinctions Among MTM/VF EIS Alternatives

No Action Alternative	• Valley Fill impacts assessed on case-by-case basis to set NWP 21 or IP process; WV fills in less than 250-acre watershed generally eligible for NWP 21 • No SMCRA rules incorporating CWA 404(b)(1) data. • Coordinated SMCRA/CWA permit not assured. • No harmonized flooding potential evaluations. • SMCRA permit issued first for NWPs, and second for IPs; COE review may require revision of SMCRA permit. • COE does public interest and NEPA review, if IP. • ESA (T&E) and NHPA issues reviewed twice. • SMCRA buffer zone (SBZ) subject to interpretation. • Independent bonding under CWA and SMCRA.
Alternative 1 (Most MTM/VF proposals processed by COE as IPs)	• MTM/VF mostly authorized through CWA Section 404 IPs. • SMCRA permit authorization dependant on CWA Section 404 IP issuance. • SMCRA review defers to COE flooding evaluations. • IP process satisfies ESA and NHPA. • SMCRA SBZ rule inapplicable to excess spoil in waters of the U.S. due to CWA Section 404 analysis. • Protocol for ADID watersheds developed. • MOA and FOP for coordination; no joint application.
Alternative 2 (Coordinated review by CWA and SMCRA regulatory authorities)	• MTM/VF impacts assessed on case-by-case basis by COE: either NWP 21 or IP process followed, as appropriate; IP process satisfies ESA and NHPA. • SMCRA SBZ rules clarified and excess spoil rules added to require minimization and alternatives analysis. • consider additional rule-making to be more consistent with the CWA Section 404(b)(1) Guidelines • Concurrent review of CWA and SMCRA permit applications with separate determinations made. • Coordinated ESA and NHPA review; protocol for ADID watersheds developed. • MOA, JPP, FOP, and joint application used for coordination. • Coordinated CWA and SMCRA bonding.
Alternative 3 (SMCRA Review relied on for NWP 21 authorization)	• MTM/VF proposals subject to SMCRA review as a basis for COE NWP 21 approval, unless mitigation insufficient. • SMCRA SBZ and excess spoil rules finalized as in Alt. 2 • consider additional rule-making to be more consistent with the CWA Section 404(b)(1) Guidelines • CWA review relies on SMCRA findings and addition of off-site mitigation to offset unavoidable aquatic impacts; no emphasis on ADIDs. • SMCRA process largely satisfies ESA and NHPA. • MOA, JPP, FOP, and joint application used for coordination. • Coordinated CWA and SMCRA bonding.

C. DETAILED ANALYSES OF THE ACTIONS TO ADDRESS ISSUES

The following section is organized according to eleven significant issues raised during scoping of this EIS. Significance, in the NEPA context, is discussed above in Chapter II.A. Each issue is briefly described and followed by an explanation of the existing regulatory controls (the no action alternative) under the CWA, SMCRA, and related laws relative to the issue. Also explained are actions addressing each issue and the relation of the actions to the three proposed alternatives. The three alternatives contain groupings of 17 actions addressing the various issues. Some actions are common to all alternatives, while other actions pertain to only one or two of the alternatives. A schematic of the format for this section follows:

Table II.C-1
Summary of the Alternatives Carried Forward

	No Action Alternative	Alternative 1	Alternative 2	Alternative 3
Issue 1: Government Efficiency	Existing program–case-by-case determination of CWA 404 permit type for fills in watersheds > 250 acres are generally IPs; fills in < 250acre watersheds are NWP	**Action 1.1** COE Lead--most CWA 404 permits IP	**Action 1.2** Coordinated Lead–CWA 404 permits can be NWPs (with regional conditions) or IPs	**Action 1.3** SMCRA as the platform--most CWA 404 permits are NWP 21
Issue 2: Definitions	Existing (CWA) program –COE defined bed and bank (OHWM)	**Action 2** Consistent stream definitions		
Issue 3: Direct Stream Loss	Significant adverse effect; water quality standard (CWA); material damage; Current SBZ rule-making (OSM)	**Action 3.1** SBZ N/A to excess spoil	**Action 3.2/3.3** Continue current SBZ rulemaking to require minimization of disturbances and prevention additional contributions of suspended solids in streams outside permit area	
		Action 4.1/4.2 Designate areas with Advance ID		—
Issue 4: Stream Impairment	Anti-degradation, water quality standards, NPDES, TMDL (CWA)	**Action 5** Evaluate effects of MTM/VF and develop/propose new WQS		
		Action 6 Refine uniform, science-based protocols for assessing function, making permit decisions, and setting mitigation.		
Issue 5: Fill Minimization	AOC (SMCRA); rule-making to require demonstration that excess spoil and adverse impacts from fill construction are minimized; no practical upland alternative (CWA)	**Action 7** Continue SMCRA rule making to require a demonstration that excess spoil and adverse impacts from fill construction are minimized		

	No Action Alternative	Alternative 1	Alternative 2	Alternative 3
Issue 6: Stream Habitat & Aquatic Function	Baseline data collection, monitoring, mitigation	**Action 8** BMP Manual for stream protocol and mitigation		
		Action 9 Refine protocols, collect data in GIS, assess minimal threshold		
		Action 10 Mitigation inspection, bonding		
		—	**Action 11** SMCRA apply COE protocol to determine on-site mitigation	
Issue 7: Cumulative Impacts	CHIA (SMCRA); projects cumulatively < minimal (CWA); NEPA	**Action 12** Refine protocols, collect data in GIS, assess cumulative threshold		
Issue 8: Deforestation	PMLU, revegetation (SMCRA); riparian vegetation as mitigation (CWA)	**Action 13** BMP Manual for growth media, reclamation with trees, and measuring success of reforestation.		
		Action 14 Congressional authority to require reclamation with trees		
Issue 9: Air Quality	PM 2.5/10, fugitive dust (CAA); fugitive dust (SMCRA)	**Action 15** BMP Manual for controlling fugitive dust and blasting fumes		
Issue 10: Flooding	CWA 404; PHC (SMCRA)	**Action 16** Flooding Guidelines		
Issue 11: T&E Species	ESA Section 7	**Action 17** Program changes if necessary to comply with ESA		

1. Government Efficiency; Sub-issue: Coordinated Decision Making

Regulation of surface coal mining operations balances resource recovery with environmental conservation, restoration, mitigation, and enhancement. There are a number of Federal/state laws and implementing rules regulating the coal industry and providing for the protection of people and the environment. The Federal agencies have a common administrative mandate to minimize duplication among the various regulatory programs [33 U.S.C. 1211(c)(12); 30 U.S.C. 1292(c) and 1303(a), and 33 CFR 322.2(f)(2)]. Coordination among the agencies leads to efficient achievement of regulatory purposes. Agencies can avoid wasteful expenditure of human resources and public funds if the regulatory products of one agency satisfy the requirements of another program. The benefit of government collaboration was part of the stated purpose of this EIS "to consider developing...coordinated agency decision-making processes...." [64 FR5778, February 5, 1999] Therefore, this EIS proposes an action to establish an integrated regulatory process for MTM/VF operations.

In West Virginia, the COE, OSM, EPA, FWS, and WVDEP have coordinated review of surface coal mining permit applications proposing excess spoil disposal in valley fills since 1999 through an "interim permitting" process [see *Bragg* discussion in Chapters I.C.2.d.4. and I.C.3.b.1.]. This resulted in interagency review procedures, protocols, and other guidelines that encourage early involvement and networking among the agencies. While an interim permitting process similar to that in West Virginia does not exist in Virginia and Kentucky, increased coordination is occurring in those states as well between state and Federal agencies. The West Virginia interim permitting experience, along with the program review conducted as part of this EIS, have revealed that increased coordination, institutionalized through interagency agreement, could provide for

information sharing, streamlining the permitting process, and enhancing the ability to accomplish agency regulatory purposes.

a. No Action Alternative: The Regulatory Program Today

Surface coal mining in the steep slope regions of Appalachia requires a SMCRA permit from the appropriate state regulatory agency in Kentucky, Virginia, or West Virginia, or from the OSM in Tennessee. If the proposed mining operation involves impacts to waters of the U.S., the applicant must seek CWA Section 404 authorization from the COE. The CWA Section 404 NWP 21 permit is used most extensively by applicants for MTM/VF proposals. This permit applies to impacts to waters of the U.S. "associated with surface coal mining and reclamation operations...authorized by the Department of the Interior, Office of Surface Mining or by states with approved programs under...SMCRA." [67 FR 2081.] Minimizing duplication of Federal regulations is one of the purposes behind NWP 21. The COE maintains that its review should not duplicate the SMCRA agency review performed in coordination with other Federal and state resource agencies. SMCRA requires compliance with the same Federal environmental laws, such as NEPA, FWCA, ESA, and NHPA as the COE does in executing its regulatory program. The COE reviews the SMCRA information to assure that the impact analysis and mitigation are in compliance with the COE policy and regulations, including the CWA Section 404(b)(1) Guidelines. State certification of CWA Section 404 permits under CWA Section 401 and CWA Section 402 permits for point source discharges are typically required prior to coal mining [Chapter II.C.4.a.]. A summary of the various regulatory processes used in evaluating proposed MTM/VF operations is as follows:

- SMCRA application reviewed by state or OSM;
- NPDES authority, either concurrently or sequentially, evaluates CWA Section 402 point source discharges;
- Approved SMCRA permit results in application for CWA Section 404 authorization by COE;
- COE requests state CWA Section 401 Certification;
- CWA Sections 401, 402, and 404 authorizations must be obtained prior to commencing operation; and
- Other regulatory reviews (e.g., ESA, NHPA, CAA, MSHA, OSHA, etc., as necessary) are provided for and considered during processing of the SMCRA and CWA Section 404 application.

At any stage of these reviews, the regulatory agencies may identify deficiencies that require revisions to the application or result in denial of the MTM/VF proposal. Most agency approvals are conditioned on obtaining all other necessary authorizations prior to initiating coal mining. If revisions are required by any agency after authorization of a project by another agency, the changes to the approved mine plan must be reconsidered. In an effort to minimize this occurrence, the COE Districts are encouraging pre-application meetings with mining companies. Flow charts illustrating the SMCRA and NPDES processing of MTM/VF proposals in West Virginia, and a general depiction of the CWA Section 404 process by the COE, can be found in Appendix B, Figures 1-3.

a.1. CWA Section 404

The goal of the CWA is to protect and restore the chemical, physical, and biological integrity of the nation's waters. CWA Section 404 helps to achieve this goal by regulating the placement of fill

material into waters of the U.S. CWA Section 404 permit applications are evaluated using the Section 404(b)(1) Guidelines to assure this goal is met.

The Guidelines require the identification of the aquatic resources affected; avoidance and minimization of impacts; prediction of the level of unavoidable impacts for various project alternatives analyzed; as well as a description of the amount and type of mitigation required to offset the unavoidable impacts. The COE is required by the Guidelines to make factual findings on chemical and physical impacts (substrate; suspended particulates/turbidity; changes in water; current patterns and water circulation; normal water fluctuations; and salinity gradients) and biological impacts (threatened or endangered species; fish, crustaceans, mollusks, and other aquatic organisms in the food web; and other wildlife). A detailed description of the chemical aspects of aquatic resources currently being collected are discussed in Chapter II.C.4 (Stream Impairment). The physical and biological data available from other programs are discussed in Chapter II.C.5 (Direct Stream Loss), Chapter II.C.6.a.2. (Assessing and Mitigating Stream Habitat and Aquatic Functions) and Chapter II.C.7.b. (Cumulative Impacts).

To predict the level of direct impact to aquatic resources, determine the type of CWA Section 404 permit process, and establish the level of mitigation, the COE is refining and employing a stream assessment protocol in the districts in the EIS study area [Chapter II.C.6.a.1.]. Indicators of aquatic functions, as used in this protocol, include the chemical, physical and biological characteristics of biotic and abiotic integrity. Variables measuring the physical and chemical (abiotic) integrity include conductivity, riparian width, canopy, and embeddedness. Variables measuring the biological (biotic) integrity include taxa richness, EPT richness, mHBI, percent Ephemeroptera, and percent (Chironomidae + Oligochaeta). To the extent that some or all of these data are currently being collected by one or more state or Federal agencies, the COE could rely on this information.

Fills in waters of the U.S. by MTM/VF can be authorized by the COE through either the general permit or IP process. If MTM/VF projects result in no more than minimal adverse impacts to aquatic systems, including mitigation, they may be authorized by NWP21, a type of general permit. NWP 21 was re-issued on January 15, 2002 with changes. The COE districts intend to implement a stream functional assessment protocol in all of the districts in the EIS study area to make case-by-case determinations, in addition to reliance on the SMCRA approval, to issue appropriate NWP 21 authorizations. See Chapters II.5.C.a.1. and II.6.C.a.1. for further discussion on IPs, NWPs, the COE protocol, and mitigation.

Minimal Impact Thresholds and NWP 21

The COE made the commitment in the reissuance of the NWPs in 2002 to re-evaluate the possibility of an upper threshold for NWP 21 after this EIS is completed [67 FR 2021]. The COE noted that data collected in this EIS, along with other available information including information resulting from individual verification of all NWP 21 projects, would be useful in determining the appropriateness of NWP 21 individual and cumulative minimal impact thresholds. Thresholds could be effective in minimizing environmental impacts and providing predictability to the stakeholders. In addition, thresholds could help the COE District better manage workloads.

As an interim measure, the COE is preparing to implement a regional condition to NWP 21, applicable to MTM/VF activities in waters of the U.S., concurrent with this EIS. The COE agreed in the *Bragg* settlement to establish a condition in West Virginia that valley fills in watersheds less

than 250 acres could generally be authorized by NWP 21. The COE Huntington District found this condition contributed to conscious attempts by the regulated coal industry to avoid the IP process by keeping proposed fill sizes below the 250-acre threshold. Consequently, as of July 2002, 81 proposals were eligible for NWP 21 in West Virginia and 5 were processed as IPs. The COE Huntington District has processed more than 160 NWP 21 permitting actions involving fills in West Virginia and Kentucky since the start of 1999.

Based, in part, on the interim 250-acre watershed threshold, CWA NWP 21 renewal requirements, and other program changes by SMCRA resource agencies (e.g., increased scrutiny of fill minimization and PMLU emphasis), there has been a reduction in the size and number of valley fills since the initiation of this EIS in 1998. The average number of fills approved in the EIS study area declined from 304 fills/year (1996-1998) to 217 fills/year (1999-2001). The average size of the fills during these two intervals also decreased 18 percent. Because of the reduction in the number and size of fills for the intervals 1996-1998 and 1999-2001, respectively, the total area directly impacted by fills decreased from 15,370 to 8,974 acres; watershed impacts decreased from 95,185 to 46,398 acres; and linear length of stream decreased from 145 to 107 miles. These data are derived from the valley fill inventory prepared for this EIS [Chapter III.K.2-5].

However, the "post-*Bragg*" regulatory environment in Appalachia was also affected by economic pressures on the industry. At times, excessive Appalachian coal supplies and reduced central Appalachian production were caused by highly-competitive coal sources. At other points in the past 4+ years, a temporary spike in the demand and commensurate price increase for Appalachian coal caused a surge in mining applications or re-activated idle permitted mines in temporary cessation. These factors and further uncertainties, due to the *Rivenburgh* injunction and other legal controversies, suppressed investment capital for new mines. It is difficult to apportion the influence of reduced MTM/VF environmental impacts, post-*Bragg*, among economic, legal, or regulatory factors.

The 250-acre threshold established in the *Bragg* agreement may be responsible in part for the reduction in the size and number of valley fills. Until such time as sufficient scientific data may be available to establish a specific minimal impact threshold, applying a 250-acre threshold as a regional condition in a defined geographic area could provide an interim administrative basis for authorization of MTM/VF projects using NWP 21. The extension of this threshold, through a regional permit condition by the COE, is an independent action from this EIS. The threshold could remain in place until supplanted by a validated functional assessment protocol for case-by-case assessments of minimal impacts by the COE or sufficient scientific data are available to establish a specific "bright line" threshold. The threshold would be a useful management tool and may be rebutted with further scientific data and analysis with each case-by-case MTM/VF proposal. Scientific evidence, gained through COE experience under NWP 21 and IP reviews, together with information from SMCRA, CWA 402, and other water quality or related programs, may warrant establishing some future type of watershed acreage, stream length, or stream flow condition that would be presumed by the COE to be a minimal impact threshold. [Chapter II.C.6 and II.C.7, Actions 9 and 12]

This threshold is an initial NWP/IP screening tool and site-specific data may change the type of CWA Section 404 permit required. Under the terms of this regional condition, the COE would rely on case-by-case use of functional stream assessments, in tandem with the acreage threshold. That is, fills proposed within watersheds less than the 250-acre threshold, would initially begin processing

as a NWP. Similarly, fills in watersheds larger than 250-acres would initially begin processing as an IP. Upon submission of a MTM/VF proposal in either CWA Section 404 permit process category, the COE would evaluate appropriate physical, chemical, and biological data on proposed aquatic impact locations (supplied by the applicant or gathered by the COE), along with offsetting mitigation plans, to see if the initial presumption holds. Stream assessment, mitigation, or other information and analyses may redirect an application into the other permit review category. For instance, a fill proposed in a 300-acre watershed may initially be processed by the COE as an IP. If the stream assessment and mitigation proposal ultimately show that particularly high quality streams are not impacted and mitigation reduces net impacts to less than minimal, the project may be authorized by NWP 21. Conversely, a NWP 21 project proposal for two fills in 125-acre watersheds could occur in extremely high quality streams where mitigation does not adequately offset impacts. Such a finding by a COE District may trigger redirecting the initial NWP 21 proposal to the COE IP process.

CWA Section 404(b)(1) Guidelines Compliance

All CWA Section 404 IPs must comply with the CWA Section 404(b)(1) Guidelines, codified as regulations at 40 CFR 230. The IP is not in compliance with the Guidelines unless all four criteria restricting the placement of fills in waters of the U.S. are met [40 CFR230.10(a)-(d)] :

> "(a): Except as provided under section 404(b)(2) [CWA Section 404(b)(2) provides a Guidelines compliance waiver for interests of navigation], no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. [5 examples of alternatives are listed as subsections in 40 CFR 230.10(a)(1)-(5).]
>
> "(b): No discharge of dredged or fill material shall be permitted if it:
>
>> "(1) Causes or contributes, after consideration of disposal site dilution and dispersion, to violations of any applicable State water quality standard;
>>
>> "(2) Violates any applicable toxic effluent standard or prohibition under Section 307 of the [CWA] Act;
>>
>> "(3) Jeopardizes the continued existence of species listed as endangered or threatened under the Endangered Species Act of 1973, as amended, or results in the likelihood of the destruction or adverse modification of a habitat which is determined by the Secretary of the Interior or Commerce, as appropriate, to be a critical habitat under the Endangered Species Act of 1973, as amended. If an exemption has been granted by the Endangered Species Committee, the terms of such exemption shall apply in lieu of this subparagraph;
>>
>> "(4) Violates any requirement imposed by the Secretary of Commerce to protect any marine sanctuary designated under Title III of the Marine Protection, Research, and Sanctuaries Act of 1972.

> "(c): Except as provided under Section 404(b)(2), no discharge of dredged or fill material shall be permitted which will cause or contribute to significant degradation of the waters of the United States. Findings of significant degradation related to the proposed discharge shall be based upon appropriate factual determinations, evaluations, and tests required by SubpartsB and G, after consideration of Subparts C through F, with special emphasis on the persistence and permanence of the effects outlined in those Subparts. Under these Guidelines, effects contributing to significant degradation considered individually or collectively, include: ... [4 examples of significant degradation are listed as subsections in 40 CFR 230.10(c)(1)-(4).]
>
> "(d): Except as provided under Section 404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem. Subpart H identifies such possible steps."

For fills proposed in special aquatic sites (e.g., riffle/pool complexes and wetlands), as defined in Subpart F of the Guidelines at 40 CFR 230.40-45, the COE evaluates the applicant's responses to the two rebuttable presumptions set forth in 40 CFR 230.10(a). The rebuttable presumptions include the following: 1) alternatives that do not involve special aquatic sites are presumed to be available, and 2) those alternatives are presumed to have less adverse impact than the proposed fill in waters of the U.S.

The CWA permit can be denied if it does not comply with the Guidelines.

Secondary and Cumulative Impact Review

IPs evaluated by the COE also consider secondary and cumulative impacts. Secondary impacts are indirect impacts caused by the proposed action, occurring later in time or further removed in distance from the project, and must be reasonably foreseeable to be considered [40 CFR 1508(b)]. For example, an IP for a MTM/VF project including sediment ponds would consider the downstream impacts of discharges from the ponds, even though the discharges are addressed through the CWA Section 402 program.

Cumulative impact considerations occur in two different contexts. The first context is the cumulative nature of all similar activities, such as all valley fills in a watershed. The second is the NEPA context of all human development on an ecoregion, in a watershed, or to a particular resource. Cumulative impact reviews are discussed at length in II.C.7.a.

Public Interest Review

The public notice for IPs is the primary method of advising all interested parties of the proposed activity for which the permit is sought and of soliciting comments and information necessary to evaluate the probable impacts of the activity. Copies of public notices are sent to all parties who have specifically requested copies of the public notices, to the U.S. Senators and Representatives for the area where the work is to be performed, the field representatives of all of the Federal agencies, the head of the state agency responsible for fish and wildlife resources, and the State Historic Preservation Officer. It is presumed that all interested parties and agencies wish to respond to public notices; therefore, a lack of response is interpreted as meaning that there are no objections

to the proposed project. District Engineers must update public notice mailing lists at least every two years, although many districts are now placing public notices on their websites to reduce mailing costs. [33 CFR 325.3]

Once the Guidelines are satisfied, the COE evaluates the comments and, with any required additional information, ensures that the proposed IP project is not contrary to "public interest." A project may have an adverse effect, a beneficial effect, a negligible effect, or no effect on any or all of the public interest factors [33 CFR 325.3(c)]. The public interest review considers the balance of reasonably foreseeable benefits and detriments of the proposed project. The criteria include:

- The extent of the public and private need for the project;
- Where unresolved conflicts exist as to the use of the aquatic resource, whether there are practicable alternative locations or methods that may be used to accomplish the objective of the project; and
- The extent and permanence of the beneficial or detrimental effects the proposed work is likely to have on the private and public uses to which the project site is suited.

Under the CWA Section 404(q) Memoranda of Agreement between EPA and the Department of the Army, and between the FWS and the COE (dated August 11 and December 21, 1992, respectively), the EPA and/or FWS can elevate a disagreement over a proposed decision by the COE to issue a CWA Section 404 permit if the proposal would have a substantial and unacceptable impact on an Aquatic Resource of National Importance (ARNI), as defined by the MOAs. The disagreement is elevated to higher authorities within each agency for resolution. Although FWS and EPA each have the independent option of initiating the CWA Section 404(q) elevation procedure for adverse impacts regarding ARNIs, only EPA has the authority under CWA Section 404(c) to veto a COE CWA Section 404 permit. EPA also has the authority to issue an advance CWA Section 404(c) veto for a specific geographic area of aquatic resources prior to the COE receipt of a CWA Section 404 permit application. This CWA Section 404(c) veto authority can be initiated over concerns regarding unacceptable significant adverse impacts to waters of the U.S., including cumulative impacts.

a.2. CWA Section 404 State Assumption and Programmatic General Permits

Two provisions of the CWA allow states to obtain Section 404 permitting authority, if the state initiates a request. First, CWA Section 404(g) allows for state assumption of the entire CWA Section 404 program, provided that certain requirements are met. Partial state assumptions are not approvable under CWA Section 404. [40 CFR 233.1] The states receive no Federal money to support their programs. Because assumption under CWA Section 404(g) is a complete transfer of the program to the state for certain non-navigable waters, there are no "Federal actions" involved with the administration of the program by a state. Thus, NEPA and other Federal laws applicable to "Federal actions" do not apply to state authorizations pursuant to CWA Section 404(g). However, NEPA compliance is required at the time of state assumption. Although the COE transfers CWA Section 404 authority to the state, EPA retains oversight responsibility.

The second way states may gain some control of the 404 program is through CWA Section 404(e), which allows the Secretary of the Army to issue general permits on a state, regional, or nationwide basis for any category of activities involving discharges of dredged or fill material. The COE

defines a programmatic permit as a type of general permit founded on an existing state, local or other Federal agency program and designed to avoid duplication with that program [33 CFR 325.5 (d)]. The COE uses SPGPs to authorize state agencies to issue CWA Section 404 permits for certain activities. To do this, SPGPs contain special conditions to ensure the effectiveness of these programs and consistency with CWA Section 404 objectives. In addition to the levels of COE review and discretionary provisions, these special conditions may restrict the impact of permitted activity to a geographic area or thresholds, such as the area or length waters of the U.S. affected by a project. If a threshold is exceeded, a state refers the activity to the COE for review. While the COE cannot deny the permit because a SPGP threshold is exceeded, it can require that the activity go through the IP process.

States seeking to obtain SPGPs must have laws comparable to the CWA Section 404 program. However, SPGPs are approved for a distinct category of activities and based on a state's proven track record of effectiveness in administering the comparable state law. After SPGP approval, the COE performs oversight review of each state action. States that have been issued SPGPs must also comply with annual reporting requirements.

The COE must comply with NEPA before issuing an SPGP. Since assumption under CWA Section 404(e) is not a complete transfer of the program to the state, there are "Federal actions" involved with the authorizations of projects by a state. Thus, NEPA and other Federal laws (e.g., ESA and NHPA) applicable to "Federal actions" apply to state authorizations pursuant to CWA Section 404(e). The COE and EPA retain oversight responsibility.

Other Federal agencies may obtain the authority to issue CWA Section 404 permits under the Regional General Permit (RGP) provision of CWA Section 404(e). RGPs may be issued by a district or division engineer for a category or categories of activities after public notice and evaluation of comments. A Federal agency seeking a RGP must have a program in place with requirements comparable to the CWA Section 404, such as the ability to require offsite mitigation and the CWA Section 404(b)(1) analysis. For activities authorized by RGPs, notification to the COE may be required, but procedures vary from district to district. For example, districts may require a case-by-case reporting and acknowledgment system. Regional permits are similar to nationwide permits, but they usually cover a smaller geographic scale.

a.3. SMCRA

SMCRA is a comprehensive program to regulate surface coal mining and reclamation operations. SMCRA requirements are similar to the CWA Section 404 relative to aquatic resources. The provisions at 30 U.S.C. 1265(b)(10) seek to minimize disturbance of the hydrologic balance within the permit and adjacent area and prevent material damage outside of the permit area [see also 30 CFR 816.41]. SMCRA, at 30 U.S.C. 1265 (b)(24), also mandates that the operator shall, to the extent possible using the best technology currently available, minimize disturbances and adverse impacts to fish, wildlife, and related environmental values, and shall achieve enhancement of such resources where practicable [see also 30 CFR 616.97].

SMCRA regulations at 30 CFR 816.57, known as the stream buffer zone (SBZ) rule, preclude impacts within 100 feet of intermittent and perennial streams absent a finding that 1) mining activities will not cause or contribute to a violation of applicable state or Federal water quality standards, and will not adversely affect the water quantity and quality or other environmental

resources of the stream; and 2) if there will be a temporary or permanent stream-channel diversion, it will comply with specific requirements applicable to the construction of diversions.

Similar to the CWA Section 404 program, SMCRA performance standards are achieved through the collection of baseline hydrologic resource data, predictions of impacts to the resources, and design of mine plans to minimize impacts. As discussed in Chapter II.C.7.b., the assessment of hydrologic impacts, while in conformance with SMCRA performance standards, varies from state to state. Typically, these assessments are based on predicted loading (generally for pH, flow, iron, TDS concentrations and other pollutants of concern) from all coal mining outfalls and water quality in an identified cumulative impact area. To better facilitate the preparation of this assessment in a standard format, OSM developed a reference document outlining a sound technical approach for obtaining and analyzing the available geologic and hydrologic information. Currently, OSM is working with the Interstate Mining Compact Commission to compile the best technical approaches for developing PHCs and CHIAs. Because hydrology varies across the nation, the technical approach to these hydrologic analyses and development of material damage criteria are best suited to regional or similar geologic and hydrologic conditions.

The SMCRA regulations do not currently contain requirements for biological monitoring or documenting physical attributes of streams. SMCRA requirements, similar to EPA water quality standards, presume that maintaining water quality and minimizing contributions of sediment are surrogates for ensuring biological integrity. Many state SMCRA or water quality agencies currently require or collect biological, physical and chemical data following established protocols. The protocol most often used for biological assessment is the EPA Rapid Bio-assessment Protocol, which includes establishing a number of sampling stations, providing habitat evaluations, descriptions, scores, and providing macroinvertebrate metric values and scores for the Family Biotic Index at the sampling stations [Chapter II.C.4.a.5].

The SMCRA authority may authorize placement of fill in intermittent or perennial streams if it finds:

- In writing, based on the CHIA, that material damage to the hydrologic balance is prevented offsite [30 CFR 773.15(e)]; and,
- That mining activities will not cause or contribute to a violation of applicable State or Federal water quality standards, and will not adversely affect the water quantity and quality or other environmental resources of the stream [30 CFR 816.57].

For excess spoil placement in ephemeral streams, the first finding cited above applies, but the second finding is not required. These requirements are discussed in more detail in Chapters II.C.7.b.(Cumulative Impacts) and II.C.3.a.2 (Stream Impairment).

The sequence and timing of project approval under CWA Sections 401, 402, and 404 can result in revision and reprocessing of previously-approved SMCRA permits. The need to change mine plans is inefficient and will likely result in increased time and cost for the applicant to secure a SMCRA permit revision and increased costs to the agencies. Evaluation by all decision agencies early in the planning phase of a mine plan provides greater flexibility to accommodate changes during the design phase, before substantial time and money have been invested in developing a final mine plan and securing all of the necessary permits.

a.4. Other Regulatory Programs

Other CWA reviews may require collection and assessment of aquatic resource data and impact predictions in order to authorize point source discharges (CWA Section 402, including NPDES, TMDL, and anti-degradation) and prepare state water quality certifications (CWA Section 401) [Chapter II.C.4.a.] These programs generally require the collection of water quality data which may become part of other program environmental analyses such as individual or cumulative impacts under CWA Section 404 and SMCRA.

a.5. Permit Sequencing

The typical sequence and timing between issuance of the SMCRA permit, the CWA Section 401 Certification, and CWA Section 402/404 permits was previously described above in Chapter II.C.1.a. Sequence and timing issues for these different permits are of concern to applicants, the agencies, and other stakeholders. Currently, under NWP 21, COE Districts receive mining applications for impacts to waters of the U.S. after the company has obtained the necessary SMCRA permit. Only at this time does the COE District complete its case-by-case determination on the applicability of the NWP. COE Districts are encouraging meaningful pre-application coordination with the applicant to obtain project-specific information regarding potential requirements necessary for securing a CWA Section 404 permit promotes efficiency through information sharing. This COE/applicant coordination, prior to submission of the COE application, helps provide the applicant with a fair, reasonable, and timely response and enhances protection of the aquatic environment.

b. Alternative 1: The Size, Number, and Location of Valley Fills in Waters of the U.S. are Determined by the COE CWA Section 404 Permit Process

Under this alternative, all MTM/VF projects proposing valley fills in waters of the U.S. would initially be reviewed by the COE as a CWA Section 404 IP rather than as a general permit. The COE would make an initial case-by-case determination of the size, number, and location of valley fills in waters of the U.S. Following this initial determination, the applicant could commence the SMCRA and other requisite application processes (e.g., NPDES, MSHA, etc.). The result of this alternative would be a series of consecutive, coordinated reviews and decisions by the COE and appropriate SMCRA agency.

Even though the COE would make the initial determination of the siting of fills, coordination and cooperation among the COE, EPA, OSM, FWS, and their state counterparts are integral in Alternative 1 to reviewing MTM/VF proposals. This coordination would be provided for in an MOA. This alternative would operate with a procedural presumption that, as a general matter, MTM/VF projects with fills in waters of the U.S. would begin the process as IPs.

Under this alternative, OSM would consider rulemaking to provide that the SBZ zone rule at 30 CFR 816.57 does not apply to excess spoil disposal in waters of the U.S. (Action 3.1). SMCRA permits would continue to state that all appropriate permits, such as the CWA Section 404 permit, must be secured prior to mining. This action would eliminate regulatory duplication and confusion, curtail unauthorized filling of waters of the U.S., and resolve perceived or actual conflict between regulation and statutory provisions within SMCRA and the CWA.

The principal difference between the regulatory framework in this alternative and the framework in the other alternatives is that the COE CWA Section 404 process would, to the extent allowed under

Federal statutes and regulations, including state water quality certifications, establish the initial limits on the size, number, and location of all valley fills proposed to be constructed in waters of the U.S. Any subsequent actions under SMCRA on a permit application would recognize the constraints established by the COE. The COE would also rely on the subsequent SMCRA permit application for information pertinent to whether an EIS or EA is needed.

Action 1.1: The COE, through an MOA establishing coordination with other agencies, would initially process all MTM/VF projects proposing to construct valley fills in waters of the U.S. as CWA Section 404 IPs.

b.1. Process and Regulatory Responsibilities

Process

This action contemplates the COE leading a coordinated IP permit process for MTM/VF, formalized through an MOA. This MOA could describe how the COE would encourage other agencies to participate in pre-application meetings, coordinate the sequencing of the IP with other MTM/VF authorizations, frame dispute resolution procedures and describe each agency's role in the process, as discussed below. The objective is to minimize duplication, unnecessary paperwork for the applicant and improve permitting decisions to protect or enhance the environment.

The COE would perform an initial review of an IP permit application to determine if avoidance, minimization, and alternative analyses have been performed and that the fill sites selected are lower functioning stream segments than those avoided; or that no practical upland alternative to the project proposal exists. An initial indication of possible project "approvability" may occur if the following conditions are met:

- Stream functional assessment data appears complete and the COE's preferred stream "scoring" process was followed;
- The applicant's projection of impacts to aquatic resources appears thorough and reasonable;
- The mitigation proposal provides appropriate combinations of on- and off-site watershed restoration, improvement or compensation for in-kind, in-basin work within the CIA to offset any direct loss of stream function or indirect impairment anticipated (meets, if appropriate and practical, TMDL plan if a CWA Section 303(d)-listed stream is involved);
- The COE evaluates aquatic impacts for issues with T&E species consulting with FWS in accord with ESA Section 7;
- The COE determines that the project is likely to comply with the four criteria to restrict fills in waters of the U.S. as listed in the CWA Section 404(b)(1) Guidelines; and
- The COE evaluates impacts to cultural/historic properties, complying with Section 106 of NHPA.

If the initial COE review rates an application as likely to comply with CWA Section 404(b)(1) Guidelines and suitable for further processing, the COE causes the SMCRA and state water quality agencies (if separate), and NPDES, CWA Section 401 certification to be notified by the applicant. Then, SMCRA completeness/technical adequacy reviews can be initiated. If the COE review

concludes the application is not likely to comply with CWA Section 404(b)(1) Guidelines (particularly high-value aquatic sites not avoided; fills not minimized; other upland alternatives not considered; stream values mis-identified; mitigation inadequate to offset; etc.), the applicant is informed by the COE that the plans must be revised.

The COE would evaluate proposals to construct valley fills in waters of the U.S. as IPs using the CWA Section 404(b)(1) Guidelines [Chapter II.C.1.a.1.], secondary impact review [Chapter II.C.1.a.1], and cumulative impact review [Chapter II.C.7.a.1], public interest review [Chapter II.C.1.a.1.], and NEPA compliance review [described below and in Chapter II.C.7.a.]. The COE standard operating procedures specify that the amount of information needed to make such determinations and the level of scrutiny required by the Guidelines should be commensurate with the severity of the environmental impact. Under the COE procedures, the severity of impact is determined by the functions of the affected aquatic resource and the nature of the proposed activity and the scope/cost of the project. The Guidelines require that the COE consider potential alternatives (i.e., that accomplish the project purpose without affecting waters of the U.S.) that are practical to the applicant taking into consideration cost, technology, and logistics.

Alternative 1 includes a provision that would allow some MTM/VF proposals to be authorized as NWPs when the COE's IP process demonstrates that the proposal would result in adverse impacts that are no more than minimal, both individually and cumulatively. If the COE reaches the conclusion that the resulting individual and cumulative adverse aquatic impacts are clearly projected to be no more than minimal, the IP process could be halted and the project authorized under the NWP. Under Alternative 1, more proposals are expected to complete the IP decision-making process than now occur under the No Action Alternative.

When the SMCRA review of mine sequencing, backfilling and grading and hydrologic reclamation plans (e.g., stability, acid and toxic forming material handling, configuration, drainage control, hydrologic consequences, cumulative hydrologic impacts, access, etc.); post mining land use, bonding and revegetation proposals; and blasting, roads, sediment ponds, impoundments, and other support facilities are finalized, the COE could utilize this information to augment the NEPA compliance and public interest review. In addition to the COE ESA consultation with the FWS concerning aquatic resources, the SMCRA agency would coordinate with FWS on additional T&E concerns in upland areas.

Ultimately, the SMCRA regulatory authority would consult with the COE on each agencies' concurrent or separate review findings. The applicant would be notified of additional data and/or analysis needs or other shortcomings which must be addressed to satisfy NEPA, SMCRA, ESA, NHPA, CWA Sections 401/402/404, etc. The COE and states (or OSM in Tennessee) would continue to coordinate until the applicant provides all required components and the final permit decisions are made.

Regulatory Responsibilities

Under this alternative, the COE would continue to be responsible for evaluating and subsequently authorizing or denying CWA Section 404 permits for the placement of fills in waters of the U.S. The COE would conduct this evaluation initially under its IP process. As a result, most of the proposals for MTM/VF activities requiring fills in waters of the U.S. would be processed completely through the IP procedures, concluding with IP decisions. The few remaining MTM/VF proposals

not processed as IPs, as well as surface coal mining and reclamation operations other than MTM/VF, could be authorized under NWP 21. The initial evaluation and ultimate determination by the COE to authorize the proposal under NWP 21 or to proceed through the IP process to its conclusion would be based on case-by-case evaluations of the project's adverse impacts on the aquatic environment. The COE also would conduct additional review in the IP process to ensure the project is not contrary to the public interest.

In making its determination to authorize valley fills as IPs, the COE would solicit and address the concerns of EPA in accordance with 40 CFR 313.3, the state agency responsible for water quality certification in accordance with 33 CFR 325.2 (b)(1), and the FWS in accordance with 33 CFR 325.2 (b)(5). The COE would be responsible for requiring compensatory mitigation to offset the loss of aquatic functions of streams and other waters of the U.S. proposed to be filled by the project, as determined primarily by the COE's stream functional assessment protocol performed on the mine site and mitigation sites. The COE's decision to authorize an IP for valley fills requires compliance with NEPA and therefore an EA and FONSI, or an EIS, as appropriate. OSM is the SMCRA authority in Tennessee and, since SMCRA permitting of any MTM/VF proposal in that state is a Federal action, NEPA requirements would apply and would be coordinated with the COE.

If the COE determines that the project may be authorized by NWP and the applicant has provided the information in accordance with the Notification requirement (General Condition 13), the COE would proceed with pre-construction notification (PCN) procedure. This procedure details the needed agency coordination, consideration of comments, compensatory mitigation and the administrative record. The applicant may proceed under NWP 21 only after receiving written authorization from the COE. [67 FR 2081] The NWP process does not require any additional NEPA analysis and does not result in an EA or EIS.

The SMCRA agency would be responsible for reviewing and processing surface coal mining permit applications as specified in the approved Federal or state surface mining regulatory program. An applicant for a SMCRA-based surface coal mining operation permit involving valley fills in waters of the U.S. would need to address conditions imposed by the COE on the proposed mining operations. Particularly the COE, in its IP review, would determine the number, size and placement of valley fills in waters of the U.S. and the SMCRA agency would explicitly condition the SMCRA permits to require operators to meet COE requirements.

Coordination would occur with the FWS and state fish and wildlife agencies regarding Federally- or state-listed T&E species and their habitat in the aquatic environment. State SMCRA agencies would further consider potential upland impacts from the mining proposal on T&E species and habitat in coordination with the FWS based on procedures outlined in the FWS 1996 BO on SMCRA. Under all alternatives, the FWS is responsible for reviewing and providing timely comments and suggestions to the COE and the appropriate SMCRA agency regarding the protection of Federally-listed T&E species and their habitat.

EPA would be responsible for timely review and comment to the COE on applications for CWA Section 404 authorizations involving valley fills in water of the U.S. for both PCNs under NWP 21 and for public notices under the IP process. The EPA is also responsible for the triennial review and approval of all State water quality standards and has a role in the state's air quality standards. EPA is jointly responsible with the COE for designating geographically-specified waters of the U.S. as "generally unsuitable for filling" under the advanced identification (ADID) process. EPA oversight

authority, including CWA Section 404(c) and (q), is unchanged for Alternative 1. FWS retains CWA Section 404(q) elevation options as well as Section 7 consultation requirements under ESA.

State agencies are provided the opportunity to review CWA Section 404 permits to determine whether the proposed operations can receive a state CWA Section 401 water quality certification [see Chapter II.C.4.a.2 for a discussion of water quality standards]. The states can either issue, deny, or waive a CWA Section 401 certification. A CWA Section 404 permit cannot be issued without a CWA Section 401 certification from the applicable state agency or a certification waiver. The COE may issue a permit that is conditioned upon the applicant receiving a CWA Section 401 certification before fills are placed in waters of the U.S. An application, deemed complete and likely to comply with the Guidelines, results in the final EIS or EA/FONSI and IP from the COE. SMCRA, CWA Section 401 and 402 permits from the appropriate agencies can follow the COE IP decision. State permit approval would contain adequate bond and conditions on accomplishing successful reclamation, including mitigation.

ESA--The COE would take the lead consulting with the FWS on compliance with ESA for IPs. The COE solicits comments from the FWS in accordance with 33 CFR 325.2 (b)(5) on the proposed project to place valley fills in waters of the U.S., with the objective of assuring protection of T&E species and their habitat. The COE would ensure the applicant takes the appropriate steps under the CWA in the configuration of valley fill disposal sites to address concerns and suggestions from FWS.

Subsequently, during the processing of a SMCRA surface mining permit application, the SMCRA regulatory authority would solicit comments from the state fish and wildlife agencies and the FWS regarding the protection of state and Federally listed T&E species, and their critical habitat. The COE initial consultation should have addressed those T&E species that could have been potentially affected by the construction of the valley fill; this consultation would be broadened to those potential effects from the mining operation in general.

NEPA--To expedite review, an applicant could prepare a preliminary EA to accompany each IP application. After making a tentative agreement with the mining company regarding the configuration of the valley fills associated with the project, the COE would notify the SMCRA agency of this agreement and the SMCRA review process would proceed, so that those sections of the permit review related to the placement of fill materials in waters of the U.S. can be completed. Following the submittal of a surface coal mining operation permit application to the SMCRA agency, the applicant would furnish the COE a copy of the administratively complete SMCRA application, and the COE would continue its determination under NEPA as to whether a EIS, or an EA/FONSI would be prepared. The COE would rely on data in the CWA Section 404 IP application, draft EA, and the SMCRA surface mining permit application to make this NEPA determination. In Tennessee, OSM would continue to be responsible for NEPA compliance for the SMCRA permit.

b.2. Memorandum of Agreement (MOA) and Field Operating Procedure (FOP)

Using the procedures in this MOA, the COE would establish initial limits on whether, how many, and what size valley fills are placed in waters of the U.S. through the evaluation required under the IP review process. The MOA would prescribe a permit process and sequence of review when surface coal mining applicants intend to place valley fills in waters of U.S. To the extent possible,

in accordance with Federal and state statutes and regulations, the initial determination of valley fill limits by the COE would precede approval from OSM or the appropriate state SMCRA regulatory authority. The COE would be responsible for processing the CWA Section 404 IP application, ensuring compliance with the CWA Section 404(b)(1) Guidelines; soliciting and considering comments from the public and other interested parties, including FWS regarding T&E species, and State Historic Preservation Officers (SHPOs) and others regarding the cultural and historic properties; conducting the public interest review; and complying with NEPA by doing a project-specific environmental assessment and/or, if warranted, environmental impact statement. The COE would continue to be responsible for applying the COE stream functional assessment protocol to determine required levels of off-site compensatory mitigation and assuring that the mitigation project is implemented as agreed upon by inspection, enforcement, and performance guarantees.

Under the MOA, the SMCRA regulatory authority would continue to be responsible for reviewing and processing surface mine permit applications under the approved Federal or state surface mining regulatory program. The SMCRA regulatory authority would, to the extent possible during the administrative completeness review, recognize the initial limits on the size, number and location of valley fills as determined by the COE. The review and approval of a SMCRA permit application would be coordinated with the tentative approval of the CWA Section 404 permit by the COE in order to minimize the need for SMCRA plan revisions related to the placement of fill material in waters of the U.S. OSM would advise a SMCRA permit applicant to obtain tentative COE approval of a mining proposal with fill sizes, locations, and offsetting mitigation prior to SMCRA approval. An applicant's SMCRA application must propose surface coal mining and reclamation activities that comport with the valley fill configuration (size, number, and location) required under CWA Section 404 by the COE. The SMCRA agency would condition SMCRA permits on compliance with applicable requirements under CWA Section 404 by the COE.

The SMCRA regulatory authority would continue to solicit and address comments from the U.S. Fish and Wildlife Service and state fish and wildlife agencies regarding Federally- or state-listed endangered or threatened species and critical habitat. State SMCRA agency decisions generally do not require individual NEPA reviews; but where OSM is the SMCRA authority (as in Tennessee) an individual NEPA review is required. In Federal program states, the OSM Field Office Director must determine if an EIS or an EA/FONSI is appropriate.

The principal purpose of this action is to improve permit coordination, reduce the overall process time and handling of data submissions and reviews and to make this a concurrent process to the extent that is possible. The secondary purpose of this action is to ensure that agencies give adequate consideration to all other activities occurring in a watershed as they make their environmental decisions. This action would further define and coordinate steps in the various permitting actions. For example, the participants could coordinate the various different public comment times under SMCRA, the CWA Section 404 program, and the CWA 402 program.

A FOP could be developed to serve as the guidelines manual that implements the MOA and provides administrative and procedural details not explained in the MOA. For a discussion on the development of a FOP, see Action 1.2.

c. Alternative 2: (Preferred Alternative) The Size, Number, and Location of Valley Fills in Waters of the U.S. are Determined by a Coordinated Regulatory Process

This alternative integrates and coordinates regulatory programs under the SMCRA and CWA as much as practicable, while maintaining independent decision making authority among the agencies. The coordinated regulatory program could be facilitated partly through: 1) the regulatory enhancements described in the OSM rule making in Actions 3.2 and 7; and 2) an MOA discussed below. A joint permit application could be a product of this alternative. With a joint application, the two regulatory processes effectively provide coordinated CWA and SMCRA permit processes under a Memorandum of Agreement (MOA). While the MOA would address a number of policy, administrative, and regulatory aspects of the respective permit processes, all agencies would continue to implement their existing regulatory responsibilities pursuant to the CWA and SMCRA.

Alternative 2 would require coordination among the COE, EPA, OSM, FWS, and their state counterparts in considering MTM/VF proposals. The COE would make case-by-case evaluations of site-specific impacts to determine the appropriate CWA Section 404 review process, in accordance with any NWP 21 regional conditions. Any existing regional conditions, such as an interim 250-acre minimal impact threshold, would continue to be implemented under this alternative until revoked or replaced. These regional conditions are described in the No Action Alternative [Chapter II.C.1.a.1.]. The evaluation would be based on proposal-specific information sharing and early coordination of these agencies. Facilitated sequencing of agencies' permitting activities would be key to better-informed decision making.

Action 1.2: The COE, through an MOA establishing coordination with other agencies, would make a case-by-case determination of the applicability of NWP 21, subject to a regional condition in certain geographic areas that valley fills proposed in watersheds larger than 250-acres would generally require IP processing. Those projects that do not result in minimal impacts to the aquatic ecosystem, both individually and cumulatively considering mitigation, would require an IP authorization.

c.1. Process and Regulatory Responsibilities

Process

This action proposes a CWA and SMCRA permit coordination process which would be coordinated with rulemaking to enhance or clarify the SMCRA process and a formal MOA to coordinate permit data submissions and review. The objective of this action is minimizing agency duplication of effort, eliminating paperwork and other regulatory burdens on applicants, as well as improving environmental decisions by evaluating mutual interests in anticipated permit requests on a watershed basis. The MOA could emphasize agency participation on a regular basis in pre-application meetings with industry in order, to the extent practicable, minimize permit deficiencies during the formal application review process. Such an MOA could also set forth the coordinated permit process in general; explain each agency's responsibilities and authorities in the process; frame the decision making and dispute resolution procedures; and establish joint SMCRA/CWA Field Operating Procedure (FOP). Elements of the MOA are described further below.

Under this action, development of a joint permit application would be explored by the SMCRA regulatory authorities, OSM, and the COE to satisfy both SMCRA and CWA information collection and analysis required for considering authorization of projects. The completed joint application would be submitted to the SMCRA agency and COE pursuant to respective statutory authorities and

responsibilities set forth in the MOA. For example, information and data relating to engineering aspects of the proposal such as slope stability would be reviewed principally by the SMCRA agency. Information relevant to both SMCRA and CWA authorization, such as fill minimization and flooding analyses, would be jointly reviewed and evaluated. The joint application is discussed in more detail, below.

As part of this action, before an application for an MTM/VF operation is prepared, the agencies would hold pre-application meetings to discuss preliminary mining plans. These types of meetings provide important feedback to potential applicants from the regulatory agencies and provide a forum for current information and technology exchange. Consequently, permit deficiencies may be minimized during formal application review and more pertinent details may be provided in the public notice.

Upon receipt of an MTM/VF proposal application, the SMCRA regulatory authority and COE would conduct a preliminary evaluation of the project alternative analysis, projected aquatic impacts, and proposed mitigation. This coordinated review would support the COE determination whether the applicant has or has not demonstrated the ability to offset unavoidable impacts to waters to a level deemed less than minimal. As a regional condition for certain geographic areas, any proposal for valley fills in watersheds larger than 250 acres would be presumed to require processing as an IP, unless rebutted with data and analyses.

If the COE concludes from this preliminary review that the applicant's plan appears to cause less than minimal impacts to waters of the U.S., the SMCRA agency would then complete the SMCRA permit process. This SMCRA permit process would, to the extent allowed by the proposed rule-making, include fill minimization and alternative evaluations. These SMCRA evaluations would be similar to and consistent with requirements of the CWA 404(b)(1) Guidelines, and accomplished, in part, through the regulatory revisions included in this alternative under Actions 3.2 and 7. This SMCRA review would establish the size, number, and location of fills for consideration under NWP 21 eligibility. The COE would then decide whether or not to authorize the NWP 21 activity unless the state has been authorized under a programmatic general permit to approve MTM/VF activities.

If the COE concludes from this preliminary review that the applicant's plan appears to cause more than minimal impacts to waters of the U.S., then the COE would initiate the IP process, including appropriate NEPA compliance reviews, described below. The COE IP process would initially establish the size number and location of valley fills in waters of the U.S. and the CWA and SMCRA permit review sequence would mirror that described in Alternative 1 [Chapter II.C.1.b.].

In evaluating an IP application, the COE public interest review may consider other information, such as blasting, post-mining land use, and revegetation, required for a SMCRA permit application. For instance, if the COE receives comments about anticipated problems from blasting, the COE may rely on the SMCRA evaluation of blasting matters to address the public comment and satisfy the public interest review.

MTM/VF projects must obtain several other authorizations prior to implementation. The NPDES permit (CWA Section 402) and state water quality certification (CWA Section 401) are important parts of the process for assuring water resource protection. Other approvals, such as the MSHA or state mine safety permits, are also required before mining can commence. The sequencing of these

permits should be addressed in the MOA and FOP to optimize the use of available information, maximize agency coordination, and minimize duplication for the applicant.

Regulatory Responsibilities

The COE would retain its regulatory authority under the CWA in carrying out the day-to-day reviews and decisions relative to Section 404 of the CWA as described in Chapter II.c.1.a.1. It would still determine compliance with the Section 404(b)(1) Guidelines; decide the applicability of IP (as described in Alternative 1) as opposed to NWP 21 (as described in Alternative 3) for any given proposal; and ensure compliance with NEPA relative to Section 404. The decision on the type of CWA Section 404 permit process would also be guided by any existing regional conditions, such as might be imposed in certain geographic areas, where fills in watersheds greater than 250 acres would generally be processed as IPs. The COE would make these determinations in partial reliance on the SMCRA information provided by the applicant as part of the joint permit application and based upon the pre-application and JPP meetings.

EPA would continue to jointly administer the Section 404 regulatory program with the COE through EPA's CWA oversight authority, including its elevation options under Section 404(q) and its veto authority under CWA Section 404(c). Similarly, the FWS would retain its elevation options under CWA Section 404(q), as well as its consultation requirements under Section 7 of the ESA.

OSM would also retain its SMCRA authorities, including oversight of state agencies implementing SMCRA. In addition, as described in Actions 3 and 7, OSM would consider additional rule-making under this alternative concerning data collection, impact predictions, alternative analysis, avoidance, fill minimization, and mitigation. Information provided to OSM under such rulemaking could also be provided to the COE, for consideration in addressing impacts to aquatic resources under CWA Section 404(b)(1) Guidelines.

State fish and wildlife agencies as well as state agencies that implement CWA Section 401 and delegated programs such as SMCRA and CWA Section 402 would continue to implement their programs concerning the protection or enhancement of natural resources.

ESA--The COE would take the lead consulting with the FWS on compliance with ESA for IPs. The COE would solicit comments from the FWS on the proposed project to place valley fills in waters of the U.S., with the objective of assuring protection of threatened or endangered species and their critical habitat. Upon notification of an IP application FWS provides the COE with a listing of T&E species within the project area. Consultation would occur during the COE processing of the CWA Section 404 permit application and in accordance with 33 CFR 325.2 (b)(5). The COE would ensure the applicant considers the appropriate steps under the CWA Section 404 in the configuration of MTM/VF activities affecting waters of the U.S. to address concerns and suggestions from FWS.

The SMCRA regulatory authority would consider the impacts of the proposal on state and Federally listed threatened or endangered species, and their critical habitat. These considerations stem from the ESA, 30 CFR 780.16, the FWS 1996 BO on the SMCRA program, and state law. The state fish and wildlife agencies and the FWS would be provided notice regarding the project. Comments solicited from FWS or state agencies may result in project revisions to exclude T&E habitat or minimize incidental take and include species-specific protection plans. While the initial COE consultation considers those T&E species that could potentially be affected by MTM/VF activities

affecting waters of the U.S., the SMCRA consultation would be broadened to those potential effects from the entire mining operation to T&E species and critical habitat.

For those projects determined to qualify for CWA Section 404 NWP 21, the SMCRA agency would solicit comments from the state fish and wildlife agencies and FWS regarding T&E species and critical habitat for the entire project. The SMCRA agency's early coordination with FWS and state fish and wildlife agencies on NWP 21 projects may reduce the time required to conduct consultation with the COE on T&E species or their critical habitat affected by MTM/VF activities in waters of the U.S. However, under Section 7 of the ESA, if the FWS does not agree with decisions reached by the SMCRA process, consultation on the CWA 404 action by the COE remains an opportunity to resolve permit issues.

NEPA–If the COE determines that project impacts are more than minimal, then the IP process must be followed. NEPA compliance is required for IPs through either an EA/FONSI or an EIS. To expedite review, an applicant could prepare a preliminary EA to accompany each IP application. Following the submittal of a surface coal mining operation permit application to the SMCRA agency, the applicant would furnish the COE a copy of the administratively complete SMCRA application, and the COE would continue its determination under NEPA as to whether a EIS, or if an EA and FONSI would be needed. The COE could rely on data in the CWA Section 404 IP application, draft EA, and the SMCRA surface mining permit application to make this NEPA determination.

If the COE determines that the project may be authorized using NWP 21, no further NEPA analysis is required because NEPA compliance occurs upon issuance of the NWPs every five years [http://www.usace.army.mil/inet/functions/cw/cecwo/reg/nw2002dd/index.htm].

SMCRA provides that state SMCRA permitting actions do not constitute a major Federal action requiring NEPA compliance. However, OSM prepared an EIS upon publication of the permanent regulatory program in 1979 and prepares NEPA compliance documentation for any subsequent major revision of the regulations. OSM cannot delegate NEPA responsibilities to the COE where/when OSM is the regulatory authority and issues federal permits (federal action). Separate, but supporting NEPA documents must be prepared by OSM and the COE for MTM/VF projects proposals in states such as Tennessee.

c.2. Memorandum of Agreement (MOA) and Field Operating Procedure (FOP)

The creation of an MOA and supporting FOP would assist in harmonizing CWA and SMCRA alternatives and stream impact data requirements. Under this MOA, the COE and OSM or the appropriate state SMCRA agency could coordinate their review of proposals for MTM/VF to the maximum extent possible, while retaining their respective independent decision making authorities. The MOA could provide a framework for coordination from project conception through pre-application meeting, application processing, inspection, enforcement, and bond release. Although the details of an MOA would be developed following selection of this alternative and a record of decision, the following section illustrates the types of issues, procedures, roles, and coordination that could be outlined or incorporated to promote joint initiatives among the regulatory agencies responsible for MTM/VF permitting, inspection, and enforcement:

- Identify the agencies, positions, and personnel to contact relative to MTM/VF applications;
- Promote:
  - a coordinated permit process;
  - regular pre-application and Joint Permit Processing (JPP) meetings;
  - standardized data collection to address identified gaps;
  - further refinement and implementation of the COE stream assessment protocol in evaluating permit applications [as described in Actions 9 and 12];
  - development of permit application assessment and mitigation procedures based on these data;
  - utilization of and networking the expertise of the various agencies;
  - development of FOPs;
  - efficient application sequencing;
  - facilitation of the coordinated processing by a lead agency;
  - development of decision-making and dispute resolution procedures; and
  - creation of a joint application;
- Contain information on existing regulatory tools for environmental protection of high value aquatic or other resources. Information could include the CWA ADID process, designated special aquatic sites, and "Aquatic Resources of National Importance" (EPA/COE CWA Section 404(q) MOA, August 1992), as well as lands designated unsuitable for mining under SMCRA;
- Identify the role of the CWA Section 404(c) and (q) elevation process in the coordinated approach;
- Describe the type of site-specific information necessary to justify formal written requests to the COE requesting NWP applications be processed as IP; and
- Encourage interagency site visits to gather site-specific resource information on which to base impact predictions, allowing the agencies to make more informed decisions.

The MOA could be announced and explained with the preparation and dissemination of a public outreach brochure. This brochure would provide details of the coordinated permit process, explain how the public can provide comments on specific proposals and how these comments can be made more effective, and present in general the various options that could be taken to mitigate impacts from mining projects, including compensatory mitigation actions. Aquatic resource functional assessment procedures, along with the details of the coordinated permit process, would be disseminated to the regulated community and public as part of outreach. The brochure would also provide any status reports related to the implementation of the selected alternative in this EIS and would therefore be updated as needed.

The Joint SMCRA/CWA FOPs would serve as the guidelines manual that implement the MOA and provide administrative and procedural details not explained in the MOA. A model FOP could be developed to maintain the highest level of consistency possible. However, the FOP could be modified as necessary to account for any unique programmatic differences between states. FOPs could be implemented by one or more COE Districts in conjunction with appropriate Federal and state agencies.

The FOP could establish a protocol for facilitating the coordinated permit process and convening JPP meetings, which would be held principally in advance of the submission of permit applications,

and be convened as needed to consider one or more proposals. FOPs could describe the agreed-upon agency contacts and protocol for coordination of agencies' information gathering and sharing, permit sequencing, assessment, public notice, dispute resolution, or other permit, inspection, and enforcement procedures.

c.3. Joint Application

An improved permit coordination process could lead to the development of a joint application. This application could enhance the coordinated regulatory process by serving as the platform for evaluation of compliance with SMCRA and CWA Section 401, 402, and 404 programs. This joint permit application would allow an applicant, at one time and on one application form, to supply all the information and analysis necessary for a regulatory agency and/or the interested public to evaluate a proposed mine project.

The information submitted by the permit applicant would be distributed to the regulatory agencies according to their respective statutory authorities. For example, information and data relating to engineering aspects of the proposal such as slope stability, revegetation, blasting, roads, etc. would still be reviewed principally by the SMCRA agency. Information relevant to both SMCRA and CWA authorization, such as fill minimization, upland alternatives, mitigation, etc., would be collaboratively reviewed and evaluated.

A critical aspect of the CWA Section 401, 402, and 404 is to provide data and make impact predictions analyzing the effects of a proposed project on water quality. Similarly, a feature of the SMCRA permit requires baseline data and analysis of the hydrologic consequences of surface coal mining proposals. These data and predictions for MTM/VF are obvious candidates for assembly in a joint permit application. Data compiled from the joint application could be exported into the GIS database mentioned in Action 14 and used for SMCRA CHIAs, CWA Section 404 cumulative analyses, CWA Section 402 discharge permit analyses, and CWA Section 401 water quality certifications.

Other elements to consider for a joint permit application are requirements to provide narrative, data, and analytical information demonstrating the following:

- the least environmentally-damaging practicable alternative valley fill locations were considered;
- unavoidable impacts will be minimized by placing as little material as possible in valley fills;
- unavoidable impacts to the waters of the U.S. can be successfully offset by a comprehensive mitigation proposal; and
- an construction cost estimate for mitigation components establish requisite bond amounts.

Although a single permit application is envisioned through this action, each agency would continue to be responsible for ensuring that all statutory and regulatory responsibilities set forth in both the SMCRA and CWA regulatory programs are met. However, common data elements in a joint application suggest the efficiency of common analytical approaches. Mutual reliance on these analytical results could minimize conflicts between agencies relative to decisions on the same

proposal. The joint permit application and standardized data could provide a basis for one agency to substantiate and confidently utilize findings made by another agency.

d. Alternative 3: The Size, Number, and Location of Valley Fills in Waters of the U.S. are Determined by an Enhanced SMCRA Regulatory Program

Under this alternative, the SMCRA regulatory authority would be the lead reviewing and facilitating agency. This could be accomplished through regulatory enhancements as part of rule making described in Actions 3.3 and 7 and an MOA similar to that described in Action 1.2. With the current and any additional rule-making enhancements in place, the SMCRA regulatory authority would conduct the initial MTM/VF application review to consider whether activities proposed in waters of the U.S. are consistent with the stream characterization, avoidance, and minimization requirements of the CWA Section 404(b)(1) Guidelines.

As with Alternative 2, Alternative 3 would require interagency coordination, sequenced permitting, and could include development of a joint SMCRA/CWA application. However unlike Alternatives 1 and 2, this alternative includes a procedural presumption that MTM/VF proposals should generally begin processing for CWA Section 404 authorization under NWP 21. This approach is based on the ability of the COE to rely on: 1) the SMCRA review information; and 2) the adequacy of the applicant's proposed mitigation of unavoidable impacts. In limited circumstances where the initial SMCRA review provides information relevant to a determination whether unavoidable impacts to waters of the U.S. cannot be mitigated below minimal adverse effects, the SMCRA regulatory authority would provide that information to the COE and the COE will determine whether to initiate its IP process.

Action 1.3: The SMCRA regulatory authority, through an MOA establishing formal coordination with other agencies, would initially review proposed MTM/VF activities and provide to the COE a recommendation and supporting information on whether the activities might result in more than minimal impact to waters of the U.S.

d.1. Process, Regulatory Responsibility, and Coordination

Process

This action proposes that the SMCRA program would lead a coordinated review process for MTM/VF proposals. Like Action 1.2, this action would include an MOA outlining the role of each agency in the regulatory process. Building upon a number of SMCRA program improvements, this action would coordinate data submissions and review. To further advance this collaborative regulatory theme OSM would consider, to the extent authorized under SMCRA, adopting regulations concerning relevant CWA Section 404 data collection, impact prediction, and alternative analysis, including avoidance and minimization (see Actions 3.3 and 7). Any such information and analysis by the SMCRA agency regarding impacts on aquatic resources and the hydrologic balance would promote compliance with the CWA Section 404(b)(1) Guidelines. Similar to the concept described under Alternative 2, the overall MTM/VF regulatory process could become more consistent in Alternative 3 with the proposed coordinated permit application review process and a possible joint application.

OSM rules effectively require that state SMCRA programs be no less effective than Federal requirements. Therefore, subsequent to adoption of any OSM final rules, states would develop similar requirements or OSM would take appropriate action to assure the revised features of the SMCRA regulatory programs are applied to MTM/VF. These regulatory revisions would include increased aquatic resource baseline data as well as impact and alternative analyses to ensure that the location of MTM/VF fills would be based on the least environmentally-damaging practical alternative.

The SMCRA regulatory authority would conduct the initial review of the surface coal mining and reclamation operation application. Following this review, the COE would be notified of the aquatic impact review (size, number and location of fills). If the COE verifies that the results of the SMCRA review for the proposed coal mining, reclamation, and mitigation activities would likely result in less than minimal adverse effect (individually and cumulatively) to waters of the U.S., a NWP 21 authorization would follow. However, the IP process would be required when the COE considers the results of the SMCRA review and: 1) agrees with the SMCRA authority that the proposed project would result in more than minimal impacts to waters of the U.S or, 2) disagrees with the SMCRA authority that the proposed project would result in less than minimal impacts.

As in Alternative 2, should an IP be necessary, the COE would determine whether information supplied in the SMCRA application is sufficient to satisfy the alternatives analysis required by the CWA Section 404(b)(1) Guidelines and the public interest review. The COE would also decide whether an EA or EIS is required for NEPA compliance under CWA Section 404. Any additional information beyond that contained in the SMCRA application needed to satisfy CWA Section 404 requirements would be requested and processed by the COE.

The appropriate SMCRA regulatory authority would initiate the processing of the joint application under Alternative 3. This application could be jointly developed by OSM with each SMCRA program state and the COE (see discussion of joint application in Action1.2). Such an application would contain all the data necessary to allow informed decisions regarding the approval or denial of the SMCRA permit and the CWA Section 404 authorization. As in Alternative 2, a joint or enhanced permit application would serve to provide a mechanism through which an applicant could provide, in one application form, all the information and analysis necessary for a regulatory agency and/or the interested public to evaluate a proposed mine project. Although a single permit application is envisioned for this action, each agency would continue to be responsible for ensuring that all statutory and regulatory responsibilities set forth in both the SMCRA and CWA 404 regulatory programs are met.

Most states, through either the CWA Section 401 certification process and/or other state water quality statutes, require some form of compensatory mitigation. However, SMCRA authorities do not have the statutory basis to require off-site compensatory mitigation. Reclamation of a mine site as a component of mitigation is discussed in Chapter II.C.6.a.2. Under this alternative, the SMCRA agency would work closely with the COE during pre-application meetings and formal application reviews to determine the extent of compensatory mitigation needed to offset any adverse effects of MTM/VF to waters of the U.S. The COE would augment the SMCRA permit requirements with off-site mitigation in the absence of state authority to require sufficient off-site mitigation.

Regulatory Responsibilities

The regulatory responsibilities described in Actions 1.1 and 1.2 are common to all the alternatives. However, the lead agency for each responsibility under the action could vary under each alternative. For instance, under this Alternative and Alternative 2, state SMCRA authorities or OSM could require applicants to use the COE stream assessment protocol and evaluate the functional level of the waters of the U.S. that would be impacted. This contrasts with Alternative 1 in which the COE would require such an evaluation. In addition, Action 1.3 anticipates that the application could identify and address on- and off-site mitigation project opportunities. The SMCRA authorities could consider all relevant mitigation proposals when making requisite SMCRA findings regarding minimized impacts to the hydrologic balance, fish, wildlife, and related environmental resources. Any mitigation not within jurisdiction of the SMCRA regulatory agency would be addressed by the COE upon NWP 21 authorization. The SMCRA permit would be conditioned on compliance with the COE authorization, including any required mitigation.

This alternative would meet the purpose of the CWA Section 404 general permit process, while retaining the ability of the COE to take discretionary authority on any project and process it as an IP. When the COE re-authorized NWP 21 on January 15, 2002, changes were made to ensure proper focus of NWP 21 and to make certain adequate aquatic resource mitigation is required. The COE would retain its authority to require appropriate onsite and offsite compensatory mitigation to offset unavoidable impacts to aquatic resources. Due to this enhanced process, it is expected that the COE would only infrequently exert discretionary authority to require IPs, for which either an EA/FONSI or EIS is required. NEPA analysis by the COE or OSM in Federal program states is described in Action 1.1. and would not change for Action 1.3. The IP process and alternatives analysis are described in Alternative 1. For those circumstances when IPs are required under Alternative 3, the IP process described in Alternatives 1 and 2 would not differ from the IP process under Alternative 3.

As in Alternative 1, the COE would solicit and address EPA and state water quality agency concerns. This alternative is no different than the other alternatives in relying on state water quality certification (CWA Section 401). See Chapter II.C.4.a.2. for a discussion of water quality certifications. EPA oversight authority, including CWA Section 404(c) and (q), is unchanged for Alternative 3. FWS retains CWA Section 404(q) elevation options as well as Section7 consultation requirements under ESA (described in Action 1.2).

As discussed in the No Action Alternative, states could assume the responsibility for all or part of CWA Section 404 authority (Chapter II.C.1.a.2). Identical to Alternative 2, it is not critical under Alternative 3 that a state seek an SPGP or full CWA Section 404 assumption, inasmuch as the COE retains discretion to process and issue CWA Section 404 permits in the absence of state involvement. States could consider adopting laws requiring mitigation and other provisions consistent with the CWA Section 404 program. The COE requirements for mitigation are detailed in Chapter II.C.6.a.1. This could allow state agencies under an SPGP to specify the extent of onsite and offsite mitigation satisfactory to the Federal program. This could establish the programs that would allow them to apply and be issued an SPGP under the COE CWA Section 404 regulatory program. Once issued, SPGPs allow a state to authorize fills into waters of the U.S. within the conditions and limitations imposed by the SPGP. These SPGPs could minimize duplication of CWA Section 404 regulatory control, yet retain the protection measures for the aquatic environment under CWA Section 404.

d.2. Memorandum of Agreement (MOA) and Field Operating Procedure (FOP)

An MOA and FOP between the COE and appropriate SMCRA regulatory authorities would establish lead and coordination role and implementation procedures so that SMCRA application reviews provide information and aquatic impacts analyses to facilitate subsequent CWA Section 404 program decisions. As in Action 1.2, the MOA and FOP could describe responsibilities and details for matters such as permit application review, CWA Section 404(b)(1) Guidelines alternatives analysis, compensatory mitigation, permit sequencing, issue resolution, and possible development of a joint permit application.

The principal purpose of the MOA and FOP is to improve consistency and permit coordination, reduce the overall process time and handling of data submissions and reviews, and to the extent possible, make this a concurrent process. A FOP would further define and coordinate steps in the various permitting actions. For example, the participants could coordinate the different public comment times under SMCRA, and the CWA Sections 401, 402 and 404 programs.

2. Government Efficiency, Sub-issue: Consistent/Compatible Definitions for Stream Characteristics and Analyses

Both the CWA and SMCRA programs regulate impacts to streams. The programs contain defined stream-related terms and methods or protocols for identifying and delineating stream types and characteristics. The programs employ certain analyses and protections based, in part, on the type and character of a stream or stream segment. Within the study area, headwater stream segments are generally represented by three types of flow characteristics--ephemeral, intermittent, and perennial. Characterizations of streams based on water quality range from “impaired” to “outstanding natural resource waters” with various categorizations in between. In some cases, similar or identical terms are defined somewhat differently by the individual regulatory programs. Methods or protocols for identifying or delineating the same or similar stream types and characteristics may also vary by program.

The CWA, SMCRA, and selected state stream definitions, protocols, and monitoring requirements were considered in the development of this EIS. Discussions of these program features can be found in Chapters II.C.3. [Direct Stream Loss], II.C.4. [Stream Impairment], II.C.6. [Stream Habitat and Aquatic Function] and II.C.7 [Cumulative Impacts]. The various regulatory programs each have their own approaches to considering headwater streams, aquatic resources and related functions. Activities in headwater streams are regulated utilizing stream delineation, assessment, monitoring, classification, description, determining baseline, and other approaches. These approaches often differ from agency to agency, in part due to the respective regulatory focus and responsibilities of each agency. Use of these approaches sometimes yield compatible information and regulations; however, other times the product of a particular approach is only useful to the agency specifying the approach. Such inconsistent approaches may lead to confusion, uncertainty, and duplication of effort for all involved with regulation of headwater streams.

The fact that each program typically requires a field visit and stream reconnaissance illustrates the potential for duplication of effort by the regulatory agencies, applicants, and stakeholders. An example of this potential for inconsistency is the determination as to the jurisdictional extent of the headwater streams to be analyzed and protected. Stream delineation is central to the COE CWA Section 404 consideration of impacts to waters of the U.S. As discussed throughout this EIS, when a valley fill is proposed in “waters of the U.S.,” the COE conducts a site visit to identify where a

headwater stream begins. The COE site visit allows a determination of the extent of waters of the U.S. based on location of a "defined bed and bank," or "ordinary high water mark." The COE also examines quality of the aquatic resources to be impacted.

Dissimilarly, SMCRA requires an analysis of mining within 100 feet of an intermittent or perennial stream to determine whether the proposed mining would have an adverse effect on specified environmental resources. Under SMCRA, an intermittent stream is a stream or reach of stream that is below the local water table for at least some part of the year, and it obtains flow from both surface runoff and groundwater discharge. A perennial stream flows year-round. In order for the SMCRA regulatory authority to analyze the mining, stream delineation procedures relying upon field data and observations are utilized. Obviously, identification of the intermittent and perennial characteristics of streams for SMCRA purposes does not delineate waters of the U.S. for the COE.

Another example of a source of uncertainty is the lack of a single definition for the term "water table." Both the CWA and SMCRA refer to the term "water table" when defining ephemeral and intermittent streams. However, each regulatory authority makes its own independent determination of where the water table is for every headwater stream.

Stream definitions used by regulatory programs to analyze a proposed project are key to making findings that project impacts do not exceed a particular program threshold. In considering the impacts of a proposed project in a headwater stream, the SMCRA program considers whether there will be an "adverse effect" on certain environmental resources. The CWA program considers whether the impacts associated with the project will be "more than minimal," but result in "less than significant degradation" to waters of the U.S. "Adverse effect" and "significant degradation" appear to be substantially similar thresholds. During the protracted, independent reviews of MTM/VF proposals, uncertainty and confusion can occur because of nuances inherent to the various regulatory programs. Moreover, since separate agencies apply the thresholds in different contexts, there is potential for agencies to reach distinctly different conclusions regarding a proposed project. Because the reviews necessitate significant time and resources to complete, conflicting results are not a desirable outcome. Applying definitions of other terms, such as "material damage," "impairment," and "cumulative impacts," could further contribute to delay and duplication in the review of MTM/VF project applications.

a. No Action Alternative: The Regulatory Program Today

Stream segment and other stream characteristic definitions (e.g. ephemeral, intermittent, perennial, defined bed and bank, ordinary high water mark, jurisdictional waters) vary among Federal agencies, from state to state, and within states. This variability is illustrated in a tabular listing of terms at the end of Appendix B. CWA and SMCRA stream definitions, along with protocols and monitoring requirements, were considered in the EIS and related discussions can be found in Chapters II.C.3., II.C.4., II.C.6. and II.C.7.

Some factors regulatory authorities use to apply the terms ephemeral, intermittent or perennial are:

- the persistence of stream flow
- a combination of the flow and the location of the local water table relative to the stream channel
- watershed size surrogate

- channel form
- biological parameters.

These differing ways to delineate stream segments sometimes create an inconsistent regulatory framework among the various states and confusion among the regulated and regulators. In addition the alternate methods may cause incompatible results which must be reconciled by the various regulatory authorities. This reconciliation of the findings by the various agencies is done on an ad hoc basis.

During preparation of this EIS, field studies were undertaken to identify an areal or biological surrogate for case-by-case delineations of stream segments. Stream surveys were conducted to correlate specific macroinvertebrate types with stream segment flow characteristics. Macroinvertebrates were collected at regular intervals downstream of a point where flow began in 37 head water streams in West Virginia. The presence of certain macroinvertebrates requiring water for a particular term of aquatic life stage were evaluated to see if statistical correlation would afford a basis for classification of a stream segment or watershed size as ephemeral, intermittent, or perennial. However, these efforts failed to produce an adequate sample population or suitable correlation for a rational, reliable, or acceptable substitute for case-by-case determinations that could satisfy various regulatory programs.

a.1. CWA Section 404

The extent of the CWA jurisdiction is defined by *waters of the U.S.* [33 CFR 329.4 (c); 40 CFR 232.2]. The COE regulations, unlike EPA regulations, contain a definition of *ordinary high water mark*, established by the fluctuations in water and indicated by physical characteristics such as shelving, destruction of terrestrial vegetation, or a defined bed and bank [33 CFR 328.3(e)].

Ephemeral, intermittent, and perennial streams are defined in the NWPs issued by the COE in January 2002 [67 FR 2094-2095]. These definitions are based on the absence or presence of a groundwater component for providing stream base flow. The type of stream in which a fill may be located is important because, for some NWPs, there is a 300-foot limitation on fills in perennial streams, a 300-foot limitation on intermittent streams (although a waiver may be obtained) and no current limit on the length of ephemeral stream which may be filled. There is no preferred methodology for determining the presence of groundwater, and the COE districts have used experience and best professional judgment in these determinations.

a.2. SMCRA

Ephemeral, intermittent, and perennial streams are defined in 30 CFR 701.5. A distinction between the three classifications is the flow. A perennial stream “flows continuously,” a intermittent stream “obtains its flow from both surface runoff and groundwater discharge,” and a ephemeral stream “flows only in response” to precipitation of melting snow or ice. The SMCRA stream buffer zone rule applies to two of these types of stream segments. The rule requires an analysis of mining within 100 feet of an intermittent or perennial stream to determine whether the proposed mining would have an adverse effect on specified environmental resources. SMCRA regulatory authorities stream definitions for ephemeral, intermittent, and perennial have been deemed as effective as the SMCRA rules. There is no OSM preferred field methodology for determining the type of stream segment and the practices vary from state to state. For instance, in West Virginia, the point where the stream

segment changes from ephemeral to intermittent is located by a fie) contributing to a watershed tributary.

a.3. Other Regulatory Programs

Other CWA regulatory programs require the application of definitions, assessments, protocols, etc. in the evaluation of activities likely to impact the resources associated with headwater streams. These programs include CWA Section 402, including NPDES, TMDL, antidegradation and state water quality certifications (CWA Section 401). The programs generally require the collection of stream information, but lack avenues to provide for the exchange and interchange of the base characterizations.

b. Alternatives 1,2 and 3

Action 2: The Federal and/or state agencies would develop guidance, policies, or institute rule-making for consistent definitions of stream characteristics, as well as field methods for delineating those characteristics.

Federal and state regulatory authorities would work with industry and environmental stakeholders and academia scientists to establish science-based methods for definition and delineation of stream characteristics (such as ephemeral, intermittent, and perennial stream segments) found in 30 CFR 701.5 and other stream-related definitions (e.g., waters of the U.S., navigable, wet weather streams, etc.) used in the CWA and implementing regulations. Those stream characteristics with particular significance in the regulatory programs could be addressed through rule-making to establish common definitions in the appropriate CFR for SMCRA and CWA. The Federal and state regulatory authorities would jointly prepare technical guidance on when and how to properly identify stream characteristics in the field. The field procedures for delineating stream characteristics could be a part of the FOP, described in II.C.1.

For Alternative 1, COE will facilitate this undertaking. For Alternative 2, EPA will facilitate this undertaking. For Alternative 3 OSM will facilitate this undertaking.

3. Direct Stream Loss

The importance of headwater streams to the ecological setting in the landscape was documented and evaluated for this EIS [Chapter III.C: Appalachian Aquatic Systems and Appendix D: Headwater Stream Symposium]. Technical studies were conducted on the scope of the direct impacts to streams from mountaintop mining and valley fills [Appendix I: Cumulative Impact Study and Chapter III.K: Fill Inventory]. Eight potential impact factors are identified and discussed in Chapter III.D.1. The factors attributable to direct stream loss discussed below are the following: loss of linear stream length; loss of biota under fill footprint or from mined stream areas; and loss of upstream energy from buried stream reaches. These direct impacts may result in stream impairment downstream. Those factors, discussed in Section 4, are the following: changes in downstream thermal regime; changes in downstream flow regime; changes in downstream chemistry; changes in downstream sedimentation; and effects to downstream biota.

Streams may be directly impacted by mountaintop mining principally by mining through the stream, constructing valley fills on top of streams, and locating support activities (haulage roads and

sedimentation control structures) within the stream. All of these activities will, at least temporarily, eliminate stream biota and the ability of these organisms to synthesize organic material to provide life supporting organic energy for down stream reaches. Approximately 1200 miles of continually or intermittently flowing streams (or 2 percent of the 59,000 miles of streams in the study area) have been directly impacted by all surface mining activities in the last ten years. About 724 miles of stream, which is about 1.2 percent of the streams in the study area, were covered by valley fills from 1985 to 2001. [Chapter III.K.2].

Scientific information outside of the EIS study area indicates that headwater streams contribute energy and nutrients to the downstream aquatic ecosystem. Studies indicate that elimination of macroinvertebrates in headwater streams causes a temporary reduction in energy and nutrients downstream. Macroinvertebrate recovery appears to be facilitated provided sufficient food sources and aquatic habitat are available. Some researchers hypothesize that tree removal during mining reduces macroinvertebrate food sources and, combined with the loss of biota in the mined and filled area, may reduce contributions of coarse and fine organic particulate matter to the aquatic systems downstream. The extent to which valley fills reduce energy (organic carbon) resources that may be used by downstream aquatic communities is not well known. There were no studies conducted within the EIS study area to measure organic carbon because of the significant cost and the absence of widely-accepted, standardized monitoring and testing procedures.

One of the principal goals of this EIS is to explore ways to minimize the adverse impacts on streams from mountaintop mining/valley fill construction. This section focuses on the existing regulatory controls and alternatives to these controls that have a bearing on the direct loss of streams as the result of valley fill construction and various options available to minimize these losses.

a. No Action Alternative: The Regulatory Program Today

Both SMCRA and CWA place a high value on stream protection but both of these programs recognize that incursions and disturbances of streams may be unavoidable. The purpose of the CWA is to protect and restore the chemical, physical, and biological integrity of the nation's waters. Section 404 of the CWA regulates the placement of fills in those waters, which limits the direct loss of streams through the permitting process.

The CWA Section 404(b)(1) Guidelines are the criteria used to evaluate proposals for actions that may result in direct stream loss [40 CFR 230.10]. These criteria address alternatives that avoid direct stream loss; maintain water quality; prevent significant degradation; and minimize and mitigate impacts to the aquatic environment. These criteria serve to mitigate unavoidable stream loss from fills and meet the purpose of the CWA.

The purpose of SMCRA is to balance environmental protection during surface coal mining operations with the nation's need for energy. SMCRA cannot supercede the CWA with respect to controls of fill placement in waters of the U.S. Further, CWA Section 515(b)(10) requires minimization of adverse impacts to the hydrologic balance within the permit area and prevention of material damage to the hydrologic balance offsite. This performance standard for protection of the hydrologic balance includes streams and is consonant to the purposes of the CWA.

a.1. CWA Section 404

The CWA governs the "discharge" of "pollutants" into "navigable waters," which are defined as "waters of the United States." Specifically, Section 301 of the CWA generally prohibits the discharge of pollutants into waters of the U.S., except in accordance with the requirements of one of the two permitting programs established under the CWA; Section 404, which regulates the discharge of dredged or fill material; or Section 402, which regulates all other pollutants under the National Pollutant Discharge Elimination System (NPDES) program. CWA Section 404 is primarily administered by the COE, or states/Tribes that have assumed the program pursuant to CWA Section 404 (g), with input and oversight by EPA. In contrast, CWA Section402 and the remainder of the CWA are administered by EPA or approved states or Tribes. The CWA defines the term "pollutant" to include materials such as rock, sand, and cellar dirt that often serve as "fill material." The CWA, however, does not define the terms "fill material" and "discharge of fill material," leaving it to the agencies to adopt definitions consistent with the statutory framework of the CWA.

Interpretation of the CWA Section 404 by EPA, COE, and other stakeholders has historically varied. Prior to 1977, both the COE and EPA had defined "fill material" as "any pollutant used to create fill in the traditional sense of replacing an aquatic area with dry land or of changing the bottom elevation of a water body for any purpose. . ." [40 FR 31325 (July 25, 1975); 40 FR 41291 (September 5, 1975)]. In 1977, the COE amended its definition of "fill material" to add a "primary purpose test," and specifically excluded from that definition, material that was discharged primarily to dispose of waste. [42 FR 37130, July 19, 1977.] This change was adopted by the COE because it recognized that some discharges of solid waste materials technically fit the definition of fill material; however, the COE believed that such waste materials should not be subject to regulation under the CWA Section 404 program. Specifically, the COE definition of "fill material" adopted in 1977 reads as follows:

> "(e) The term 'fill material' means any material used *for the primary purpose* of replacing an aquatic area with dry land or of changing the bottom elevation of an [sic] water body. The term does not include any pollutant discharged into the water primarily to dispose of waste, *as that activity is regulated under Section 402 of the Clean Water Act*." [33 CFR 323.2(e) (2001)(emphasis added).]

EPA did not amend its regulations to adopt a "primary purpose test" similar to that used by the COE. Instead, the EPA regulations at 40 CFR 232.2 defined "fill material" as "any 'pollutant' which replaces portions of the 'waters of the United States' with dry land or which changes the bottom elevation of a water body *for any purpose"* (emphasis added). The EPA definition focused on the effect of the material (an effects-based test), rather than the purpose of the discharge in determining whether it would be regulated by CWA Section 404 or CWA Section 402. Unlike the definition of "fill material," the EPA and COE existing regulations defining the term "discharge of fill material" were substantively identical.

While in practice some COE Districts and EPA Regions have developed regionally consistent approaches for determining whether proposed activities would result in a discharge of fill material, national uniformity would ensure better environmental results. Moreover, two judicial decisions, Resource Investments Incorporated v. U.S. Army Corps of Engineers, 151 F. 3d 1162 [9th Cir. 1998] ("*RII*") and Bragg v. Robertson, [Civil Action No. 2:98–636, S.D. W. Va.], vacated on other grounds, 248 F. 3d 275 [4th Cir. 2001] ("*Bragg*"), indicate that the differing EPA and COE definitions can result in judicial decisions that further confuse the regulatory context. In April 2000,

the COE and EPA proposed a rule, finalized in May, 2002, to promote clearer understanding and application of the CWA regulatory program [65 FR 21294 – 95 and 67 FR 31129-43, respectively].

The COE and EPA final rule reconciled the CWA Section 404 regulations defining the term "fill material" and amended the definitions of "discharge of fill material." The final rule defines "fill material" in both the COE and EPA regulations as material placed in waters of the U.S. where the material has the effect of either replacing any portion of a water of the U.S. with dry land or changing the bottom elevation of any portion of a water. The final rule amends the "discharge of fill material" to include the following: 1) "placement of fill material for construction or maintenance of liners, berms, and other infrastructure associated with solid waste landfills; and 2) placement of coal mining overburden." The final rule clarified the CWA Section 404 regulatory framework consistent with existing regulatory practice. Direct stream loss as a result of valley fills requires authorization under CWA Section 404 by the COE.

The COE uses the CWA Section 404(b)(1) Guidelines in evaluating proposals to convert waters of the U.S. to dry land [Chapter II.C.1.a.1.]. Applicants are required to demonstrate they have considered upland alternatives that would avoid streams; that if avoidance is not possible, fills have been minimized to the extent practicable; that the proposal would not result in significant degradation to waters of the U.S.; and that proposed unavoidable impacts to waters can be offset by appropriate mitigation to compensate for the aquatic ecosystem functions lost in conversion. If fills in waters of the U.S. result in no more than minimal impact, individually and cumulatively, including compensatory mitigation, authorization can be by a NWP, which is an expedited review process. If the fills have more than minimal impact, the proposals undergo a more detailed review under the IP review process. Although both permit processes require compensatory mitigation for direct stream loss, the combination of an expedited review and the cost of compensatory mitigation result in projects designed with less stream loss. As a result, there is an incentive for applicants to propose projects that would be eligible for NWPs. The process the COE uses to determine minimal impacts is discussed Chapter II.C.1.a.1.

The Special Aquatic Site provisions of the CWA Section 404(b)(1) Guidelines [40 CFR 230.10] can also protect against stream loss. These sites are geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. These areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of the region. Special Aquatic Sites currently include wetlands, mud flats, vegetated shallows, coral reefs, and riffle and pool complexes. Headwater streams in the Appalachian Highlands often exhibit riffle and pool complexes and other aquatic habitats that are categorized as Special Aquatic Sites. These sites may warrant comprehensive functional assessments of the stream environment and more rigorous alternatives analyses as part of the permit application process; and the COE may rely on the results of these evaluations to deny valley fill permit applications or employ them to develop measures to minimize adverse environmental effects of those permits issued.

For fills to be authorized in special aquatic sites, the applicant must demonstrate that the project is water dependent or rebut the presumption that there are practical upland alternatives. Valley fills are not "water dependent." Consequently, if a valley fill is proposed in a special aquatic site, upland alternatives with less adverse impacts on the aquatic ecosystem are presumed to exist unless clearly demonstrated otherwise by the applicant.

The COE and EPA also have the ability in a process referred to as an Advanced Identification of Disposal Sites (ADID) to identify special aquatic areas generally unsuitable for fill. The process is identified under Subpart I of the CWA Section 404(b)(1) Guidelines (Planning to Shorten Permit Processing Time). The ADID process, although never having historically been used in association with valley fills from mountaintop mine sites, is a tool to inform potential applicants about the relative ease or difficulty they can expect in applying for a permit to fill within the designated waters, and consequently serves as an incentive to design projects in such a way as to avoid and minimize impacts to those waters.

a.2. SMCRA

Several SMCRA statutory provisions and complementary regulations prevent or minimize direct stream loss. With a few exceptions, SMCRA requires that all surface coal mining and reclamation operations return overburden, spoil, and waste material to the mined area to reconstruct the approximate original contour. Only when the operator demonstrates that, due to the expansion of volume of overburden, spoil, and waste the material removed from the mining sites is more than sufficient to reconstruct the approximate original contour, can this excess spoil material be placed outside the mined area. This excess material must be shaped and graded to prevent slides, erosion, and water pollution [30 U.S.C. 1265 (b)(3)]. By minimizing the volume of excess spoil material, the potential for direct stream loss is also minimized.

SMCRA also requires that disturbances to prevailing hydrologic balance be minimized at the mine-site and off-site areas [30 U.S.C. 1260 and 1265(b)(10)]. The complementary Federal regulations at 30 CFR 816.41 further require that surface mining and reclamation activities prevent material damage outside of the permit area [30 CFR 816.41].

In addition, SMCRA requires that surface coal mining and reclamation operations use the best technology currently available to minimize disturbances and adverse impacts on fish, wildlife and related environmental values, and enhance such resources where practicable. [paraphrase of 30 U.S.C. 1265(b)(24)]. The complementary Federal regulations at 30 CFR 816.97(f) requires that operators conducting surface mining activities avoid disturbances to, enhance where practicable, restore, and replace wetlands and riparian zones along rivers and streams. These regulations additionally require that surface mining activities avoid disturbances to, enhance where practicable, or restore habitats of unusually high value for fish and wildlife.

Another SMCRA provision which may protect against stream loss is the stream buffer zone (SBZ) rule at 30 CFR 816.57. The SBZ rule stems from SMCRA Section 515(b)(10) related to minimization of the adverse impacts to the prevailing hydrologic balance, and SMCRA Section 515(b)(24) relating to minimization of adverse impacts on fish, wildlife, and related environmental resources. For protection of the hydrologic balance, the primary focus of the SBZ rule is on preventing addition contributions of suspended solids to stream flow outside of the permit area. Both SMCRA Sections 515(b)(10)(B)(i) and (24) require the use of best technology currently available (BTCA). The principal purpose of the SBZ rule is to implement BTCA to minimize impacts to the hydrologic balance, fish, wildlife, and related environmental resources. The SBZ rule limits incursions into areas around streams with exceptions as determined by the SMCRA regulatory authority. The SBZ rule states:

> (a) No land within 100 feet of a perennial or intermittent stream shall be disturbed by surface mining activities, unless the regulatory authority specifically authorizes surface mining activities closer to, or through, such a stream. The SMCRA regulatory authority may allow such activities only upon finding that–
>
> > (1) Surface mining activities will not cause or contribute to a violation of applicable State or Federal water quality standards, and will not adversely affect the water quantity and quality or other environmental resources of the stream;
> >
> > (2) if there will be a temporary or permanent stream-channel diversion, it will comply with specific requirements applicable to the construction of diversions.
>
> * * *

The principal purposes of the stream buffer zone regulation are the following: (1) to maintain vegetated buffers around intermittent and perennial streams to minimize the contribution of sediment to the streams outside of the permit area, and (2) to minimize gross disturbances to the prevailing hydrologic balance, fish and other biologically important plants and animals that may live in the streams or riparian zones adjacent to the streams. However, the regulation also recognizes that unavoidable incursions into the buffer zone may be necessary and the regulations establish standards for allowing these incursions.

Historically, OSM has not viewed, applied, or enforced the buffer zone regulation to prohibit mining activities within the buffer zone if those activities would have less than a significant effect on the overall chemistry and biology of streams, i.e., the overall watershed or stream below the activity. Therefore, excess spoil fill construction within the buffer zone has been allowed if a demonstration of no significant effect on downstream water quality was made by the permit applicant to the satisfaction of the SMCRA regulatory authority. This interpretation resulted because to interpret the SBZ rule as an absolute prohibition for constructing valley fills in streams would counter other statutory provisions. SMCRA recognized the necessity of excess spoil fills in SMCRA Section 515(b)(22), and the only available location for excess spoil placement in steep slope mining is in valleys adjacent to the mining area. These valleys may contain headwater streams.

Further, in the Final EIS 1: Supplement (1983) in the analysis of the impacts of the current SBZ rule, OSM recognized that some small headwater streams in Appalachia would be disturbed by mining and not restored. This supplement assumed that intermittent streams draining less than 640 acres would not be protected by the SBZ rule, even though those streams could harbor a viable biological community or serve as fish spawning area. [USDOI OSM, January 1983, p. IV-37.]

OSM is currently preparing a draft proposed rule that would amend the rules at 30 CFR 816.57 and 817.57 to clarify the SBZ requirements. These amended rules would more closely align with the principal statutory basis for the rule [30 U.S.C. 1265(b)(10) and (b)(24)]. Exemptions to the SBZ requirements would only be granted upon a demonstration by the coal operator, to the satisfaction of the SMCRA regulatory authority, that encroachment into the SBZ is necessary and that disturbances to the prevailing hydrologic balance at the mine-site and in associated offsite areas have been minimized. The operator would use the BTCA to minimize adverse impacts to fish, wildlife, and other environmental values, and to prevent, to the extent possible, additional contributions of suspended solids to stream flow or runoff outside of the permit area. As a complementary rule

change, the excess spoil regulations would be amended to ensure that the volume of excess spoil is minimized and that excess spoil fills are constructed in a manner and location to cause the least environmental harm after consideration of alternative designs and locations [Chapter II.C.5.b., Action 7].

SMCRA also contains provisions to designate lands unsuitable for mining. If sufficient information is provided in a petition to the SMCRA regulatory authority to demonstrate that reclamation required by SMCRA is not technologically or economically feasible, areas containing particularly sensitive aquatic sites may be deemed off limits for surface coal mining operations. SMCRA also provides for temporary or permanent diversion of streams prior to surface coal mining affecting stream segments [30 CFR 816.46]. Permanent stream diversions require restoration of aquatic and riparian features to offset mining impacts. These provisions of the SMCRA program may directly or indirectly provide restrictions to stream loss from valley fills.

b. Alternative 1

Action 3.1: OSM would continue existing SBZ rule-making and consider additional rule-making specifically exempting excess spoil disposal from the stream buffer zone rule [30 CFR 816.57], but adding a requirement that all other applicable environmental permits, such as a CWA Section 404 permit, be secured prior to the placement of fills in waters of the U.S.

This action would not affect the current OSM rule-making to clarify the SBZ rule as described under the No Action Alternative [Chapter II.C.3.a]. Under this action, OSM would consider further amendments to the SBZ rules to specifically exempt excess spoil disposal from SBZ requirements. In light of this exemption, the SMCRA agency would rely more on the expertise of the CWA Section 404 agency to determine whether excess spoil fills are allowed to be placed in jurisdictional waters; and their location, size, and number. Further, more emphasis would be placed on SMCRA permit conditions requiring the applicant to secure all necessary permits, including all applicable CWA permits, prior to the placement of fills in waters of U.S. Other SMCRA standards for protection of the hydrologic balance, as well as fish, wildlife, and related environmental resources would continue to apply to excess spoil fills. To be consistent with this potential change in the Federal program, analogous provisions from state regulatory programs could also be the subject of rule-making.

c. Alternative 2 and 3

Action 3.2 and 3.3: OSM would continue with current rule-making to amend the stream buffer zone rule and would consider additional rule-making in the future to increase consistency with the CWA Section 404 program, if appropriate, and to the extent authorized by SMCRA.

The No Action Alternative discusses ongoing rule-making to amend and clarify the SBZ rule. This action could also include later OSM consideration of additional amendment to the SBZ rule to increase consistency with the CWA Section 404 program, if appropriate and supported by SMCRA. Rule-making considerations could occur in concert with or following the collaborative efforts described under Alternatives 2 and 3. For instance, OSM could further clarify or expand regulatory requirements related to incursions in the SBZ, if the development of a joint application, MOA, FOP, and JPP identify warranted changes authorized by SMCRA provisions and compatible with objectives in the CWA Section 404 program.

d. Alternative 1 and 2

<u>Actions 4.1 and 4.2</u>: Designate Areas Generally Unsuitable for Disposal Referred to as Advanced Identification of Disposal Areas (ADID).

The ADID [40 CFR 230.80] is an area-wide planning process that provides the public and potential permit applicants with information on the functions and values of streams and other waters, creates greater regulatory predictability by providing an indication of factors to be considered in permit reviews, and assists other local planning efforts. Approximately 65 identification and special area management plans based on such advance identifications have been implemented nationwide. Because ADID efforts are usually based on watershed planning, they are extremely compatible with geographic and ecosystem initiatives such as EPA's Watershed Protection Approach.

The basis for designating areas generally unsuitable for disposal is the likelihood that use of the area in question for dredged or fill material disposal would not comply with the CWA Section 404(b)(1) Guidelines. However, this “advance identification” of areas generally unsuitable for fill is not a veto or advance denial; in fact, the regulations state "[t]he identification of areas that generally would not be available for disposal site specification should not be deemed as prohibiting applications for permits to discharge dredged or fill material in such areas." Applicants are not prohibited from applying for a permit for activities within an ADID, and the COE is not prevented from issuing a permit where the CWA Section 404(b)(1) Guidelines can be met and no practicable alternative exists.

The ADID process was developed to identify particularly sensitive or high value aquatic resources. The ADID regulations have historically been used only for specific geographic locations and not applied to a general class of particular stream segments or water resources. The ADID designation only occurs following exhaustive site-specific data collection and analysis, thorough public participation, and, often, contentious legal challenges. The ADID designation highlights areas where projects would receive more stringent scrutiny before any authorizations might be possible. Although not traditionally used in this fashion, the COE and EPA agree that the ADID process is available to designate particularly significant stream segments based on special aquatic conditions. Alternatives 1 and 2 provide this as an advisory action. Selection of Alternative 3 would not include ADIDs. EPA and the COE would explore use of this ADID approach.

4. Stream Impairment

Activities in headwater streams have the potential to influence downstream aquatic functions and resources. Information on mountaintop mining indirect stream impacts is discussed in Chapter III.D. The relationship of mining to groundwater quality and quantity as it relates to stream base flow is presented in Chapter III.H. Coal mine drainage effects on stream water quality are discussed in Chapter III.E. Technical studies were conducted on the scope of stream impairment from mountaintop mining and valley fills [see Appendix D studies on stream chemistry, macroinvertebrates, fisheries, temperature, flow, headwater streams, etc.].

Eight potential impact factors are identified and discussed in Chapter III.D.1. The factors attributable to stream impairment discussed in Section II.C.3 above are the following: loss of linear stream length; loss of biota under fill footprint or from mined stream areas; and loss of upstream energy from buried stream reaches. These direct impacts may result in stream impairment

downstream. The factors discussed here are the following: changes in downstream thermal regime; changes in downstream flow regime; changes in downstream chemistry; changes in downstream sedimentation; and effects to downstream biota.

Studies indicate that aquatic communities downstream of surface coal mining operations and valley fills may be impaired. Data show an increase in water temperature in winter and a decrease in summer below valley fills. Streams below valley fills may shift from ephemeral or intermittent to perennial flow. Temperature and flow changes are the result of mining backfill and valley fill interaction with groundwater contributions to stream base flow.

Certain chemical parameters (such as sulfates, specific conductance, selenium) are sometimes elevated downstream of mining or valley fills. Stream reaches below mining and valley fills may have changes in substrate particle size distribution from increased fine material due to sedimentation. Excessive sedimentation does not appear to occur in first and second order streams; however, the studies were inconclusive in higher order stream reaches.

Some macroinvertebrate communities change in terms of diversity, population size, pollution tolerance. Total fish species downstream of some filled sites were lower than mined and reference sites. However, fisheries sampling was limited by drought conditions during the study period and the sample population may not be statistically representative.

The sample size and monitoring periods conducted for the EIS were not considered sufficient to establish firm cause-and-effect relationships between individual pollutants and the decline in particular macroinvertebrate populations. Impairment could not be correlated with the number of fills, their size, age, or construction method.

a. The No Action Alternative: The Regulatory Program Today

CWA regulatory measures are designed to minimize or prevent stream impairment and to restore streams where impairment exists. This section describes how antidegradation policy, water quality standards, effluent standards, and monitoring provisions combine to address stream integrity. The SMCRA and CWA Section 404 program rely on these measures to regulate surface coal mining operations.

a.1. CWA Antidegradation policy

CWA regulations establish an “antidegradation policy” at 40 CFR 131.12. Basically, this policy says that states and/or EPA must adopt an antidegradation policy and a plan for implementation that, at a minimum, maintains and protects existing in-stream water uses and the quality of water necessary for those uses. The antidegradation policy must provide for review before allowing degradation of “high quality” waters of the U.S. High quality waters can only be degraded if the review finds that lower water quality is warranted to accommodate important economic or social development in the area. No degradation of “outstanding national resource” waters is permissible. The WQS Fact Sheet [Appendix B] outlines the basic anti-degradation requirements in state water quality standards.

As it applies to CWA Section 404 permits, EPA has recognized the Congressional intent to allow fills and has interpreted that the antidegradation policy is satisfied with regard to fills if the discharge

did not result in "significant degradation" to the aquatic ecosystem as defined under 40 CFR 230.10(c) of the CWA Section 404 (b)(1) Guidelines [USEPA 1994]. This provision provides a mechanism to address potential impairment of streams from valley fills.

a.2. CWA Water Quality Standards

Water quality standards are the foundation of water quality-based control program mandated by the CWA. The four basic elements in establishing water quality standards are designated uses, water quality criteria, antidegradation policy, and general policies for implementation. The states specify, based upon scientific criteria, the appropriate water uses to be achieved and protected. Appropriate uses are identified by taking into consideration the use and value of the waterbody for public water supply, for protection of fish, shellfish, and wildlife, and recreational (including fishing and swimming), agricultural, industrial, and navigational purposes. Water quality criteria include aquatic life, human health, biological, nutrient, microbial, and wetlands. Antidegradation implementation procedures identify the steps and questions that must be addressed when regulated activities are proposed that may affect water quality.

Water quality standards are adopted by states under Section 303 of the CWA, subject to EPA approval. The water quality standards assist in maintaining the physical, chemical, and biological integrity of a water body by designating its uses, setting criteria to protect those uses, and establishing provisions to protect water quality from degradation. Standards help to identify water quality problems caused by improperly treated wastewater discharges, runoff or discharges from active or abandoned mining sites, sediment, fertilizers, and chemicals from agricultural areas, erosion of stream banks caused by improper grazing practices, etc. Several CWA features act as mechanisms to implement water quality standards so as to achieve and maintain protective water quality conditions. These features include the following:

- Total maximum daily loads (TMDLs) [40 CFR 130.7], waste load allocations (WLAs, CFR) for point sources of pollution, and load allocations (LAs, CFR) for non point sources of pollution require establishment of existing stream conditions and plans for restoring and or protecting stream uses.

- Water quality management plans [CWA Section 303] prescribe the regulatory, construction, and management activities necessary to meet the water body goals [40 CFR 130.6].

- NPDES [CWA Section 402] results in water quality-based effluent limitations for point source discharges which considers actual water quality conditions and uses of the water body. [40 CFR 122.44(d)].

- CWA Section 401 water quality certifications provide for state evaluation and concurrence for Federal actions affecting water quality [40 CFR 131].

- CWA Section 305(b) requires documenting current water quality conditions in periodic reports.

- CWA Section 319 requires management plans for the control of non-point sources of pollution.

The CWA requires states and authorized Indian Tribes to review their standards from time to time, but at least once every three years, and revise them if appropriate. Updates may be needed, for example, due to changing water quality conditions or water body uses or new scientific information on the effects of pollutants in the environment. In preparing proposed revisions to their standards, states and Tribes consider requests from industry, environmental groups, and the public, and review available information (e.g., CWA Section 305(b) reports, EPA guidance).

States and Tribes have the authority to adopt water quality criteria with sufficient coverage of parameters and of adequate stringency to protect designated uses. In adopting criteria, states and authorized Tribes may undertake the following:

- adopt the criteria that EPA publishes under Section 304(a) of the Clean Water Act;
- modify the Section 304(a) criteria to reflect site-specific conditions; or
- adopt criteria based on other scientifically-defensible methods.

States and authorized Tribes or EPA typically adopt both numeric and narrative criteria, subsequently approved or revised based on EPA review. Numeric criteria are important where the cause of toxicity is known or for protection against pollutants with potential human health effects. Narrative criteria are also important; narrative "free from" toxicity criteria typically serve as the basis for limiting the toxicity of waste discharges to aquatic species (based on whole effluent toxicity testing).

Section 303(c)(2)(B) of the CWA requires states and authorized Tribes to adopt numeric criteria for Section 307(a) priority toxic pollutants for which the EPA has published Section 304(a) criteria, if the discharge or presence of the pollutant can reasonably be expected to interfere with designated uses. The Section 307(a) list contains 65 compounds and families of compounds, which EPA has interpreted to include 126 priority toxic pollutants.

EPA approval of a new or revised water quality standard is considered a Federal action which may be subject to the ESA Section 7 consultation requirements. Section 7 of the ESA requires Federal agencies to utilize their authorities in furtherance of the ESA by carrying out programs for the conservation of threatened and endangered species. It also states that Federal agencies shall, in consultation with the FWS, insure any actions authorized, funded, or carried out by such agency “is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined to be critical...” Accordingly, consultation with the FWS on standards that may affect listed species is an important part of EPA's water quality standards approval process.

Proposed surface coal mining operations must demonstrate the ability to comply with these water quality standards prior to authorization of valley fills or outfalls in waters of the U.S. Compliance with these program features provide protection from impairment of waters, or fosters restoration of waters.

Total Maximum Daily Loads (TMDLs)

CWA Section 303(d) requires states or EPA to identify impaired waters and establish a priority ranking for them, taking into account the severity of pollution and uses to be made of such waters. Section 303(d) also requires states or EPA to establish TMDLs for these impaired waters. These

impaired waters do not meet water quality standards even after point sources of pollution have installed the minimum required levels of pollution control technology. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs are calculated by summing the allowable loads of a pollutant in a waterbody from all contributing point and non-point sources and must include a margin of safety. The calculation must also account for seasonal variations. A TMDL plan is designed to reduce point source loadings through application of effluent limits in NPDES permits. Non-point source loadings are generally reduced through application of best management practices.

Some TMDLs are established and others are being developed. Where TMDLs are established, no additional loadings may occur for the TMDL pollutant unless the net loading of that pollutant is reduced in the affected reach. TMDL pollutants currently identified for some streams in the EIS study area include pH, iron, and manganese. These pollutants are also the subject of technology-based effluent limitations for coal mining. Other pollutants could be identified for inclusions in a TMDL if those pollutants are identified on the CWA Section 303(d) list as the cause of stream impairment. TMDLs are not self-implementing. The components of TMDL plans are implemented through existing Federal, state or local programs with enforcement capabilities (e.g., NPDES for point source pollutants; or through voluntary BMP-based programs for non-point source pollutants). For example, if a new coal mining project is proposed within a watershed subject to TMDLs, the NPDES permit for the project cannot be approved until a net reduction of the designated pollutant(s) occurs within the watershed. [40 CFR 130.7]

a.3. CWA Section 402 NPDES Permits and Water Quality Protection

Discharges of pollutants through point sources to waters of the U.S. require permits issued under the NPDES program, authorized by the CWA. Technology based effluent limits for the NPDES program are established by EPA to restrict the concentration of particular pollutants associated with a particular industry (e.g., iron for coal mining discharges). While it retains oversight authority, EPA has approved the permitting and compliance authorities of the NPDES program to Kentucky, Tennessee, Virginia, and West Virginia as well as all of the other coal mining states in the eastern U.S. For the coal mining industry, NPDES permits are required for the following: all chemical treatment outfalls; sedimentation control structure outfalls, including in-stream ponds associated with valley fills; and non-point source sheet flow from disturbed or reclaimed areas.

NPDES permits include effluent limits and requirements for self-monitoring and submitting the results to the NPDES authorities on discharge monitoring reports (DMRs). NPDES permits are issued for five-year periods and applications for re-issuance are required 180 days prior to permit expiration. In its oversight authority, EPA may review, comment on, and, where not in compliance with NPDES regulations or CWA, object to draft NPDES permits for coal mining. Although the states regularly review DMRs, EPA does not normally review DMRs for mining facilities, unless it considers them to be major permits. However, EPA periodically visits NPDES program offices in its coal states and reviews permitting and compliance actions, including DMRs.

NPDES permits for municipalities and most industries are normally handled by the respective state water protection agency. However, to maximize agency resources, some state SMCRA agencies have elected to conduct coordinated SMCRA/NPDES application reviews. This provides improved efficiency and environmental assessment, since applications for surface coal mining operations

undergo comprehensive SMCRA reviews, including aspects to protect aquatic resources. The approaches for NPDES/SMCRA processing by states within the EIS study area are the following:

- Kentucky - The KYDNREP, Division of Water provides NPDES reviews and permitting separately from SMCRA permitting, which is provided by the KYDNREP DSMRE.

- Tennessee - The Tennessee Department of Environment and Conservation, Division of Water Pollution Control is the authorized NPDES reviewing agency. This agency coordinates NPDES issuance with the OSM SMCRA review and approval.

- Virginia - The DMME, DMLR is the authority for both the SMCRA and NPDES programs.

- West Virginia - The WVDEP, Office of Mining and Reclamation, provides joint reviews of SMCRA and NPDES permit applications, issues SMCRA permits, and drafts NPDES permits. The WVDEP, Office of Water Resources, is the NPDES authority and issues the NPDES permits in coordination with the Office of Mining and Reclamation.

Activities authorized under SMCRA and CWA Section 404 proposals for surface coal mining operations with valley fills must comply with any applicable NPDES effluent limits. The effluent limits for point sources associated with coal mining consider industry-wide treatment technology and address specific concentrations for iron, manganese, pH, and suspended solids as well as measures to protect aquatic life and human health. The DMR provides for industry and state regulatory agency monitoring data to indicate compliance and tools to protect stream quality. This feature of the CWA program guards against impairment levels affecting designated uses.

a.4. CWA Section 401 Certification

CWA Section 401 provides that states certify that Federal activities or activities requiring Federal approvals relative to CWA Section 404 would not violate applicable effluent limitations, or other limitations, or other water quality requirements. A CWA Section 404 permit for MTM/VF proposals cannot be issued unless a CWA Section 401 certification is issued or waived for a particular proposal. The state may consider antidegradation, technology-based effluent limitations, and water quality requirements in determining whether to certify the proposal under CWA Section 401. The state can add conditions to its certification. The COE recognizes and the applicant is required to abide by the conditions to the certifications. Some states issue a general CWA Section 401 certification with conditions for NWP21. Individual certifications or waivers are required for all IPs and any NWP not covered by a state's general CWA Section 401 certification. The COE presumes that a state water quality certification satisfies the requirements of CWA Section 401; the CWA Section 404(b)(1) Guidelines relevant to water quality under 40 CFR 230.10(b)(1); and the COE rules at 33 CFR 320.4(d). A state can deny CWA Section 401 certification if it finds that a proposed activity will not meet applicable limits, fails to protect designated uses, or will not appropriately guard against stream impairment.

a.5. Stream Bio-monitoring

The objective of bio-monitoring is to provide a functional assessment of the ecological characteristics of aquatic sites. These assessments are to consider the ecological functions included in the CWA Section 404(b)(1) Guidelines. Bio-monitoring normally includes macroinvertebrate surveys using the EPA Rapid Bio-assessment Protocols. These include establishing a number of sampling stations, providing habitat evaluations, descriptions, scores, and providing macroinvertebrate metric values and scores for the Family Biotic Index at the sampling stations. Accordingly, EPA recommends that bio-monitoring be provided on streams to be impacted by proposed valley fills. This monitoring aids in permitting decisions (e.g., minimal impact and mitigation decisions), including CWA Section 404 permits. EPA published guidance for chemical/biological protocols in January 2000 as an interim monitoring approach. The protocols can be found on EPA's mountaintop mining web page (http://www.epa.gov/region3/mtntop/documents/html).

In December 2002, the COE issued a Regulatory Guidance Letter (RGL) Number 02-2 recommending a functional assessment by qualified professionals or the best professional judgement of Federal, tribal, and state agency representatives to determine impacts and compensatory mitigation requirements. This functional assessment protocol should include benthic, chemical, and physical characterization of the aquatic ecosystem, such as a Hydrogeomorphic Assessment or Wetlands Rapid Assessment Procedure. COE Districts (i.e., Huntington, Norfolk, and Nashville Districts) are in the process of implementing consistent protocols based on EPA Rapid Bio-Assessment procedures and a functional scoring system developed by the Louisville District and currently in use by the Louisville, Nashville and Huntington Districts in Kentucky. These functional assessments would be an integral part of COE determinations to decide whether MTM/VF proposals must undergo IP processing or be eligible for authorization under the NWP 21 permit. Further, data from the application of these protocols would be used by the COE to establish science-based impact thresholds, if feasible [Chapters II.C.6 and II.C.7; Actions 9 and 12]. Please see Chapter II.C.6 for additional discussion of functional stream assessments and mitigation.

While all CWA Section 404 permits require use of bio-monitoring, additional approaches for bio-monitoring by the state SMCRA or water quality agencies are as follows:

- Kentucky - Stream bio-monitoring is conducted as a part of the permitting process on a case-by-case basis for operations where aquatic life impacts are a concern.

- Tennessee - Stream bio-monitoring is not conducted as a part of the permitting process, but may be provided on a case-by-case basis for operations where aquatic life impacts are a concern.

- Virginia - Similar to Kentucky, bio-monitoring may be conducted on a case-by-case basis on streams below discharges where aquatic life impacts are a concern.

- West Virginia - Baseline benthic surveys are required within the footprint and below the fill on intermittent and perennial sections of streams proposed to be permanently filled by the applicant. Those fills having more than 250-acre drainage areas are required to have semi-annual benthic and annual fisheries monitoring throughout the life of the permit per the interim protocols. This is primarily to provide an assessment of aquatic impacts due to permanent valley fills and temporary fills such as in-stream sedimentation ponds or deep mine face-ups. It also is used to help

determine downstream impacts for the State CWA Section 401 certification. Also, toxicity tests are run on pond effluents on a case by case basis, particularly where manganese discharges and potential over treatment with alkaline reagents are a concern.

The bio-monitoring of baseline stream conditions assists the regulatory authorities in determining stream uses, appropriate protective measures, and compensatory mitigation measures necessary to guard against stream impairment or other loss of aquatic resources.

a.6. Stream Monitoring of Metals and pH

Stream monitoring requirements for pH and metals (normally iron, manganese, and aluminum) occur under both the CWA [40 CFR 434.35] and SMCRA [30 CFR 816.41] during the application, operational, and reclamation stages. Monitoring stations are normally upstream, downstream, and in the vicinity of the outfalls. Sampling frequency is normally the same as the NPDES outfall sampling frequency, twice monthly until the area contributing to the discharge is backfilled and regraded. This would be applicable to outfalls downstream of valley fills. Results are screened for possible water quality standard violations, and also used to indicate water quality trends resulting from the mining operation and discharges. Monitoring and screening are used to achieve performance standards and, thus, are mechanisms that serve to minimize stream impairment.

b. Alternatives 1, 2, and 3

The actions listed below could deal directly with stream impairment by: 1) developing additional water quality standards based on additional study and data collection regarding impacts; and, 2) using monitoring protocols for aquatic ecosystem functional assessment. Other actions developed for issues such as III.C.3. Direct Stream Loss; III.C.5. Fill Minimization; III.C.6. Stream Habitat and Aquatic Functions; III.C.7. Cumulative Impacts; and III.C.8. Deforestation could mitigate stream impairment as well.

Action 5: The agencies would continue to evaluate the effects of mountaintop mining operations on stream chemistry and biology. As appropriate, EPA would develop and propose criteria for additional chemicals or other parameters (e.g., biological indicators) that would support a modification of existing state water quality standards.

Monitoring data collected during permitting and surface coal mining activities would be compiled and analyzed by the agencies to determine whether statistically valid and reliable relationships can be established between mining/fills and stream impairment. In addition, these data would be used to develop appropriate controls to avoid or mitigate such impacts. As appropriate, EPA would utilize these data to develop and propose criteria for additional chemicals (e.g., sulfates) or other parameters (e.g., biological indicators) that would support a modification of technology-based effluent limits and/or existing state water quality standards. Modifications could result in changes to monitoring requirements and mitigation.

Action 6: Federal agencies would continue to work with states to further refine the uniform, science-based protocols for assessing ecological function, making permit decisions, and establishing mitigation requirements.

Used in combination with water quality monitoring, bio-monitoring procedures can be effective in pinpointing certain parameters to focus upon when accomplishing the following:

- designing water quality control features of a project;
- establishing mitigation measures to replace or restore aquatic function;
- evaluating the effects associated with different fill sizes, construction techniques, or locations as part of the alternative fill siting analysis; and
- assessing the advisability of individual and/or cumulative impact thresholds;
- identifying stream reaches supporting naturally diverse and high quality aquatic populations for possible advanced identifications (ADIDs).

An example of bio-monitoring to assess baseline stream health using macroinvertebrate data is the West Virginia Stream Condition Index (WVSCI), which was used in some of the aquatic studies conducted for this EIS. The COE stream functional assessment protocol developed by the COE Louisville District for use in the Appalachian region takes into account biological, chemical, and physical conditions of the stream reach. The COE protocol establishes a reproducible "score" with which to evaluate the level of stream functions using similar, least disturbed reference sites for comparison. In addition, the protocol establishes the comparable mitigation level to offset unavoidable impacts to stream segments [see description of protocol under III.C.6. Issue E, Stream Habitat and Aquatic Function]. States and other Federal agencies have different terminology and yardsticks for determining ecological functions and values; and different methods are being used for assessing impacts.

This action builds upon existing science-based methods such as the WVSCI and COE functional assessment protocol. The action's goal is to bring stakeholders as well as state and Federal agencies together to establish a workable set of criteria and science-based methods for determining baselines, impacts, and mitigation requirements. Further, this monitoring information could be used to identify and evaluate listed species habitats, stream reaches supporting naturally diverse and high quality aquatic populations; sole or principal drinking water source aquifers, or other specially-protected areas.

5. Fill Minimization

The size, number, and location of valley fills correlate with direct loss of streams and riparian and terrestrial habitats. SMCRA and the CWA provide mechanisms to address impacts to these resources.

The CWA 404(b)(1) Guidelines require that no fill be permitted if there is a practicable upland alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. The Guidelines further require that, if impacts to streams are unavoidable, fills be minimized to the maximum extent practicable.

Section 515(b)(3) of SMCRA requires all surface coal mining and reclamation operations backfill, compact, and grade overburden and other spoil material to restore the approximate original contour (AOC). A fundamental principle of SMCRA is that surface mines will be reclaimed to AOC so "that the surface configuration generally resembles the land prior to mining and blends into and complements the drainage pattern of surrounding terrain, with all highwalls, spoil piles, and coal

refuse piles eliminated;..." [30 U.S.C.1265(b)(3)]. The AOC requirement compels mining companies to return spoil material to the mined-out area, thus limiting the amount of excess spoil placed in valley fills. However, 30 U.S.C. 1265(b)(3) also provides an exception to AOC in situations where the volume of overburden is large relative to the thickness of coal. In those situations, the operator is required to demonstrate that due to volumetric expansion the amount of overburden and other spoil and waste material is more than sufficient to restore the approximate original contour.

Section 30 U.S.C. 1265(b)(22) specifies the manner in which excess spoil material must be handled and placed. A global requirement of 30 U.S.C. 1265(b)(22) is that fills be designed and constructed in a manner so that all other SMCRA provisions are met. This would include 30 U.S.C. 1265(b)(10), which basically requires minimizing the disturbance to the prevailing hydrologic balance at the mine-site and in associated off site areas, and 30 U.S.C. 1265(b)(24), which requires the use of best technology currently available to minimize disturbances and adverse impacts on fish, wildlife, and related environmental values. These SMCRA provisions provide a statutory basis to minimize the volume of, if not to avoid, excess spoil generation. They also provide the basis for ensuring fills are constructed or placed in a manner which minimizes environmental disturbance.

While OSM regulations exist to implement these SMCRA provisions, current SMCRA regulations do not specify a fill minimization process and do not specifically require valley fills to be located based on the most environmentally protective practical alternative similar to CWA Section 404(b)(1) Guidelines. Discussion of selecting fill locations are in Chapter III.I: Overview of Appalachian Region Coal Mining Methods; Chapter III.J: MTM/VF Characteristics; Chapter III.K: Excess Spoil Disposal; Chapter III.L: Mine Feasibility Evaluation and Planning; and Appendix H: Mining and Reclamation Technology Symposium Proceedings.

a. No Action Alternative: The Regulatory Program Today

a.1. CWA Section 404 Program

When filling waters of the U.S. is unavoidable to conduct a project, the CWA Section 404(b)(1) Guidelines require selection of the practicable alternative (defined below) that is least damaging to the aquatic environment. These Guidelines also require that the amount of filling be minimized and offset by mitigation that restores the lost aquatic functions [40 CFR 230.10(d)]. Compliance with the Guidelines is required before a COE permit can be issued. An applicant must demonstrate to the COE that the size, number and location of valley fills proposed resulted from consideration of practicable alternatives to avoid and minimize aquatic impacts in light of the overall project purpose. Filling, after considering mitigation, cannot result in more than a significant adverse impact (individually or cumulatively from all projects) to the downstream water quality. [40 CFR 230 and 33 CFR 320.]

An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics, in light of overall project purpose. Considerations of cost, however, do not necessarily mean that the least-cost alternative would be selected over the most environmentally preferable alternative. The environmentally preferred alternative is based on an assessment of the aquatic resources within each potential fill site and areas of indirect impacts. An area not presently owned by the applicant which could reasonably be

obtained, utilized, expanded or managed in order to fulfill the basic project purpose may be considered practicable [40 CFR 230.10(a)(2)].

A detailed assessment of costs by the applicant may be required as part of a COE permit evaluation. For example, this assessment could include considerations such as haulage costs to alternative upland sites, alternative mining methods, and property acquisition. Technological considerations could include a demonstration by the applicant that mining methods other than valley fills, such as underground mining, were considered in extracting the coal reserves. For instance, the ability to conduct underground mining is dictated by coal seam thickness and depth of cover. Seams less than twenty eight inches cannot be mined by underground technology but could be mined by surface mine methods if overburden to coal ratios are cost effective. Examples of the logistics of evaluating alternative disposal site design includes upland excess spoil disposal sites, such as abandoned mining benches, placement on previous mining backfills, and for reclamation of coal mine waste embankments.

The considerations of cost, technology, and logistics are included in the determination of whether or not some or all of the upland alternatives are practicable, thus demonstrating that the avoidance of fills in waters of the U.S. has been achieved to the maximum extent practicable. If additional disposal sites within waters of the U.S. are required to accomplish the project purpose, the applicant must then demonstrate that fills in waters have been minimized. Once fills have been reduced to minimize stream loss, the location of valley fills is based on the COE stream assessment protocol. Characterization of streams based on the protocol prioritizes potential fill locations for mining project design, with a preference for protecting high quality streams. For example, the COE may determine that one large valley fill in either high or low quality streams is environmentally preferable to several small valley fills scattered throughout a watershed of high quality headwater streams.

Compensatory mitigation for unavoidable impacts is required by the CWA for both general and individual permits [see Chapters II.C.5: Stream Habitat and Aquatic Functions and III.D.2: Mitigation for MTM/VF Impacts]. The amount and type of compensatory mitigation required are determined by the stream functional assessment of the waters impacted by a specific project; i.e., higher quality streams require more mitigation than lower quality streams. The functions of streams lost through filling can require substantial mitigation as compensation. Consequently, mitigation to replace and restore aquatic functions lost beneath valley fills can be a costly endeavor. Therefore, the cost of compensatory mitigation can serve as an incentive to minimize valley fills in aquatic habitats.

Valley fills in waters of the U.S. must be authorized by COE general permits (including nationwide permits) or individual permits [see description in Chapter II.C.3: Direct Stream Loss]. Since December 1998, based on the *Bragg* settlement agreement, as a general matter, fills in watersheds less than 250 acres are authorized by NWP 21 in West Virginia. Between March 1999 and February 2002 in West Virginia, there have been 5 individual permit applications compared to the 81 projects approved using NWP 21 (http://www.osmre.gov/mtindex.htm). This general principle is currently proposed to apply in specific geographic areas through COE implementation of a regional general condition to the NWP 21 [Chapter II.C.1.a.1]. This regional condition would generally establish an interim threshold of 250 acres. Fills in watersheds greater than 250 acres would generally be processed as an IP, unless subsequently rebutted in the review process by data and analysis. Mining companies have generally designed their valley fills in the EIS study area using the 250-acre

watershed size criterion. Absent this regional condition, mining companies have been concerned that larger fills might trigger an IP requirement.

In January 2002, the COE reissued all of the nationwide permits, including NWP21 [67 FR 2020-2095], which authorizes fill activities associated with surface coal mining activities [see I.C.3.a and II.B.1]. The new NWP 21 requires the COE to complete a case-by-case evaluation of surface coal mining permit applications. This evaluation, which considers compensatory mitigation, determines whether project impacts result in minimal impact to waters of the U.S. If aquatic impacts are determined to be no more than minimal, a project may be approved under NWP 21. Projects that exceed minimal impacts are processed as individual permits. While the general principle of 250 acres still applies in West Virginia, projects would be evaluated on a case-by-case basis in all of the Appalachian states to determine which CWA Section 404 permit review process is appropriate. If regional conditions are added to NWP 21 in specific geographic areas, the conditions would supplement the case-by-case evaluation.

a.2. SMCRA Program

As discussed earlier [Chapter II.C.5], SMCRA provides a statutory basis to minimize the volume of excess spoil, and to design, construct, and locate valley fills so that areal disturbance of fills and the environmental effects of fills are minimized. While the current regulations provide general requirements for carrying out the statutory mandate, the regulations do not specifically extend this mandate to excess spoil. OSM recognizes the importance of this specificity and is initiating the rulemaking process to clarify the obligations of operators to demonstrate that the volume of excess spoil would be minimized, and that the excess spoil fills would be configured and located as to cause the least adverse impacts, both individually and cumulatively.

The proposed rule would likely require the permit applicant to provide volumetric calculations for total spoil, backfill, and excess spoil (including the size and storage capacity of each fill), based on the particular bulking characteristics of each distinct stratigraphic layer comprising the overburden and interburden at the proposed mine site. The new rule could also require that the excess spoil fill areal extent and unavoidable adverse environmental disturbances be minimized to the maximum extent practicable, taking into consideration the configuration, drainage, and stability requirements of 30 CFR 816.102(a) and the fish and wildlife protection requirements of 30 CFR 780.16(c). Finally, the rule could obligate the permit applicant to provide an analysis of all alternative locations for excess spoil fills in the permit and adjacent permitted areas to demonstrate the selection of the least environmentally damaging alternative.

The AOC requirement compels mining companies to reclaim by returning spoil material to the mined-out area, minimizing the amount of excess spoil requiring valley fills [30 U.S.C. 1265 (b)(3)]. Current SMCRA regulations place no quantifiable limits on the application of the AOC concept. That is, final backfill elevations do not have to be within a specified vertical distance from pre-mining elevation. Similarly, there is no requirement that a certain percentage of the volume of material removed during mining must be returned to the mined out area. In the preamble to the AOC rule [48 FR 23356], OSM concluded that development of numerical limits was best left to individual regulatory authorities due to varying topographic and mining conditions around the country.

In 1999, OSM developed guidance for states to consider in assessing AOC compliance, based on several terms within the SMCRA definition of AOC. The terms included in the guidance are the following: backfilling and grading; closely resembles; configuration; drainage patterns; mined area; and terracing or access roads. These terms can be considered variables for analysis purposes and logically grouped into the following three focus areas: configuration (including access); stability; and drainage. In addition to achieving AOC, surface coal mining reclamation must meet performance standards for these focus areas. In other words, mined land must attain a configuration that closely resembles the land prior to mining and be accessible and stable with adequate drainage control. OSM guidance served as the basis for policies currently used in the SMCRA programs in Kentucky, Tennessee, Virginia, and West Virginia [see Appendix J].

In 2000,West Virginia (with assistance from OSM and as a term of a consent decree in *Bragg*) developed and implemented a policy with a protocol that provides an objective and systematic process for achieving AOC on steep slope surface mining operations. The WVDEP AOC protocol maximizes the amount of spoil returned to the mined area and determines excess spoil quantities requiring disposal sites, i.e., valley fills. The WVDEP AOC models are objective yet flexible processes for determining post-mining surface configurations for contour and other mountaintop mining operations. The resultant post-mining configuration should closely resemble the pre-mining topography and satisfy the access, drainage control, sediment control, and stability performance standards, thus achieving AOC as well. This process minimizes impacts to aquatic and terrestrial habitats. EPA, COE, and OSM recognized the WVDEP AOC guidance as an integral component of CWA fill minimization and alternatives analysis.

No detailed protocol similar to the WVDEP policy has been developed or implemented by the Federal SMCRA program. However, OSM has encouraged other Appalachian steep-slope states to develop AOC policies. Kentucky, Virginia, and Tennessee have written new policies that do not contain specific engineering formulae, but incorporate the basic principles of drainage control, access, configuration, and stability from the OSM guidance.

b. Alternatives 1, 2, and 3

Action 7: OSM would continue the on-going rule-making process to clarify the obligations of an operator to demonstrate that the volume of excess spoil will be minimized, and that the excess spoil fills be configured and located as to cause the least adverse impacts, both individually and cumulatively. OSM could undertake additional future rule-making to increase consistency with the CWA Section 404 program, as appropriate and authorized by SMCRA.

The COE and EPA use the CWA Section 404(b)(1) Guidelines to require the permit applicant to demonstrate that placement of fill materials in waters of the U.S. has been avoided and minimized to the maximum extent practicable. The current rule-making effort by OSM would clarify the SMCRA obligations to minimize excess spoil and the adverse impacts stemming from valley fill construction [Chapter II.C.5.a.2]. This amendment to the SMCRA regulations would not only be in accord with SMCRA provisions, it would also increase consistency with CWA Section 404(b)(1) Guidelines.

OSM would also consider whether additional future rulemaking is warranted. This later rulemaking might increase consistency with the CWA Section 404 program or “fine tune” fill minimization and alternative analysis that grow out of the ongoing rule making [Chapter II.C.3.a.2]. OSM rule-making may be appropriate after experience is gained with Federal and state agencies involved in

the development of elements of coordinated decision making and collaborative CWA/SMCRA permitting program described under Action 1 for all alternatives.

The creation of the MOA, FOP, joint application, etc., may indicate that additional data collection, impact predictions, and analysis could increase SMCRA consistency with CWA standards, e.g., by satisfying CWA Section 404(b)(1) Guidelines analysis. OSM could consider future amendments to the excess spoil rules and/or other permitting/performance requirements in this regard. These types of amendments are most likely under Alternative 2 and 3, since the COE will perform IP processing and CWA Section 404(b)(1) analysis under Alternative 1. Similar review under the SMCRA program could be unnecessarily redundant for Alternative 1.

6. Assessing and Mitigating Stream Habitat and Aquatic Functions

The discussion of the importance of headwater streams is in Chapter III.C: Appalachian Aquatic Systems and Appendix D: Headwater Stream Symposium. Technical studies were conducted on the scope of the direct impacts to streams from mountaintop mining and valley fills in Appendix I: Cumulative Impact Study and Chapter III.K: Fill Inventory. Chapter II.C.3. discusses the issue of direct stream loss and the existing regulatory controls for limiting such loss. Chapter II.C.5 describes the way the regulatory programs seek to minimize fill impacts that cannot be avoided. This section focuses on ways to assess the aquatic habitats and stream health of potential fill sites. The use of stream functional assessments determine the mitigation required for unavoidable adverse impacts from MTM/VF. Mitigation methods and success criteria are also discussed in this section. Information related to aquatic mitigation is also discussed in Chapter III.D.2. Studies on surface coal mining reclamation using wetlands and aquatic ecosystem enhancement are in Appendix D.

Mitigating for lost stream functions is important to ensure that significant degradation to waters of the U.S. does not occur. Reclamation and compensatory mitigation plans are significant considerations in the authorization of fills in waters of the U.S., including headwater streams. For such mitigation plans, there is a preference for onsite (on the same site as the habitat being impacted) and in-kind (same habitat as that being impacted) compensation. However, recreating headwater streams onsite to functionally replace those directly lost from filling operations is difficult and not often undertaken as compensatory mitigation. Experience with the technology required to create streams that match those directly lost through valley fills is very limited. To recreate intermittent or perennial streams onsite, the channel must intercept local groundwater. The potential channel locations and elevations may not coincide with prevailing geologic structure (dip or hydraulic gradient) making local groundwater horizons difficult to capture for establishing stream flow [Appendix D: Aquatic Ecosystem Enhancement Symposium].

While proven methods exist for larger stream channel restoration and creation, the state of the art in creating smaller headwater streams onsite has not reached the level of reproducible success required for these efforts to be reasonably relied upon programmatically as an option for full compensatory mitigation. Consequently, other forms of compensatory mitigation are employed and other sites outside the footprint of the fill are often utilized to offset unavoidable aquatic impacts of valley fill operations. Mitigation sites (on- or offsite) require a conservation easement so that protection of the aquatic resources is assured in perpetuity. Because mining companies often lease mine sites and may not own or control offsite areas, this easement requirement can sometimes pose a significant barrier to the location of suitable mitigation opportunities–either onsite or offsite. These factors can also result in greater consideration of in lieu fee arrangements whereby mitigation

is accomplished through monetary payment for aquatic conservation/restoration projects identified by government resource agencies.

Effective compensatory mitigation plans frequently include a variety of components that address aquatic habitat functions such as improvements to water quality and temperature; organic input; and, macroinvertebrate, fisheries, and riparian habitat. Offsite mitigation watershed improvement efforts may include, under certain circumstances:

- Creating riparian wetlands and re-establishing flood plains;
- Planting riparian vegetation;
- Creating channel improvements (e.g., riffle/pool complexes, dredging, sinuosity, bank stabilization, and measures to minimize downcutting such as weirs);
- Controlling and reducing sedimentation and pollution sources (e.g., reclamation of abandoned mine lands and remediation of other adverse environmental conditions within the watershed);
- Re-establishing adjacent forests;
- Employing water quality improvement techniques (e.g., anoxic limestone drains, drums, flumes, and other passive treatment systems);
- Improving fisheries habitat (e.g., shading, increasing habitat heterogeneity, aeration through riffles or other natural means); and,
- Removing stream encroachments (e.g., roads, crossings, ponds, or other fills).

A comprehensive mitigation strategy may include any number of these approaches, but must result in the replacement of the appropriate type and quantity of aquatic functions lost due to project impacts. The success of any comprehensive mitigation strategy is dependent upon a high degree of inter-governmental cooperation, public participation and coordination of all necessary permits or approvals.

a. No Action Alternative: The Regulatory Program Today

The CWA Section 404 regulatory program requires compensatory mitigation for unavoidable impacts to waters of the U.S. Compensatory mitigation is designed to replace the aquatic functions lost or degraded due to fills in aquatic habitats. To design appropriate compensatory mitigation plans, stream functions must be identified and quantified.

Compensatory mitigation can be in the form of restoration, enhancement, preservation, and creation of aquatic habitats. Mitigation may be part of reclamation of the mine site or restoration of impaired or degraded stream functions off-site. Preference is given to on-site mitigation and then to off-site mitigation that results in the greatest benefit to the affected watershed. The goal of on- or off-site mitigation is to offset adverse project impacts and thereby avoid significant degradation to aquatic resources. The restoration of existing impaired streams [identified by states in accordance with CWA Section 303(d)] to meet designated uses may be considered as opportunities for off-site mitigation. The COE has the authority to require bonds to ensure completion of approved onsite and off-site mitigation [33 CFR 325.4(d)].

SMCRA, in order to protect society and environment from the adverse effects of surface coal mining operations, requires that reclaimed surface coal mining operations restore the land to a condition capable of supporting, at a minimum, the pre-mining uses. Thus, to the extent technologically feasible, the SMCRA hydrologic reclamation plan would provide for restoration of aquatic and

riparian habitat to fulfill SMCRA performance standards to minimize impacts onsite; prevent material damage offsite; and enhance fish, wildlife and related environmental resources where practicable. The SMCRA hydrologic reclamation plan stems from SMCRA performance standards to ensure that the hydrologic balance is not adversely affected. This plan includes elements such as diversion, impoundment, and sediment control designs; water supply replacement; and special material handling to prevent toxic mine drainage. While surface coal mining operations must comply with CWA Section 404 requirements described above, unlike the CWA, SMCRA contains no provision for offsite mitigation. SMCRA requires performance bonds to assure reclamation is accomplished in accordance with the approve coal mining reclamation permit. SMCRA bonds cover only on-site mitigation as a component of reclamation.

a.1. CWA Section 404 Program

Under the COE program, after impacts to the aquatic environment have been avoided and minimized to the extent practicable, compensatory mitigation is required to offset any remaining unavoidable adverse effects of the proposed project.

NWPs

On January 15, 2002, the COE reissued all of its NWPs. Those permits generally identified upper limit thresholds (e.g., 1/4 acre of wetland impact, 300 feet of intermittent or perennial streams) for NWP applicability of each of the identified activity. In considering the need for thresholds for NWP 21 (SMCRA-related NWP), the COE determined that there was currently no scientific basis for a programmatic threshold. Additionally, the COE believes that coal mining is different from activities authorized under other NWPs in that coal mining projects are reviewed for environmental impacts under other Federal authorities (SMCRA, CWA Section 402). For this reason, the determination of whether the project will result in more than minimal adverse effects is best made on a case-by-case basis. [67 FR 2042.] However, the COE made the commitment to re-evaluate the possibility of an upper threshold for NWP 21 after this EIS is completed. The COE intends to use the results of this EIS and all other information that may be available at the time, including information resulting from individual verification of all NWP projects as required under the revised 2002 terms and conditions, to make sure that NWP 21 results in no more than minimal impacts (site-specifically and cumulatively) on the aquatic environment [67 FR 2021]. For authorization of a coal mining project under NWP 21, Districts will determine on a case-by-case basis the requirement for adequate mitigation to ensure the effects to aquatic systems are minimal [67 FR 2081]. With these case-by-case determinations based on the results of the stream assessment protocol, the COE may conclude that the impacts are more than minimal (individually or cumulatively) and that the application must be processed as an IP. The process the COE uses to determine minimal impacts is discussed Chapter II.C.1.a.1.

Compensatory Mitigation

The COE issued RGL 02-2 on December 24, 2002, outlining the appropriate compensatory mitigation requirements for adverse impacts to waters of the U.S. These requirements, which are based on sound ecological and hydro-geomorphological principles, include an analysis of the aquatic resource functions. Indicators of aquatic functions, as used in the COE stream assessment protocol, include the physical, chemical and biological characteristics of biotic and abiotic integrity. Variables measuring the physical and chemical (abiotic) integrity include conductivity, riparian

width, canopy, and embeddedness. Variables measuring the biological (biotic) integrity include taxa richness, EPT richness, mHBI, percent Ephemeroptera, and percent (Chironomidae + Oligochaeta).

Full compensation for impacts to the aquatic environment requires equivalent increases in aquatic functions that would be provided as a result of the compensatory mitigation project. That is, the project must sufficiently offset the decline in functions resulting from the authorized impacts. Evaluating the appropriateness of compensatory mitigation requirements involves a comparison between the aquatic functions lost (type and quantity) due to the authorized impacts and the functions gained (type and quantity) for the proposed mitigation project.

Factors considered in determining the adequacy of a compensatory mitigation proposal include, but are not necessarily limited to, the type of functions being replaced; the level at which they are replaced; the speed at which functional replacement is achieved; and the risk that the compensatory mitigation site would not perform as expected. Compensatory mitigation may be accomplished through a combination of onsite restoration (e.g., removal of sediment control structures and restoration of stream channels to pre-mining conditions) and off-site stream rehabilitation or enhancement. The COE encourages applicants to perform compensatory mitigation projects in conjunction with mining operations; however, this is not always possible and in-lieu fees are one option [RGL 02-2]. A permanent conservation easement is required for mitigation sites and coal mine companies frequently do not own the property they are mining. In-lieu fee agreements are government approved monetary payments by applicants to accomplish aquatic resource mitigation. Such agreements exist in Kentucky, Tennessee and Virginia for approved stream restoration projects.

Prior to the reissuance of NWP 21 in January 2002, the COE considered mitigation adequate with inclusion of an OSM or state-approved SMCRA <u>onsite</u> mitigation plan in the permit application. All states in the EIS study area require onsite hydrologic reclamation under SMCRA (regardless of watershed size). In addition, several of the states in the study area require <u>offsite</u> compensatory mitigation based upon state statutes and regulations and as a condition of their CWA 401 water quality certification.

West Virginia requires compensatory mitigation (e.g., aquatic restoration projects, payment into a Stream Restoration Fund, etc.) for fills in watersheds of 250 acres or more [WV Code Section 22-11-7a]. Except for small isolated wetlands of minimal ecological value, the Virginia Water Protection Permit Program [Section 62.1. -- Waters of the State, Ports and Harbors] requires compensatory mitigation of impacts to waters of the Commonwealth, with no watershed acreage limitation. Virginia also has provisions for compensation in lieu of mitigation in limited circumstances. Kentucky is prohibited by statute [KRS 224.16-070] from requiring compensatory mitigation for stream loss from valley fills in watersheds less than 480 acres, except for streams designated as Outstanding State Resource Waters or Cold Water Aquatic Habitat streams [http://water.nr.state.ky.us/wq/Special_waters/]. For fills in watersheds over 480 acres, compensatory mitigation is required for all stream loss due to filling. Kentucky would allow mitigation onsite, offsite or in the form of an in-lieu fee payment to the Kentucky Stream Restoration Fund.

Under Tennessee's program, the state generally requires compensatory mitigation with no watershed acreage limitation for impacts to waters of the state [T.C.A. Chapter 1200-4-7 Aquatic Resource Alteration]. The only exception is small, isolated wetlands of 1/4 acre or less that do not impact

threatened or endangered species. Currently, Tennessee has no regulatory provisions for compensation in lieu of mitigation. The COE Nashville office has an in-lieu fee agreement with the state of Tennessee for aquatic resource mitigation.

The present NWP 21 requires the COE to make a case-by-case determination, with the consideration of any proposed regional conditions, that each project results in no more than minimal impact (individually and cumulatively) to the aquatic ecosystem, including compensatory mitigation. A proposed project would result in an overall minimal impact if impacts to the aquatic environment have been avoided to the extent practicable and any unavoidable impacts have been adequately compensated through mitigation projects providing appropriate replacement of aquatic functions. The COE would evaluate SMCRA onsite hydrologic reclamation and state-approved offsite mitigation during the case-by-case determination of mitigation adequacy. If the COE finds that SMCRA or state-approved mitigation is inadequate based on stream functional assessments, additional mitigation would be required.

COE Stream Assessment Protocol

During the pre-application stage of mine plan development, the COE requires functional assessments of aquatic resources targeted as potential disposal sites as well as potential mitigation sites. Evaluating these site-specific stream assessments allows the COE to provide technical input to the applicant regarding applicable permitting requirements for different mining scenarios. For example, impacts to high quality streams may require IP processing. Awareness of potential concerns and requirements in the early planning stages of a mining proposal allows the applicant to avoid increased costs associated with securing a permit, selecting appropriate fill sites, and demonstrating adequate mitigation of substantial impacts to the aquatic environment. These pre-application discussions with COE assist in identifying the appropriate locations for functional stream assessments.

Functional assessment data are used in demonstrating avoidance and fill minimization in the design of mining projects and evaluation of mitigation adequacy. If adequate data are not included in the initial application to the COE, a permit decision cannot be reached until the information is complete and technically adequate with respect to functional assessment data and project/mitigation design. The time required to conduct any additional stream evaluations prolongs permit processing. Such evaluations can only be conducted during appropriate field conditions, which may not occur for several months depending on the season. Without adequate stream characterizations, redesign of mining projects or mitigation to satisfy the CWA Section 404(b)(1) Guidelines cannot occur. This information is particularly valuable for projects involving higher quality aquatic resources where applicants to must design project(s) in a manner to avoid, minimize, and provide adequate compensation for impacts to the aquatic environment and mitigation requirements would be more demanding.

In order for the approach outlined above to be effective, the COE must be confident that the measures of aquatic functions used to set the targets for compensatory mitigation are sufficient and reliable. An interagency team of state and Federal agencies, co-chaired by representatives from the COE and the EPA Region IV, was assembled by the COE Louisville District to collect data and develop a stream assessment protocol for headwater streams for eastern Kentucky [http://www.lrl.usace.army.mil/orfpn/info/ekystreamassess/eastkystreamassessment.htm]. The model was based on study data collected by the Kentucky Division of Water while developing a

macroinvertebrate bioassessment index for small headwater streams in the eastern Kentucky coalfield (Pond and MacMurray, 2002). The protocol has been calibrated in eastern Kentucky and is being used by the COE Louisville District to process CWA Section 404 applications involving MTM/VF. The COE Norfolk and Huntington Districts are gathering additional data to calibrate the model so it is representative for their areas. This stream assessment methodology will ultimately be calibrated and used by the COE Districts within the geographic extent of the EIS study area (e.g., the Louisville, Huntington, Norfolk, and Nashville Districts). In specific geographic areas, use of the protocol would be preceded by a NWP 21 regional condition that valley fills in watersheds larger than 250 acres would begin processing as an IP [Chapter II.C.1.a.1.]. Following the initial processing decision based on the 250 acre threshold, the protocol would determine if the impacted aquatic resource is too valuable, or mitigation is insufficient to warrant NWP authorization, then the project must complete processing as an IP.

The stream assessment procedure is largely based on EPA's Rapid Bioassessment Protocols (RBP) for Use in Streams and Wadeable Rivers (Barbour et al., 1999) and depends on reference data calibrated to streams within the region. The RBP is based on sound ecological principles and has undergone extensive peer review and wide field application. The functional stream assessment protocol is a cost-effective tool for baseline data collection by the applicant. In addition, the protocol accommodates review period limitations of the COE District staff when independently verifying functional assessment scores of stream or mitigation sites.

The COE stream protocol includes characterization, assessment, and analysis phases:

> Characterization phase: Similar to the RBP, this phase involves a checklist for describing the headwater stream ecosystem, the surrounding landscape, and the existence of special resources such as endangered species or cultural resources.
>
> Assessment phase: Regionally-calibrated models are developed and used to calculate an ecological integrity index for a defined stream ecosystem. The index represents an estimate of ecological integrity of the stream ecosystem relative to reference (i.e., least disturbed) stream conditions in the same region. The output of the model ranges from 0–1 in decimal increments, calibrated such that a score of 1.0 represents the best stream conditions (i.e., indicative of the reference streams). The model is further calibrated so that a score approaching 0 represents degradation, which indicates maximum deviation from reference conditions. The computed ecological integrity index is multiplied by the length of stream involved (i.e., length of stream impacted due to a proposed discharge of fill or length of stream rehabilitated during compensatory mitigation) to derive a measure of *ecological integrity units* (EIU).
>
> The computed EIUs serve as an estimate of the functions represented by a specific aquatic resource at the time of survey. Assessments of ecological integrity are performed for existing (i.e., pre-project) stream conditions and post-project (following onsite restoration or offsite mitigation) stream conditions. The estimated EIU provides a “currency” to measure the relative quality and quantity of undisturbed stream ecosystem functions; the functional loss expected due to project impacts; and the functional gains anticipated from offsetting mitigation measures.

Analysis phase: Analysis of the characterization and assessment phase results involves the following:

- Description of the potential project impacts;
- Description of the actual completed project impacts;
- Identification of ways to avoid and minimize proposed project impacts;
- Determination of the least damaging alternative to the proposed project;
- Determination of compensatory mitigation needs to offset unavoidable impacts of the proposed project;
- Determination of stream restoration potential within the watershed;
- Development of design criteria for stream restoration projects;
- Planning, monitoring, and managing stream mitigation or restoration projects;
- Monitoring and evaluating performance standards or success criteria for stream mitigation efforts;
- Comparison of stream management alternatives or results;
- Determination of appropriate in-lieu fee ratios; and
- Identification of priorities for in-lieu fee mitigation projects.

Inspection and Bonding

Mining operations must comply with all SMCRA, NPDES, and other state or Federal permit conditions. SMCRA and NPDES permits are designed to provide environmental protection in a manner similar to the objectives of the CWA Section 404 permit terms and conditions. NPDES and SMCRA permits are monitored by routine inspections to assure mining and reclamation occurs in accordance with approved plans. The COE District Engineer (DE) may take into account the existence of controls imposed under other Federal, state or local programs which would achieve the objective of the desired permit terms and conditions, e.g., the number, size and location of valley fills and completion of a mitigation plan [33 CFR 325.4(a)(2)]. The COE may rely on the permitting, data collection, reporting, monitoring, inspecting and enforcement controls established under SMCRA, NPDES and other Federal or state regulatory programs for purposes of CWA Section 404 compliance.

Ensuring compliance with required CWA Section 404 offsite compensatory mitigation (e.g., in-lieu fee payment or aquatic resource projects) through inspection and bonding is the sole responsibility of the COE, unless all or some of the offsite mitigation is also required by state law or regulation. If the DE has reason to consider that the permittee might be prevented from completing work which is necessary to protect the public interest, the DE may require the permittee to post a bond of sufficient amount to indemnify the government against any loss as a result of corrective action it might take [33 CFR 325.4(d)]. The amount of the bond would depend on the amount and type of work to be completed based on past experience.

a.2. SMCRA

Aquatic, Fish, Wildlife, and Related Environmental Resource Characterization

As previously discussed in this Chapter, SMCRA performance standards require minimizing disturbance of the hydrologic balance within the permit area to prevent material damage to the hydrologic balance outside of the permit area. The applicant must adequately characterize the

hydrologic resources through representative baseline data collection of seasonal surface and groundwater quality and quantity. The applicant must also use the baseline data to assist in predicting the probable hydrologic consequences (PHC) of surface coal mining operations on these hydrologic resources. The PHC addresses such factors as how mining operations would avoid stream impacts that would significantly alter runoff and stream flow contributions to different tributaries; adversely affect water quality; temporarily or permanently divert streams; and, manage drainage within and leaving the mine site so that erosion and sedimentation are properly controlled. [30 CFR 780.21.]

SMCRA baseline surface water data collection documents stream flow, temperature, and chemistry. Water quality parameters may include, but are not necessarily limited to, total suspended solids, total dissolved solids or specific conductance, total iron, pH, total manganese, acidity, and alkalinity within and downstream of the proposed mining project. An example of type of baseline information and analysis for PHC preparation is contained in the OSM PHC/CHIA guidance document [Permitting Hydrology: A Technical Reference Document for Determination of Probable Hydrologic Consequences (PHC) and Cumulative Hydrologic Impact Assessments (CHIA); [http://www.osmre.gov/pdf/phcchiareport.pdf]. The SMCRA regulations do not currently contain requirements for biological monitoring or documenting physical attributes of streams. SMCRA requirements, similar to EPA water quality standards, presume that maintaining water quality and minimizing contributions of sediment are surrogates for ensuring biological integrity.

While SMCRA does not specifically require biological monitoring as part of baseline stream characterization, the regulations provide a basis for requesting supplemental information when PHCs suggest that adverse hydrologic impacts may occur as a result of the surface coal mining. In addition, many state SMCRA or water quality agencies currently perform protocols including many of the biological, physical and chemical elements of the COE functional stream assessments. Therefore, between the surface water quality and quantity data required by SMCRA and the biological monitoring required by states, most of CWA Section 404 functional assessment data components are already being gathered for some stream locations.
In addition to these aquatic resource characterizations and hydrologic impact predictions, SMCRA regulations specifically provide details for identification and protection of unusually high value fish, wildlife, and related resources. Minimization of impacts to, and enhancement of, these values are required (to the extent practicable using the best technology currently available), regardless of the level of resource value. Identification of important values and the level of detail for baseline information and the protection plan are established by the regulatory authority, in consultation with the state and Federal fish and wildlife agencies. The fish and wildlife protection plan must be included in the permit application and must contain site-specific considerations. The FWS is afforded the opportunity to review and comment on the protection plans. Many states have included the state fish and wildlife agencies in this review.

During the permitting baseline data collection phase, the regulatory authority, in consultation with the wildlife agencies, has the authority to require definition of the extent of the riparian zone if it is of unusually high value or requires special protection under state or Federal law. Valuable fish and wildlife habitats must be identified and site-specific resource information obtained under 30 CFR 780.16. A protection and enhancement plan for eligible resources is then developed based on the baseline information. A necessary element of stream restoration projects and protection of fish and wildlife values is the replacement of adequate riparian zones. The regulatory authority can require

establishing riparian zones as part of reclamation (whether special resources are involved or not) through the authority of 30 CFR 816.97.

Onsite Mitigation

The AOC performance standard, described in Chapter II.C.5.a.2., is a part of the restoration component of mitigation. This SMCRA provision requires reclamation of the mine site, through backfilling and grading, to conditions closely resembling the pre-mining configuration and blending in with and complementing the surrounding drainage patterns. OSM regulations also require permanent stream diversions designed and constructed so as to restore or approximate the pre-mining characteristics of the original stream channel, including the natural riparian vegetation to promote the recovery and enhancement of the aquatic habitat [30 CFR 816.43(a)(3)]. SMCRA reclamation is not considered complete until water quality leaving the site complies with CWA standards without additional treatment. Sediment control structures may be removed and reclamation performance bonds released when water quality meets standards before entering the sediment pond/structure.

Monitoring and Inspection

Surface water sampling and testing are required during and after mining as part of the approved SMCRA monitoring plan. This monitoring allows comparison of discharges leaving the mine site with baseline quality and quantity as well as receiving stream water quality standards. Such monitoring determines if violations occur and indicates if onsite mitigation is restoring particular water quality functions [30 U.S.C. 1257(b)(9), (11), (13); 30 CFR 816.42].

The approved mining plan includes detailed operational sequencing steps; engineering designs and specifications for roads, drainage control structures, impoundments, backfills, valley fills, etc.; and other hydrologic reclamation plans (such as special material handling, monitoring plans, water replacement contingencies, etc.). The mining plan must be followed by operators when conducting the mining project and is used as a blueprint by SMCRA inspectors to check compliance with both SMCRA and CWA standards.

Bonding for Reclamation

All surface coal mining operations must provide financial mechanisms (e.g., insurance, cash, certificates of deposit, or other types of surety bonding instruments) adequate to cover the SMCRA regulatory authority's anticipated costs of carrying out the approved reclamation plan. The reclamation plan may include onsite mitigation measures. Performance bonds are controlled by the SMCRA authority so that, if the company becomes bankrupt or otherwise insolvent, the reclamation plan can be completed. The amount of the bond required for each mine site "shall depend upon the reclamation requirements of the approved permit; shall reflect the probable difficulty of reclamation giving consideration to such factors as topography, geology of the site, hydrology, and revegetation potential..." as determined by the SMCRA regulatory authority. "The amount of the bond shall be sufficient to assure the completion of the reclamation plan if the work had to be performed by the regulatory authority in the event of forfeiture and in no case shall the bond for the entire area under one permit be less than $10,000." [30 U.S.C. 1259, 30 CFR 800.] Effectively, the SMCRA bond also provides financial assurance that the portion of reclamation constituting onsite mitigation approved by the COE is completed.

b. Alternatives 1, 2, and 3

Action 8: CWA and SMCRA regulatory authorities would continue to assess aquatic ecosystem restoration and mitigation methods for mined lands and promote demonstration sites. The agencies would also work with interested stakeholders to develop a "best management practices" (BMPs) manual for restoration/replacement of aquatic resources.

As discussed previously, the CWA requires avoidance, minimization, or compensatory mitigation for unavoidable impacts to waters of the U.S. Creation of riparian zones, organic carbon re-generation by tree planting, stream reconstruction techniques (such as those identified by Rosgen), constructed wetlands, and other methodologies can be used as mitigation for aquatic resource impacts under the CWA. Mining proposals for CWA Section 404 authorization must design and describe these measures.

The sections above also describe the SMCRA provisions to minimize adverse impacts onsite to the hydrologic balance and to unusually high value fish, wildlife, and related resources. Impact minimization is accomplished through a process of resource characterization, prediction of mining impacts, and development of detailed mining and reclamation plans. SMCRA requires a reclamation plan designed to accomplish performance standards. Onsite mitigation components are part of the reclamation plan.

The technology for re-establishing aquatic functions of impacted streams and related environmental resources is not thoroughly documented in one set of comprehensive guidelines. For example, the Rosgen method [Rosgen, 1996] widely applies to the restoration of perennial streams is based upon detailed criteria. Similar criteria for restoring smaller headwater streams that flow ephemerally or intermittently are not currently well documented. Consequently, mitigation efforts for headwater streams must be based on past experiences and documented use of best professional judgements founded upon existing technology, sound science, and data. The information derived from these experiences in the field would be embodied in the BMP mitigation manual.

This action proposes collection of information on successful restoration of aquatic and riparian habitat at mining or similar construction projects causing stream impacts. CWA and SMCRA regulatory authorities' can promote aquatic ecosystem restoration concepts through demonstration projects and also build a useful body of scientific knowledge on the application of restoration methods to mined lands. Study of headwater streams relocated on natural hillsides or placed on backfill and/or valley fills could document aquatic functional replacement. This data would become the basis for establishing future onsite mitigation requirements. The use of EPA grants or approval of these approaches under OSM's experimental practice program may be methods for increasing knowledge in this area.

Under this action, the state and Federal agencies would develop and maintain a detailed technical handbook or manual of information. The manual would build upon existing COE, EPA, OSM, and state agency publications (e.g., EPA Stream Corridor Restoration: Principles and Practices, COE Mitigation Regulatory Guidance Letters, OSM Diversion Handbook, etc.) and be tailored to coal mining situations. Periodic technical conferences would be held to develop, review, and update the manual information. The manual would include the following:

- BMPs for protection, enhancement, and development of aquatic and riparian ecological resources;
- Information on the characterization, mitigation, restoration and replacement of streams, riparian zones, and related ecological resources;
- Stream delineation guidelines developed with the cooperation of stakeholders and academia and approved by agencies that regulate mining [see Chapter II.C.4.a.5, Actions 6 and 9];
- "How-to" discussions of mitigation strategy implementation;
- An inventory of AML, active mining, construction, or other COE-approved restoration projects that demonstrate successful aquatic habitat creation, restoration, or enhancement; and,
- "Road maps" for successful partnering with case studies and comprehensive lists of necessary approvals for implementing mitigation.

The BMP manual described above could provide guidelines for ecological restoration methods complementing the engineering design and performance standards. For instance, the manual would discuss restoring aquatic habitat using innovative design, construction, and grading techniques incorporating excess spoil fill, backfill, and natural ground configurations. An explanation of SMCRA implementing regulations at 30 CFR 816.71 allow an applicant to choose different excess spoil configurations other than the typical durable rock, valley, or head-of-hollow fills specified in other OSM regulations. The difficulties of capturing groundwater moving through the mined area at the down-dip area of the "pavement" or "bench" to provide necessary water for aquatic habitat reconstruction should be incorporated. Lining any channels reconstructed on backfill to minimize infiltration should also be discussed in such a manual.

The manual might also explore different landforming concepts. Landforming concepts were advanced in the Mining and Reclamation Technology Symposium [Appendix H]. This approach could result in final backfill grades with a more natural appearance, without the straight lines usually presented by terraces on outslopes. The mining industry proposed another landforming concept to shape an excess spoil fill to create a man-made ridge line between the existing natural ridges with stream channels restored in the intervening valleys. Another proposal designed a side-hill fill with a stream channel constructed at the intersection of the fill and natural ground. Other feasible landforming opportunities may be conceived and included as the state of the science develops with additional data, experience in mitigation, and engineering design. Opportunities to employ landforming and stream restoration techniques in the mine design may provide features such as sinuosity, pools, riffles, riparian vegetation, or other appropriate aquatic habitat to replace stream function. The manual would remind the designer that use of any alternative fill configurations must simultaneously satisfy fill minimization, drainage control, long-term stability, and also conform to any other performance standards and reclamation requirements (such as erosion control, revegetation, etc.). Meeting all of these requirements may present unique design, construction, and regulatory program conflicts. Inter-governmental cooperation and flexibility are critical for implementing a comprehensive mitigation strategy.

Action 9: The COE would refine and calibrate the stream assessment protocol for each COE District where MTM/VF operations are conducted. This protocol would be used to assess stream conditions and to determine mitigation requirements as part of the permitting process. The COE would compile data collected through application of the assessment protocol and other information in a GIS database. These data would be used to evaluate whether programmatic "bright-line"

thresholds, rather than case-by-case minimal individual or cumulative impact determinations, are feasible for CWA Section 404 MTM/VF permits.

The stream assessment protocol is calibrated and in use in the portion of Kentucky under jurisdiction of the COE Louisville District. Calibration is ongoing within the COE Huntington and Norfolk Districts for use in eastern Kentucky, southwestern Virginia, and southern and central West Virginia. The COE Nashville District calibration and implementation would apply to MTM/VF proposals in portions of the eastern Kentucky coalfields and all of the Tennessee coalfields. The COE would continue to refine the stream assessment protocol as increased data and experience accrue in the Appalachian states.

The application of the stream assessment protocol, along with other baseline data, provides information on the type (ephemeral, intermittent or perennial), quality, length, and watershed size of streams being impacted. Other data from CWA, SMCRA, and NPDES permits are available, including areal extent of permit disturbances, HUC codes, land use, groundwater, additional downstream water quality/quantity, etc. Relevant data could be compiled in COE GIS databases for analysis to make permitting decisions consistent with the CWA Section 404(b)(1) Guidelines. Moreover, with sufficient information and experience, the COE may find that certain impacts (e.g., stream length lost, watershed size affected, percent of watershed disturbed, or other qualitative/quantitative resource impacts) typify projects requiring an IP process.

Under Alternative 2, the existing regional condition would continue to apply to MTM/VF proposals in certain geographic areas where impacts in watersheds larger than 250-acres would generally begin processing as IPs. This condition would apply until such time as the COE, utilizing its GIS database and analysis of scientific data, determines if programmatic individual or cumulative impact thresholds are appropriate to replace or modify the case-by-case determinations.

Action 10: Incorporate mitigation/compensation monitoring plans into SMCRA/NPDES permit inspection schedules. Coordinate SMCRA and CWA requirements to establish financial liability (e.g., bonding sureties) to ensure that reclamation and compensatory mitigation projects are completed successfully.

To ensure that adequate mitigation projects are approved in the SMCRA and/or CWA 404 permits, the application review would incorporate use of the functional assessment protocols to determine if the mitigation attains EIUs equivalent to those lost by unavoidable impacts (see Actions 5, 6, and 9 as well as the description of the existing CWA Section 404 program in Chapter II.C.4.a., above). Construction plans, specifications, time lines, and deadlines to accomplish the mitigation project(s) would be incorporated into the applicable permit (e.g., offsite mitigation in the CWA Section 404 permit and onsite mitigation in the SMCRA permit). Another permit which may cover mitigation projects is an NPDES permit, monitored by routine inspections to assure that discharges from permitted outfalls to waters of the U.S. are in compliance with the approved permit, effluent limits, and water quality standards. These various permits could provide inspectors with the plans they need to inspect and enforce the respective on- and offsite mitigation/compensation plans.

Bonding mechanisms exist under both SMCRA and CWA Section 404. These bonding mechanisms could be used in combination to provide financial assurance for the completion of compensatory mitigation projects.

This action envisions development of a state and/or Federal agency coordination process to:

- Secure joint concurrence on mitigation project design adequacy;
- Avoid "double bonding" under state and/or Federal statutes; and,
- Inspect approved mitigation projects to ensure compliance.

Coordination in these areas could involve joint meetings with the applicant; appropriate permit review sequencing, consensus selection of mitigation measures and plans; delineation of agencies' bonding responsibilities to encompass all components (offsite and onsite) of the mitigation measures; and, shared inspection duties, monitoring reports, communication regarding enforcement actions. Action 1 discusses the agencies' establishing a memorandum of understanding (MOA) including coordination procedures and a joint permit application for SMCRA and CWA 404 applicants. The MOA would also outline the process for the interaction on selection, bonding and inspection of compensatory mitigation.

This following action applies to Alternatives 2 and 3:

Action 11.2 and 11.3: The SMCRA regulatory agency, in conjunction with the PHC, CHIA, and hydrologic reclamation plan, could apply the COE's stream assessment protocol to consider the required level of onsite mitigation for MTM/VF.

SMCRA applications contain baseline data, predictions of hydrologic consequences and a reclamation plan designed to minimize impacts to the hydrologic balance, fish, wildlife, and related environmental resources. While SMCRA does not currently require biological monitoring as part of baseline stream characterization, Actions 3.2, 3.3, and 7 propose to revise the SMCRA regulations to provide a basis for application of stream assessment protocols as an integral part of baseline data collection where adverse impacts to waters of the U.S. would result from an applicant's proposal. The applicants' PHCs would detail the resources and anticipated consequences. The hydrologic reclamation plan would include onsite mitigation measures to offset unavoidable adverse impacts. The SMCRA agency would review this information, factor it into the CHIA, and the COE could substitute the resultant SMCRA plans and findings for the onsite mitigation portion of the CWA Section 404 permit. If the COE finds that SMCRA or state-approved mitigation is adequate, additional mitigation would not be required. SMCRA applicants must describe the steps to be taken to comply with CWA permit requirements, including any required compensatory mitigation measures [30 U.S.C. 1258(a)(9) and (13) and 30 CFR 780.18(b)(9)]. Selection of Alternative 1 does not include this action.

7. Cumulative Impacts

The Council on Environmental Quality (CEQ) regulations [40CFR 1500-1508], implementing the procedural provisions of NEPA, define cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions [40 CFR 1508.7]." "Actions," as used in CEQ regulations, may include a broad range of activities from those as specific as individual construction projects to those as general as implementing regulatory programs. Individual adverse impacts from an action may be insignificant individually, but may accumulate over time from one or more origins and collectively result in significant adverse impacts that degrade important natural resources. The cumulative impacts of a

particular action can be viewed as the total effects on natural resources, socioeconomic resources, human health, recreation, quality of life aspects, and cultural and historical resources of that action and all other activities affecting those resources, compounding the effects of all actions over time.

This EIS evaluated the cumulative effects of MTM/VF on various resources, socio-economics, and the human or natural environment: Chapter III.N, Past and Current Mining in the Study Area; Chapter III.O, The Scope of Remaining Surface-Minable Coal in the Study Area; Appendix G, Post Mining Land Use Assessment--Mountaintop Mining in West Virginia, Mountaintop Technical Team Report, Phase I and II Economic Studies, Case Studies Report on Demographic Changes Related to Mountaintop Mining; Appendix I, Landscape Scale Cumulative Impact Study of Mountaintop Mining Operations and Figure III.O., The Extent of Potential Mountaintop Minable Coal.

The data compiled and technical studies performed for this EIS indicate that in 1998 the EIS study area represented about 25% of national coal production [Chapter III.N]. The 12,000,000 acres of the study area are dominated by 92% forest cover. Surface mining has disturbed about 400,000 acres in the last ten years, or about 3% of the study area. When impacts of mining, logging, and human development are combined, an estimated 11% of the forested portion of the EIS study area is projected to be deforested in a ten-year period. This estimate does not include any reforestation efforts following mining and timbering. [Appendix I] The study area is underlain by scattered but considerable remaining coal deposits; however, the portion of the remaining deposits that is minable could not be accurately estimated due to the inability to generalize site-specific mining engineering considerations on a regional scale [Chapter III.O]. Various economic evaluations [Appendix G and H] indicate that the size of valley fills is directly proportionate to the amount of coal recoverable by existing MTM/VF methods. Absolute limitations on valley fill size would result in: 1) reserves typically accessible by larger mining equipment becoming unminable; 2) more rapid depletion of reserves minable by smaller equipment spreads; 3) increased competitive pressure on central Appalachian coal from Powder River Basin, natural gas, or other imported/domestic coal sources; and 4) resultant increases in mining costs, drops in mining and related employment, decreases in severance taxes, etc. [Appendix G]

The West Virginia portion of the study area contains previously-mined or currently-permitted acreage not returned to AOC that could be developed in support of existing or future infrastructure based on population trends. One study indicated that demographic factors, such as population and economic growth, influence the demand for developable mine sites. Further, the study observed that mined sites are more developable because they do not have slope and other limitations (e.g., landslides, poorly draining soils, etc.). Rural residents in the West Virginia portion of the EIS study area could be impacted (noise, truck traffic, etc.) by future mining due to proximity within two miles or less of mining sites. [Appendix G: Yuill, 2002] The demographic data, compiled from census comparisons, indicates that population, family income, and levels of employment have been in decline within the EIS study area over several decades. Some residents interviewed from the West Virginia and Kentucky portion of the EIS study area perceived that MTM/VF negatively affected these factors, but the data showed similar declines in areas outside of the MTM/VF activities. [Appendix G: Case Studies Report on Demographic Changes Related to Mountaintop Mining]

NEPA requires that environmental, socio-economic, indirect and cumulative impacts be identified and evaluated for Federal actions [40 CFR 1508.8]. While, under NEPA, agencies must consider all impacts of their actions, the authority of a particular agency to take action to remedy those impacts may be limited [40 CFR 1500.6]. For instance, the COE's jurisdiction for controlling

environmental impacts is provided by CWA Section 404 and is generally limited to waters of the U.S. Accordingly, while broader impacts are considered, individual and cumulative impacts to aquatic resources are the portion of the COE's NEPA analysis for which impacts can be directly addressed [Appendix B to 33 CFR Part 325 - NEPA implementation procedures for the Regulatory Program]. The collective Federal involvement of the COE and other Federal agencies is sufficient to grant legal control over CWA Section 404 project aspects beyond aquatic resources (e.g., T&E species, cultural and historic resources, or SMCRA permits in Tennessee). Therefore, CWA Section 404 project effects other than aquatic resources may be considered and addressed in NEPA analysis.

The COE considers direct, indirect, and cumulative impacts of each project requiring a CWA Section 404 IP and documents those impacts as required by NEPA in the accompanying EA or EIS. The COE considers the same impacts programmatically for categories of projects of a certain size or type when CWA Section 404 NWPs are re-authorized every five years. The NEPA review for the NWP renewal has found that authorization of projects under this general permit would result in no more than minimal cumulative impact. Projects authorized under NWP need no additional NEPA compliance review. To verify NWP eligibility, the COE evaluates each project to determine if impacts are less than minimal, either individually or cumulatively. For those projects that meet the criteria for a NWP, but would have more than minimal individual or cumulative impacts, processing as an IP and separate NEPA analysis are required.

SMCRA Section 702(d) states that SMCRA rulemaking is a major Federal action requiring NEPA compliance. Consequently, OSM prepared a programmatic EIS and supplement upon promulgation of SMCRA permanent program regulations [USDI, OSM, 1979 (EIS-1) and 1983 (EIS-1 Supplement v.1)]. However, OSM delegation of SMCRA authority to each state is not a major action requiring NEPA compliance [30 U.S.C. 1292(d)]. The OSM 1979 EIS explained this SMCRA section, stating that additional NEPA review was not required upon state adoption of comparable statutory and regulatory requirements, because NEPA review occurred upon promulgation of the SMCRA regulations. That is, since state SMCRA programs must be as stringent and effective as the Federal program [30 U.S.C. 1252], NEPA compliance by OSM on state delegation of similar provisions would duplicate that done for the Federal rules. Following SMCRA program delegation to a state, each state surface coal mining permit approval is not considered a major Federal action, and NEPA compliance is unnecessary.

Unlike the other states in the EIS study area, coal mining in Tennessee is under the jurisdiction of the OSM Federal program and each SMCRA permit approval is considered a Federal action requiring NEPA review. NEPA reviews in Tennessee tier off of the SMCRA permanent program EIS, but may consider and address resource impacts from coal mining beyond the focus of CWA Section 404 NEPA reviews.

Like the COE, SMCRA NEPA compliance may consider broad environmental, socio-economic, and cumulative impacts; but SMCRA authorities can directly address only those coal mining impacts under their authorities. SMCRA, exclusive of NEPA, addresses many environmental issues, such as post mining land use, revegetation, aquatic resources, fish and wildlife resources, and offsite damage from landslides, and effects on the public including blasting, noise, water supplies and fugitive dust. SMCRA applications reviews in all states in the EIS study area consider these impacts for each mining proposal independent of NEPA. SMCRA also requires consideration of the cumulative hydrologic impacts of existing and anticipated surface coal mining operations.

This EIS proposes a number of actions (reduced stream loss, reforestation, air quality controls, improved water quality) described under the various issues of this Chapter, that minimize cumulative impacts on the natural and human environment. A cumulative impact action, discussed below and applicable to all alternatives, is the continued collection and analysis of environmental and socioeconomic information and development of cumulative impact thresholds for regulated activities.

a. No Action Alternative: The Regulatory Program Today

a.1. CWA

NEPA Role in CWA Section 404 Cumulative Impact Analyses

This document has previously described how CWA Section 404 applications consider cumulative impacts in the NEPA context for general and individual permits. When the NWP permits are initially issued, they undergo a NEPA analysis for a category of activities to determine that, individually and cumulatively, the projects would result in no more than minimal aquatic impacts. NWP 21 specifically authorizes the category of coal mining-related fills in waters of the U.S. To verify NWP 21 eligibility, the COE evaluates each project case by case to determine if impacts are no more than minimal, either individually and cumulatively. Projects authorized under an NWP need no additional NEPA review. Some projects may qualify for a NWP, but would have more than minimal impacts, either individually or cumulatively. If this is the case, processing as an IP with a separate NEPA analysis is required.

For IP applications, the COE establishes whether an EA/FONSI or EIS is needed to address the impacts of fills in waters of the U.S. Regardless of the scope of the Federal action, the COE considers all impacts of its action, including indirect (or growth-inducing) effects [40 CFR 1508.8]. The scope of the NEPA analysis by the COE includes the environmental impacts on portions of a project that extend beyond waters of the U.S. where there is combined involvement of the COE and other Federal agencies. In determining whether sufficient combined Federal involvement exists to expand the NEPA analysis to upland portions of a project, the COE considers whether other Federal agencies are required to take Federal action under the Fish and Wildlife Coordination Act [16 U.S.C. 661 et seq.]; the National Historic Preservation Act of 1966 [16 U.S.C. 470 et seq.]; the Endangered Species Act of 1973 [16 U.S.C. 1531 et seq.]; Executive Order 11990, Protection of Wetlands, [42 U.S.C. 4321 91977]; and other environmental review laws and executive orders. Once the scope of analysis has been defined, the NEPA analysis for the proposal would include direct, indirect and cumulative impacts. The COE, whenever practicable, incorporates by reference environmental reviews conducted by other Federal, and integrates state agency reviews, as appropriate. [Appendix B to 33 CFR Part 325 - NEPA implementation procedures for the Regulatory Program.]

The COE is guided in its cumulative impact review of IPs by regulations at 33 CFR 325.3(c)(1), generally described as follows. The decision whether to issue a CWA Section 404 permit is based on the evaluation of the probable impacts, including cumulative impacts, of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The projected benefits of the proposal must be balanced against its reasonably foreseeable detriments. All factors relevant to the proposal, including their cumulative effects, are considered. These factors include conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water

supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership and in general, the needs and welfare of the people.

CWA Role in Cumulative Impact Analyses

In addition to NEPA's broader cumulative impact reviews of several types of environmental resources, the goal of the CWA in protecting the integrity of the nation's waters necessitates that cumulative impacts on aquatic resources be considered in project reviews. For MTM/VF and their outfalls in waters of the U.S., CWA Sections 303, 401, 402, and 404 play a role in addressing cumulative impacts. These sections were previously outlined or discussed as they pertain to water quality in Chapter II.C.4.a.

A CWA Section 404 permit cannot be issued without a state CWA Section 401 Certification that state water quality standards will not be violated by authorizing the proposed activity. The state may consider both the individual water quality impacts of the project and impacts of the project in light of other activities in the watershed, technology-based effluent limits, water quality standards, TMDLs (if applicable), and antidegradation requirements. The anti-degradation requirements work to reduce or eliminate cumulative impacts by providing a process to maintain existing water quality levels to meet intended uses. If individual or cumulative effects of a project violate state water quality requirements, the state may deny certification. The state certification may include special conditions to protect or restore water quality. These conditions subsequently become part of the CWA Section 404 permit. The COE presumes that a state water quality certification satisfies the requirements of CWA Section 401; the CWA Section 404(b)(1) Guidelines relevant to water quality under 40 CFR 230.10(b)(1); and the COE rules at 33 CFR 320.4(d). Therefore, the COE views the state water quality certification as satisfying the water quality portion of cumulative impact analysis [COE RGL 90-4; Water Quality Considerations].

EPA has a role in the review of COE CWA Section 404 permit authorizations. When the COE considers issuance of an IP, CWA Section 404(q) and Section 404(c) provide dispute resolution processes for the COE and EPA regarding individual or cumulative adverse impact determinations. [Chapter II.C.1.]

a.2. SMCRA Cumulative Hydrologic Impact Analyses (CHIA)

SMCRA Section 507(b)(11) requires the applicant to provide "a determination of the probable hydrologic consequences (PHC) of the mining and reclamation operations, both on and off the mine site, with respect to the hydrologic regime, quantity and quality of water in surface and ground water system including the dissolved and suspended solids under seasonal flow conditions and the collection of sufficient data for the mine site and surrounding areas..." The PHC allows an assessment "made by the regulatory authority of the probable cumulative impacts (CHIA) of all anticipated mining in the area upon the hydrology of the area and particularly upon water availability...." [30 U.S.C. 1257].

The CHIA is performed for a watershed, the cumulative impact area (CIA), defined by the regulatory authority based on the hydrology of the area. The SMCRA regulations require "[H]ydrologic and geologic information for the cumulative impact area necessary to assess the probable cumulative hydrologic impacts of the proposed operation and all anticipated mining on surface- and ground-water systems..." [30 CFR 780.21]. The size of the CIA must be large enough to encompass a number of mining operations, but not so large that the influence from mining

operations on the hydrology cannot be detected. CIAs in the EIS study area tend to comprise watersheds of 10,000 to 40,000 acres of similar geologic characteristics and hydrologic connectivity.

A CHIA is updated with each new mining proposal to assure that additional impacts within the CIA do not result in unacceptable adverse impacts to surface water quantity and quality. Unlike the assessment required under the CWA of all sources of aquatic impacts within a watershed, the CHIA only requires consideration of cumulative impacts from known and anticipated coal mining within the CIA. However, in assessing the impacts of coal mining, the CHIA considers the overall water quality of the watershed. A CHIA determines whether the proposed operation is designed to prevent material damage to the hydrologic balance outside the proposed permit area. This provides an opportunity for SMCRA to identify and evaluate cumulative impacts to surface and ground-water systems from mining and other human activities in the area. In addition to the CHIA, where NEPA applies (e.g., Tennessee), all impacts must be disclosed, including direct, indirect (e.g., growth-inducing) and cumulative impacts, and OSM must consider all reasonably foreseeable actions together with mining operations [40 CFR 1508.7 and 1508.8].

To better facilitate the preparation of CHIA documents by the various SMCRA regulatory programs, OSM developed a technical reference document entitled "Permitting Hydrology, A Technical Reference Document for Determination of Probable Hydrologic Consequences (PHC) and Cumulative Hydrologic Impact Assessment (CHIA)--Baseline Data" [http://www.osmre.gov/pdf/phcchiareport.pdf] This guidance document assists in the preparation and review of proposed surface coal mining operations by outlining a sound technical approach for obtaining the geologic and hydrologic information to meet baseline data requirements needed to support development of PHCs and CHIAs. To finalize this document and facilitate its acceptance and use by both the coal producers and the various SMCRA regulatory agencies, OSM organized and participated in an intergovernmental workshop on PHC/CHIAs.

The amount and type of hydrologic data varies from state to state, but similar data sources are used to compile PHC/CHIA analysis input. SMCRA and NPDES require upstream and downstream water quality monitoring of permitted outfalls at existing mining operations (see Chapter II.C.4.a.6). Data from other surface water quantity and quality monitoring points are part of the SMCRA baseline information before mining and approved surface water monitoring plans during mining. These data sources are closest to the mining disturbance and they provide indications of upstream hydrology in the CIA, and provide compliance data on particular pollutant loadings. Various monitoring stations accumulate watershed information characterizing the downstream reaches of the CIA. At the downstream limit of the surface water component of the CIA, several states have developed "trend stations." Water quality and quantity information collected at these trend stations indicates background conditions and provides the basis for both detection of potential influence from upstream mining operations and modeling or other forms of predictive analysis. Some relevant historical or current hydrologic monitoring data may be available, including U.S. Geological Survey (USGS) and COE stream gauging stations, USGS NAWQUA, WATSTORE and STORET hydrologic data, state CWA antidegradation monitoring points, and other state water quality basin survey locations.

Limitations of the existing trend analysis systems include the following: water chemistry data collection is focused solely on coal mining impacts; stations were not randomly selected and may not be statistically located; concerns have been expressed as to excessive watershed size; there are no reference stations in the system (stations on undisturbed streams of similar size and geology); no

biological data are collected; and all existing data (TMDL, NPDES, USGS NAQWA, EQUIS, etc.) are not available in a single GIS database. Integration of all these data sources in one GIS system would be beneficial to applicants, the public, and regulatory agencies.

Requirements for both PHCs and CHIAs are general performance-type standards that identify hydrologic objectives but do not prescribe exact methodologies for predicting hydrologic impacts. The CHIA is an assessment based upon available information and results in defining the incremental hydrologic impacts of the proposed operation in combination with the impacts of all other existing and anticipated mining within the CIA. SMCRA regulatory authorities have the flexibility to combine data specifications, verifications and controls for technically-sound hydrologic impact analyses and supportable permitting decisions. Typically, based upon the predicted loading from all coal mining outfalls in the CIA, the water quality at the trend station or other CIA analysis point is evaluated to determine if effluent limits or in-stream standards would be exceeded. A general discussion of how the states in the EIS study area perform CHIAs follows:

- Kentucky-In 1982, KYDSMRE modeled anticipated loading for coal mining indicators of TDS and sulfates in eleven eastern Kentucky watersheds ranging from 90,000 to 1,400,000 acres (based on USGS HUC-8 watersheds). This Stream Quality Unit Response Model (SQURM) performs long-term predictions based on estimates of loading derived from existing water quality and past coal mining disturbance. For instance, the model predicts the year that TDS concentrations could exceed secondary drinking water standards when mining production surpasses a particular rate. KYDSMRE is currently converting the Fortran-based model to the Windows environment. KYDSMRE will subsequently validate and calibrate the model predictions with stream quality and quantity data collected since 1982 from mining operators SMCRA and NPDES monitoring, USGS data, Kentucky Division of Water basin surveys or antidegradation information, and other available sources. Preliminary evaluation of SQURM predictions indicate close correlation with actual data. Updating the model will allow subdivision of the large watersheds to calibrate SQURM predictions for smaller basins. KYDSMRE anticipates linking existing hydrologic data through GIS to the SQURM model.

- Tennessee-In 1985, OSM established 189 trend analysis stations in sub-watersheds of 6,000-14,000 acres. Downstream monitoring stations, usually located in smaller watersheds (<several hundred acres), are also established by the operators for NPDES and SMCRA discharges associated with mining. The CHIA assumes worst-case conditions as if the total area of active and proposed mine sites are simultaneously disturbed. Drinking water standards for parameters such as sulfates may also be used as material damage thresholds where other life use criteria are not established. If the CHIA predicts any parameters in excess of thresholds, the state water quality agency is notified and additional surveys of water quality and benthics occur. If the state water quality agency determines that supported uses can be maintained, the proposed project may be approved. All of this information is in GIS or other databases; however, the data are not integrated to provide ready access for permit reviewers or other stakeholders. OSM plans to explore the use of models, similar to those under consideration by WVDEP, for CHIA preparation.

- Virginia-Virginia utilizes the USGS HUC-14 watershed classification for 25-30 CIAs, ranging from 10,000 to 40,000 acres. SMCRA permit boundaries and monitoring stations, and NPDES monitoring information are in a GIS, and, other hydrologic information databases for the basis for VADMLR CHIAs. Trend stations are not established in Virginia; however, trend analyses of applicant monitoring data provide for comparative CIA watershed quality and quantity as part of the CHIA. Many Virginia coalfield streams have been adversely impacted by past coal mining and are subsequently included on CWA Section 303(d) lists of impaired waters. The majority of new coal mining proposals reaffect or remine previously-mined areas. Therefore, VADMLR CHIAs tend to evaluate whether or not a proposed coal mining project will improve watershed health in addition to assuring that material damage outside the permit are will not occur.

- West Virginia-WVDEP delineated CIAs based on the hydrology of the area. WVDEP, with OSM assistance, recently established a system of 240 trend analysis stations in 20,000- to 30,000-acre coalfield watersheds. Trend stations were located based on professional judgement (similar geology, hydrologic connectivity, etc.), logistical, and budget considerations. The data from these trend stations assist in preparation of PHCs and CHIAs. The trend stations sometimes correspond with downstream limits of the CIA and are located downstream of NPDES baseline water quality stations (BWQs). BWQ sites, nearer to the proposed mining operations in watersheds of several hundred acres or less, are selected by WVDEP. BWQ points are monitored by the operator before and during mining for pH, flow, iron, manganese, and sometimes aluminum or other identified pollutants of concern. Within these stream monitoring areas, there are also 12 existing USGS gaging stations. For detailed information on the WVDEP CHIA process, see Chapter 32 of the WVDEP Mining Permit Handbook [http://www.dep.state.wv.us/Docs/66sect32.pdf].

  WVDEP hydrologists and geologists assess this information to make a determination as to whether the hydrologic assessment of the CIA indicates that the addition of the proposed operation to all probable cumulative impacts of all anticipated mining may cause more than minimal disturbance to the hydrologic balance within the permit area and adjacent areas, or may cause material damage to the hydrologic balance outside the permit area.

  The WVDEP is currently compiling mining information on a data base to facilitate electronic permitting and public access to information. WVDEP plans to examine the various hydrologic data, using models such as the Watershed Characterization Modeling System(WCMS) developed at West Virginia University along with the USGS Hydrological Simulation Program-Fortran (HSPF) and Mining Data Analysis System(MDAS) developed by Tetra Tech, Inc. to perform CHIAs.

Beyond the CHIA, the SMCRA program also addresses aspects of mining impacts on other natural and human environmental resources through performance standards in the areas of: protection of terrestrial ecosystems; topsoil and subsoil; protection of specific land uses; protection of air quality; noise and vibration; explosives; community integrity and quality of life; post mining land use; excess spoil; coal mine waste disposal; backfilling and grading; revegetation; and roads. While

these performance standards apply to individual mine sites, cumulatively they minimize effects and thus can be relied upon by the COE in their cumulative impact analysis.

b. Alternatives 1, 2, and 3

Action 12: The COE, with assistance from the other agencies, would compile data collected through application of the stream functional assessment protocol, along with PHC, CHIA, antidegradation, NPDES, TMDLs, mitigation projects, and other information into a dynamic GIS database for evaluating and tracking aquatic cumulative impacts. These aquatic and other relevant data would be used to determine the extent of cumulative impact areas for appropriate resources and ascertain whether a programmatic "bright-line" cumulative impact threshold is feasible for CWA Section 404 MTM/VF permits.

This action proposes use of information technology for compiling aquatic resource and other relevant information, as well as defining and analyzing cumulative impact areas in order to satisfy both the CWA Section 404 and NEPA cumulative reviews. As previously described in this section, the COE must consider the individual and cumulative effects of proposed projects on aquatic resources to comport with CWA Section 404(b)(1). Moreover, for those projects resulting in more than minimal individual or cumulative effects (i.e., proposals requiring IPs), the NEPA cumulative assessment of project impacts on broader environmental resources must be part of an accompanying EA or EIS.
The scope of the NEPA analysis relative to MTM/VF may involve several Federal agencies because of T&E species, historic properties, a Federal coal mining permit on state or Federal lands, etc. This action would involve developing an interagency, interdisciplinary approach for NEPA and CWA aquatic cumulative impact assessments, including definition of the cumulative impact area for each resource of significance.

b.1. Data Integration

CWA aquatic resource data

Chapter II.C.4, Stream Impairment, II.C.5, Assessing and Mitigating Stream Habitat and Aquatic Functions, and this cumulative impact section describe a variety of CWA criteria and programs to maintain and restore water quality and aquatic resources. Collection of background aquatic data, impact predictions, and monitoring are fundamental components to accomplish CWA program goals. SMCRA shares this approach and, in combination with data generated in CWA implementation, these statutes provide extensive arrays of information that would be useful in cumulative impact determinations. Because these data are collected for different purposes, by different agencies, and by different methods, the information is only rarely viewed in an integrated fashion. With the advent of GIS and automated data processing, integration is feasible but requires screening and conversion of these multiple data sources to assure functional compatibility. Data resolution (statistically valid, representative of the area, and dependent on scale), identifying data gaps, and adequate methods for evaluation of both individual project and cumulative human impacts are other important factors requiring consideration in assembling appropriate data elements. Temporal factors are also key to the spatial distribution and analysis of data. Data reliability may turn on how recently the data were collected due to improved collection, testing, and analytical methodologies.

Water quality and quantity data are available from NPDES and SMCRA monitoring, antidegradation stream classification baseline water quality sampling (also CWA Section 303(d) stream data), TMDLs, USGS, requisite COE stream functional assessment protocol, and other state water quality and stream condition index surveys. Modeling and other analytical predictions have been performed to evaluate potential impacts of mining and other watershed disturbances (e.g., PHCs and CHIAs; other classes of CWA Section 404 permits, such as road crossings, wetlands, dredging, etc.; and other human activities such as community development, logging operations, utilities, and other infrastructure). These data, once assembled in geospatial context, would serve as a basis for cumulative impact area demarcation and as the foundation for other data collection to fill gaps for cumulative impact analyses. Ultimately, assembling and evaluating these data may indicate that standardized data collection methods are advisable to eliminate dissimilarly collected or analyzed data. Standardization could raise the confidence level and usefulness of the varied data sources in maintaining or restoring water quantity and quality. The MOA and joint permit application proposed in Action 1 in the previous section on government efficiency [Chapter II.C.1] could address ways to achieve standardization between the CWA Section 404 and SMCRA regulatory programs.

Sharing and integrating these data would not only allow CWA Section 404 project impact analysis in an individual or cumulative sense but also provide valuable information for consideration in renewing NWP21 or setting impact thresholds for NWP 21; issuing state CWA Section 401 Certifications; developing TMDL plans and waste load allocations; and reviewing NPDES and SMCRA permits. This action would promote evaluation of science-based cumulative and individual impact thresholds for MTM/VFs, if it is possible to replace current case-by-case impact determinations. This action was envisioned by the COE in the preamble of the 2002 NWPs [67FR 2020-2095] and is discussed in this EIS [Chapter II.C.1.a.1; Chapter II.C.5 (Action 6), and Chapter II.C.6 (Action 9)].

NEPA resource, ecosystem, or human community data

NEPA cumulative analysis for CWA Section 404 IPs must encompass human actions, impacted environmental resources, and ecosystems, so that the effects of the proposed action are examined. Analysis includes indirect and direct effects on the following values: aquatic, terrestrial, cultural, historic and air resources; aesthetics; socioeconomics; and public health. In performance of the NEPA analysis of the specific action proposed, consideration must include reasonably foreseeable actions in the area that may influence these values.

The COE, in the exercise of its CWA jurisdiction, focuses principally on aquatic resource impacts. COE review of an IP application for MTM/VF activities expands the focus to a broader NEPA compliance analysis and consideration and documentation of each affected non-aquatic resource, ecosystem, and human community, as described above. NEPA documents inform the decision maker and the public of project consequences, individually and cumulatively, regarding impacts that may result from the project and other human activities in the cumulative impact area.

In those circumstances when the COE considers non-aquatic resources, such as terrestrial T&E species or critical habitat, in its regulatory review process as described above, the COE NEPA analysis becomes more detailed for this particular resource due to ESA protections [Chapter II.C. 11]. Where non-aquatic resources are impacted, the NEPA alternatives analyzed would concurrently look for ways to accomplish the project purpose while minimizing aquatic <u>and</u> T&E species impacts.

Impacts to upland and aquatic T&E species are addressed in the SMCRA permit process through consultation or coordination with FWS. The COE NEPA analysis could rely on the SMCRA permit for this information. When it is reasonably foreseeable that the natural resources, ecosystem, and human community will be affected but those impacts are not addressed by a particular Federal statute or regulatory program (e.g., CWA, ESA, NHPA, SMCRA, FWCA, etc.), the COE can document these cumulative impacts in the NEPA document for an IP as these impacts relate to the proposal to fill waters of the U.S. In these cases, a proposed MTM/VF IP could result in deforestation, noise, or other impacts to resources beyond COE jurisdiction. The alternatives in the NEPA review will look to various ways to accomplish the project purpose, while minimizing aquatic resource impacts. These alternatives may incidentally lessen or increase affects to other non-aquatic resources, but are geared to the COE jurisdictional decision at hand.

The use of GIS to compile other relevant resource, ecosystem, or community information is a logical augmentation to the aquatic data for use in COE NEPA compliance. Use of information technology and GIS to collect and update these non-aquatic environmental resources and other cumulative effects data will not only aid in current COE NEPA compliance, but build a reference library to better inform future decisions.

The data collection mandated by different regulatory programs results in voluminous information, typically only assessed for particular program requirements. The collective cost of this data collection and analysis is considerable. Compiling similar data from other varied sources could add value by serving multiple program goals and objectives [see Chapter II.C.1]. In summary, collecting, compiling, screening, and updating aquatic and other resource information in GIS, linked to various databases, will allow more-informed, expeditious COE CWA Section 404 and NEPA cumulative impact considerations. This is particularly true for MTM/VF applications within the EIS study area, where considerable coal resource remain and continued receipt of new mining proposals is certain.

b.2. Delineation of Cumulative Impact Areas (CIAs)

Cumulative effects on a given resource, ecosystem, and human community are rarely aligned with political or administrative boundaries. Resources typically are demarcated according to agency responsibilities, county lines, magisterial districts, or other administrative or political boundaries. Because natural and sociocultural resources are not usually so aligned, each political entity actually manages only a portion of the affected resource or ecosystem. Cumulative effects analysis on natural systems must use natural ecological boundaries and analysis of human communities must use actual sociocultural boundaries to ensure consideration of all effects. Further, project-specific analyses are usually conducted on the scale of counties, resource management units (e.g., forests,), installation boundaries, or merely project boundaries; whereas, cumulative effects analysis should be conducted on the scale of human communities, landscapes, ecosystems, watersheds, airsheds, or viewsheds. Therefore, definition of the appropriate CIA and scale (data resolution) for each resource, ecosystem, or human community is an important step prior to cumulative impact analysis.

CWA Section 404 CIAs

The extent of the CIA for aquatic resource cumulative impact analysis should be large enough to encompass the hydrologic regime contributing to the aquatic ecosystem affected by existing and reasonably foreseeable activities. However, the CIA size should not be so large as to reduce

sensitivity or prevent meaningful consideration of predicted impacts for individual and multiple projects. This section earlier described how SMCRA evaluates cumulative impacts from surface coal mining operations on the hydrologic balance (i.e., CHIAs) in geologically similar conditions of hydrologic connectivity, typically a certain-sized watershed. Based on evaluation of the compiled available data using a GIS, as conceptualized with this proposed action, the COE may deem the SMCRA CIA as an appropriate boundary for CWA Section 404 and NEPA analyses of cumulative aquatic impacts. However, since CWA review evaluates all aquatic resource effects within a watershed and not just coal mining impacts, the COE may conclude that smaller or larger CIAs are warranted. Where "piggybacking" on the SMCRA CIA is appropriate, the COE would rely, to the extent practicable, on SMCRA CHIAs as the foundation of the CWA Section 404(b)(1) individual and cumulative impact prediction. The COE can augment the CHIA with the functional stream assessment protocol and other hydrologic data described above to make the required regulatory and NEPA determinations.

CWA Section 404 IP NEPA cumulative impact areas

The extent of CIAs often varies by resource, i.e., the watershed, viewshed, airshed, or other resource areas may not coincide with one another. An interdisciplinary approach is essential to evaluate the cumulative effects to each resource, ecosystem, or human community. McHarg was credited with developing a model in 1969 [*Design with Nature*], coinciding with enactment of NEPA, whereby land use, archaeology, wildlife, vegetation, flood plains, hydrology, slope, soils, geology, and other factors were superimposed to determine the capability of the land to support human activity and the land's suitability for a particular type of development. This process was a precursor to current-day GIS analysis, as envisioned by this action. Creating GIS data layers for each resource, ecosystem, or human community, allows evaluation of each layer individually, or in combination with other layers, and does not necessarily rely on coincident boundaries for each factor assessed.

Data Analysis

The GIS cataloguing of various data types creates the ability to use GIS models, or export the data to other predictive models. Similar to the evolving use of technology to perform the CHIA required by SMCRA, the COE would develop and continually improve comprehensive analytical and predictive technology to implement this action and conduct the CWA and NEPA cumulative impact reviews.

b.3. Establishing Cumulative Impact Thresholds

If the COE determines that the individual aquatic resource impacts of a MTM/VF proposal are more than minimal, the application must undergo IP processing to consider if a CWA Section 404 permit authorization is possible. Moreover, a MTM/VF proposal with individual effects that are less than minimal may contribute to impacts that are cumulatively more than minimal within a CIA. In such a case, IP processing is also required. The *Bragg* settlement agreement recognized the CWA Section 404 distinction between individual and cumulative minimal impacts. The settlement agreement generally established, for proposals in West Virginia, that if the toe of an individual valley fill is in a watershed less than 250 acres, minimal impacts would result (and thus NWP 21 applicability). The agreement further provided that if multiple individual fills within 250-acre sub-watersheds (i.e., part of a larger CIA) have more than minimal cumulative impacts, then IP processing is required. This agreement created a programmatic threshold for NWP 21 that is similar in concept to minimal

impact thresholds for CWA Section 404 general permits for wetlands and stream crossings. No similar cumulative impact threshold was defined by the *Bragg* settlement.

The 250-acre general minimal impact threshold was intended as an interim threshold based on the assumption that this EIS would find the basis for some other threshold for NWP 21 applicability. Options explored for this EIS to address cumulative impacts included the following:

- preserving/restoring equal lengths of streams lost to valley filling (within the basin affected);
- preserving 50% of first-order streams in a second-order watershed;
- establishing a general 250-acre minimal impact threshold for all MTM/VF activities;
- establishing various minimal impact thresholds less than 250 acres (35, 75, and 150 acres); and
- requiring CWA Section 404 IP processing when more than 4 fills per project are proposed or when more than 10% of total stream length in a defined CIA would be impacted by MTM/VF activities.

Based upon the fact that there have been 5 individual permit applications compared to the 81 projects approved under NWP 21 in West Virginia, it appears applicants are designing the majority of MTM/VF proposals to stay below the 250-acre minimal impact threshold and thereby avoid the IP process. If applicants considered this 250-acre threshold more as an absolute limit for valley fills, then adoption of a smaller watershed size as a minimal impact threshold may have similar results. Because the absolute limits of fills to watersheds of 35, 75, and 150 acres were considered in this EIS [see Chapter II.D.2], the economic and environmental effects of limiting fills to these watershed sizes provides some basis for comparison of these watershed sizes as a substitute for the 250-acre minimal impact threshold. Analysis of smaller watershed sizes as fill restrictions indicated the following:

- Fill restrictions may result in a smaller direct impact to each headwater stream as a result of the fill footprint. However, many small fills within a watershed may be necessary to meet project needs, resulting in greater cumulative impacts from the multiple fill footprints.

- Smaller fills may not reduce water quality impacts downstream. Many small fills may cause greater water quality impacts than fewer large fills.

- Coal reserves available with current surface mining methods are reduced by fill restrictions. Coal reserves rendered unavailable under these restrictions may never be extracted given the current mining technology.

- Fill restrictions may accelerate the depletion of available reserves at current levels of coal consumption.

- Mining and utility costs may increase with fill restrictions. Severance taxes and employment may decline.

Scientific data collected as part of this EIS do not indicate a programmatic “bright line” minimal or cumulative impact threshold applicable in all circumstances. No direct causal links between

environmental impacts and the size, age, or number of fills could be established with the available data. While useful data were collected and subsequent findings made during this EIS, the data and analysis could not result in statistically valid conclusions concerning duration, extent and magnitude of downstream impacts. Watershed impacts directly attributable to mining and fills could not be distinguished from impacts due to other types of human activity. Consequently, a "bright line" cumulative impact threshold could not be developed and supported.

The COE underscored this position upon re-issuance of NWP 21 in January 2002, deciding that case-by-case determination of project impacts was warranted due to the different site-specific project details and aquatic resource characteristics. The COE responded to comments regarding appropriateness of impact thresholds in that rulemaking, explaining that high quality watersheds less than 250 acres exist and lower quality watershed greater than 250 acres exist. The COE explained that use of particular thresholds could result in a proliferation of smaller valley fills in lieu of larger valley fills that might not be the best outcome for the aquatic environment. The COE did not rule out future development of thresholds through the public notice and comment process as regional permit conditions or upon consideration of relevant information becomes available through the appropriate development of criteria or NWP 21 modification. [67 FR 2042.]

This proposed action, part of all alternatives, depends on the development of a GIS with statistically valid data for cumulative impact analysis. This tool could provide a basis for determining CWA individual or cumulative minimal impact thresholds for MTM/VF projects. Similarly, in the NEPA context, the significance of impacts to non-aquatic resources, ecosystems, or human community values, may emerge with compilation and appropriate modeling analyses of GIS data.

8. Deforestation

The importance of terrestrial habitat is discussed in Chapter III.F: Appalachian Forest Communities. Four technical studies were conducted in West Virginia that included considerations of soil microbiology, terrestrial wildlife, vegetation, and cumulative impacts to interior forest cover. These studies are presented in Appendix E: Terrestrial Plant (Spring Herbs, Woody Plants) Populations of Forested and Reclaimed Sites; Terrestrial Vertebrates (Breeding Songbird, Raptor, Small Mammal, Herpetofaunal) Populations of Forested and Reclaimed Sites; Soil Health of Mountaintop Removal Mines in Southern West Virginia; and Bird Populations Along the Edges. In addition to these studies, OSM conducted a literature review of soils and forest productivity [Chapter III.B.4.].

The cumulative impact study evaluated ecological condition, biodiversity, forest loss and forest fragmentation. The 12,000,000 acres of the study area are dominated by 92% forest cover. Surface mining has disturbed around 400,000 acres in the last ten years, or about 3% of the study area. When impacts of mining, logging, and human development are combined, an estimated 11% of the forested portion of the EIS study area is projected to be deforested in a twenty-year period (between 1992 and 2012). This estimate does not recognize any reforestation efforts following mining and timbering and assumes all lands disturbed will remain unforested [Appendix I, Landscape Scale Cumulative Impact Study of Mountaintop Mining Operations.]

The EIS, OSM literature search, and other studies generally report the following as a result of MTM/VF activities within the central Appalachian region:

- fragmentation of the valuable eastern, mixed mesophytic interior forest;
- ecosystem conversion from forest to other land uses;
- reclamation with trees on mountaintop mining sites has not been particularly successful because of over-compaction, competition with trees from grasses and legumes planted for erosion control, and grazing wildlife;
- reclamation techniques may impede rates of natural succession on sites without reforestation as part of the post mining land use;
- density, height, and expanse of grasses act as barriers to forestry seed dispersal, germination, and survival;
- minesoils at study sites are approaching stable, developed soils that could develop properties similar to native soils;
- mine sites revegetated with a growth medium of certain organic material and topsoil substitutes promotes reforestation with yield potential greater than native soils;
- some forest interior species (e.g., certain neotropical songbirds, raptors, amphibians, etc.) are negatively impacted by forest loss, fragmentation, and grassland conversion; and
- some edge and grasslands species (e.g., certain reptiles, birds, mammals, raptors, etc.) are positively impacted by the terrestrial habitat diversity.

Currently, a mine site is usually logged before mining, and economically recoverable forest products are removed from the site. The remaining forest material may be subsequently windrowed at the edge of the mine site to provide wildlife habitat enhancement. Some portion may be burned and/or buried beneath the backfill. Use of these remaining organic by-products as soil amendments and mulch could augment reclamation. A best management practices (BMP) manual could describe these and other practices for developing the reclamation/revegetation plans and enhance reforestation efforts.

Selection of ground cover species for reclamation within the EIS study area has typically been oriented to those species relatively easy to establish for maximum control of erosion, with minimal post-mining maintenance or management costs required. Consequently, the post mining land uses often selected minimize or eliminate the reestablishment of trees. Post Mining Land Uses (PMLUs) without trees were historically perceived to be easier to achieve and less costly, as well as result in a shorter liability period for release of performance bonds. Therefore, PMLU selection is a key factor in the establishment of tree species on reclaimed mined land. A BMP manual emphasizing the latest cost-effective reforestation techniques could encourage forestry-related PMLUs.

Where trees are planted without use of the latest techniques to reduce compaction and provide suitable tree-rooting medium, growth rates are typically lower than prior to mining. OSM and SMCRA state regulatory agencies have recognized for some time that effective reforestation of mined lands could be more prevalent and should be encouraged. Research at Virginia Polytechnic Institute and State University (VPI) and the University of Kentucky demonstrated that far more productive forest land could be created during the reclamation process than existed on un-mined land. One forestry reclamation approach developed at VPI entails loosely grading 3 to 4 feet of surface soil and/or weathered, sandstone overburden taken from the surface 10 feet of the mined area. Also, woody debris and native seeds should be included in the growth media, where possible. (Burger and Torbert, 1992; Torbert et al., 1994) A BMP guide could describe cost-effective practices for developing suitable growth media as part of the reclamation/revegetation plans that could enhance reforestation efforts.

In addition, this research documents that mine site reforestation can be more cost-effective than other types of revegetation. It is possible other economic incentives could encourage reforestation. For instance, air quality regulations imposing legally-binding carbon dioxide limitations could be developed to create a market demand for "carbon credits" among the electric utility and coal mining industries. Such rules could create tradable air pollution credits obtained through the estimated amount of carbon sequestration associated with successful tree planting and maintenance. A BMP manual could explain eligibility for such credits and other incentives to encourage reforestation on mined lands.

Recognizing the historic difficulties associated with successful, productive establishment of forest communities on reclaimed mine sites; the opportunities for improved land productivity and economic incentives; and the potential environmental impact that loss of forest habitat may have, OSM began a "Reforestation Initiative." The initiative promotes the use of trees in reclamation and, when trees are used, promotes reclamation techniques that improve site productivity to levels meeting or exceeding those prior to mining. As part of the initiative, OSM has identified impediments to the successful use of trees in reclamation. OSM and the states have conducted numerous interactive forums and symposia for government and private interest groups to promote the benefits and methods of reclaiming with trees. Pilot projects and partnerships with various government and private interests have also been conducted to demonstrate effective and economical reclamation with trees. A BMP manual could document the forestry reclamation knowledge gained from these outreach efforts.

The state SMCRA regulatory programs within the EIS study area have also recognized the need to improve reclamation practices as related to the establishment of trees. These state programs have taken the initiative in developing their own regulations or guidelines to enhance reforestation. For example, West Virginia has worked with forestry experts to promulgate regulations that require salvaging and redistribution of four of the upper ten feet of organic and weathered subsoil and overburden as the preferred growth medium and set target yields to ensure the success of commercial forestry PMLU. Virginia and Kentucky state guidelines for reforestation also reflect the state-of-the-art in forestry reclamation. Although it is too early to fully evaluate the success of these recent Federal and state initiatives, it is reasonable to assume that these efforts have, to varying degrees, made improvements in 1) selection of the most appropriate growth medium for establishment of trees on reclaimed mine sites, 2) reducing soil compaction of the growth medium, 3) using less competitive herbaceous ground cover species, and 4) creating more effective standards for measuring success of revegetation efforts.

a. No Action Alternative: The Regulatory Program Today

The CWA program does not directly address terrestrial impacts such as deforestation or forest fragmentation. However, the CWA indirectly addresses such impacts where erosion control of upland activities is required to maintain water quality standards and riparian vegetation mitigates fill impacts to aquatic resources. The Clean Air Act may provide incentives for planting trees on surface coal mining sites to offset carbon dioxide emissions from electrical generating facilities.

The SMCRA regulatory program provides no mandate that mined land must be returned to forest. The choice of vegetative cover is a function of the desired post mining land use (PMLU) for a mine site. The PMLU is selected by the landowner and mining company, as long as the SMCRA regulatory authority finds that the operator will "restore the land affected to a condition capable of

supporting the uses which it was capable of supporting prior to any mining, or higher or better uses." [30 U.S.C. 1265 (b)(2)] OSM regulations at 30 CFR 816.97 also require operators to, "the extent possible using the best technology currently available, to minimize disturbances and adverse impacts of the operation on fish, wildlife, and related environmental values and to achieve enhancement of such resources where practicable." [30 U.S.C. 1265(b)(24)] The SMCRA program reclamation performance standards indirectly relate to the ability of reclamation to address deforestation impacts; however, OSM has not prescribed detailed techniques to meet these standards because of the wide diversity of conditions throughout the nation's coalfields.

a.1. CWA Program

The COE considers terrestrial impacts as part of the NEPA review for IPs. The protection and/or restoration of forested riparian habitat as part of aquatic resource enhancement may result in mitigation credit by the COE for CWA Section 404 permits [RGL 02-02]. Additional guidance regarding the appropriate use of vegetated buffers as a component of compensatory mitigation is currently under development. The establishment of buffers in riparian areas may only be authorized as mitigation if the District Engineer determines that this is best for the aquatic environmental on a watershed basis.

a.2. DOE Program

Carbon sequestration is the net removal of carbon dioxide (CO_2) from the atmosphere into such things as biomass (e.g., trees), products created from biomass (e.g., lumber), living biomass in soils (e.g., roots and microorganisms), or organic and inorganic carbon in soils and strata. Forests can offset carbon emissions from human activities. The amount of carbon a plant can sequester depends a number of variables, including species and age. On average, trees are approximately 25% carbon by weight.

Forestation and deforestation abatement efforts may be one of the most cost-effective means of reducing atmospheric levels of CO_2. Carbon storage estimates have been produced for live trees, understory vegetation, litter and other organic matter on the forest floor, coarse woody debris and soil. These estimates by the U.S. Forest Service and EPA cover 120 years beginning with the regeneration of clear-cut timberland, cropland, or pasture. The sequestration rate is determined as the rate of increase in carbon storage during the lifetime of the trees. An estimate of the accumulation rate for West Virginia has been calculated to be 1.686 lbs/acre/year (EPA, 1993). The terrestrial biosphere is estimated to sequester approximately 2 billion metric ton of carbon per year. Research and development is underway to increase the sequestration rate. There are two fundamental approaches to sequestering carbon in terrestrial ecosystems: 1) protection of ecosystems that store carbon so that sequestration can be maintained or increased; and 2) manipulation of ecosystems to increase carbon sequestration beyond current conditions. [http://www.fe.doe.gov/coal_power/sequestration/index.shtml]

There has been increased interest by the energy industry in establishing a uniform method for calculating and trading carbon sequestration "credits" for tree planting. Carbon sequestration credits are sometimes calculated based on accumulated pounds/acre/year times the acres of forest. Over a 70-year life span, an acre of trees withdraws 500 tons of CO_2 out of the air and turns it into wood, provided the wood never burns or decomposes. One credit could equal one ton of CO_2 removed

from the atmosphere. In Europe, where government-regulated trading is already taking place, a ton of sequestered CO_2 equals $8 (Forbes: March 17, 2003).

Currently, there is no legislation or regulation that provides tangible incentives for carbon sequestration. However, the U.S. tax code provides a tax credit for businesses and individuals to recover a percentage of the amortized cost (e.g., equipment, seed, seedlings, site preparation, labor, etc.) of reforestation of qualified timber properties [Internal Revenue Code, Title 26, Subtitle A, Chapter I, Subchapter A, Part 4, Subpart E, Section 48(b)]. The Energy Policy Act of 1992 [16 U.S.C. 1650(b)] established a program for reporting results of voluntary measures to reduce, avoid or sequester greenhouse gas emissions. As a result, hundreds of U.S. companies annually report almost 2,000 projects to record their efforts to reduce or sequester greenhouse gases. These projects have steadily grown and, in 2001, reported 222 million metric tons of CO_2 equivalent direct reductions, 71 million metric tons of indirect reductions, 8 million metric tons of reductions from carbon sequestration and 15 million metric tons of unspecified reductions [http://www.eia.doe.gov/oiaf/1605/vrrpt/summary/index.html]. U.S. companies continue this voluntary reporting so they may receive actual credits, if and when a formal regulatory basis exists for trading such credits. Many states have or are considering similar incentives for reforestation and carbon sequestration. A formal Federal program establishing carbon sequestration credits could provide additional incentives for reclaiming coal mining sites with trees.

a.3. SMCRA Program

The following features of the SMCRA program address some of the pertinent aspects of a post mining land use including reclamation with trees. OSM regulations specify that applications for a surface coal mining operation must provide a revegetation plan [30 CFR 780.18(b)(5)]. Therefore, if the chosen PMLU involves reforestation, the required revegetation plan designs and describes how the operation intends to meet performance standards. The plan must include, but is not limited to, descriptions of the following items:

- schedule for revegetation;
- species and amounts per acre of seeds and seedlings to be used;
- methods to be used in planting and seeding;
- mulching techniques;
- irrigation, if appropriate, and pest and disease control measures, if any;
- measures proposed to be used to determine the success of revegetation; and,
- a soil testing plan for evaluation of the results of topsoil handling and reclamation procedures related to revegetation.

Topsoils, Subsoils, and Substitutes

If the revegetation plans involve trees, a suitable rooting and growth medium must be placed on the backfilled area following grading. Applicants may propose to salvage native soils or a substitute for native soils with suitable properties for establishing vegetation. If native topsoil is not salvaged, stored, and used as the reclamation growth medium, the proposed plan identifies specific zones within the geologic profile to be selectively recovered and used as topsoil substitute materials. The selection of these materials is primarily based upon the pH of the growth medium being neutral or slightly alkaline (i.e., pH 7.0 or above) in order to minimize potential production of low pH runoff and maximize the successful establishment of ground cover to control erosion. Typically the

substitute material is redistributed to a depth of 6 inches, with all materials beneath the topsoil substitute heavily compacted to maximize stability of the backfill.

Topsoil substitutes--Selected overburden materials may be substituted for (or used as a supplement to) topsoil, if the operator demonstrates to the regulatory authority that the resulting soil medium is equal to or more suitable for sustaining vegetation than the existing topsoil. The resulting soil medium must be the best available in the permit area to support revegetation. Because of typically thin native topsoil in the EIS study area, the majority of surface coal mines propose topsoil substitutes (i.e., in lieu of salvaging, protecting, and redistributing native soils). When topsoil substitution is proposed, the permit application must contain results comparing physical and chemical analyses of the overburden topsoil substitute material with the native topsoil. The results must demonstrate that the resultant topsoil substitute is at least as suitable as the native topsoil for sustaining revegetation. Tests must be certified by an approved laboratory (e.g., U. S. Department of Agriculture, state agriculture agency, university, Tennessee Valley Authority, Bureau of Land Management or U. S. Forest Service published data). Alternatively, the applicant may provide results of physical and chemical analyses, field site trials, or greenhouse tests of the topsoil and overburden substitute materials (soil series) from the permit area. If the applicant demonstrates, through soil survey or other data, that the topsoil and unconsolidated material are insufficient and that substitute materials will be used, only the substitute materials must be analyzed. [30 CFR 816.200(c) further interpreting 30 CFR 816.22(e).]

Native soils--If a revegetation plan for trees requires salvaging, protecting, and redistributing native soils or subsoils within the proposed surface coal mining operation, this plan is achieved through compliance with the SMCRA performance standards for soils handling. To ensure that these soils are available for redistribution on completion of coal extraction, backfilling, and grading, soils must be salvaged before mining and protected during the course of mining. Before any surface disturbance occurs, the mining area is cleared of all vegetative material. At least six inches of topsoil must be removed independent of subsoil material and stockpiled in a designated topsoil storage area, protected from contaminants and unnecessary compaction. To prevent erosion, the stockpile is temporarily revegetated and located so that winds and surface drainage do not blow or wash it away. Subsoils may also be removed and stockpiled, if necessary to achieve the revegetation plan. When mining is completed, but before topsoil and subsoil are distributed on the mined area, the soil is tested to determine if any additional nutrients or soil amendments are needed to ensure an adequate growing medium. The soils are then redistributed over the mined area so that a uniform thickness is achieved, and prepared for seeding or planting. [30 CFR 816.22.]

Revegetation

Successful mine site reclamation to a PMLU including trees requires successful revegetation. The operator is required to establish a vegetative cover on all areas that were disturbed during the mining operation in accordance with the vegetation plan and 30 CFR 816.111-116, paraphrased below. The permanent vegetative cover approved in the plan must conform with the following characteristics:

- diverse, effective and permanent;
- comprised of species native to the area (or of certain introduced species where necessary to achieve the PMLU);
- at least equal in extent of cover to the natural vegetation in the area;
- capable of stabilizing the land surface from erosion;

- compatible with the approved post mining land use;
- same seasonal characteristics of growth as the original vegetation;
- capable of regeneration and plant succession; and,
- compatible with plants and animals in the area.

Revegetation of the mine site must occur during the first normal planting season after the site has been backfilled and topsoil replaced. Once seeding and/or planting of the area has occurred, the area will either be mulched or some other approved soil stabilizing practice used to prevent erosion, unless the regulatory authority determines that erosion will not be a problem. A BMP manual could describe woody species suited to typical mine soils and compatible with succession and terrestrial ecosystems.

Bonding and Success Measurement

Performance bond liability is required for the duration of the surface coal mining and reclamation operation and for a "period of extended responsibility" for successful revegetation. If revegetative success does not occur within this period, the liability remains until SMCRA, regulatory program, and permit reclamation requirements are met. [30 CFR 800.13(a)(1)]

Prior to bond release of the site, success of revegetation will be measured by the regulatory authority. At a minimum, revegetative success standards must consider the following in order to support the approved PMLU:

- For areas developed for fish and wildlife habitat, recreation, shelter belts, or forest products, the success of vegetation is determined on the basis of the densities of tree, shrub and vegetative ground cover.
- Minimum stocking and planting arrangements are specified by the regulatory authority on the basis of local and regional conditions and after consultation with and approval by the state forestry and wildlife agencies. Consultation and approval may occur program wide or on a permit-specific basis.
- Trees and shrubs used to determine the success of stocking and the adequacy of the plant arrangement shall be those with utility for the approved PMLU.
- Trees and shrubs counted in determining vegetative success will be healthy and in place for at least two growing seasons.
- Statistically valid sampling tests must used. Ground cover, production or tree and shrub stocking shall be no less than 90 percent of the approved success standard.
- At the time of bond release, at least 80 percent of the trees and shrubs used to determine vegetative success will have been in place for 60 percent of the bonding period.
- Vegetative ground cover shall not be less than that required to achieve the approved post mining land use.
- For areas that will be remined or otherwise redisturbed by the proposed surface coal mining operation (e.g., areas disturbed by mining before August 3, 1977 and not reclaimed to the SMCRA standards) the minimum vegetative ground cover will be no less than the ground cover existing before redisturbance and adequate to control erosion.

Operators within the EIS study area have a five-year period of extended responsibility for measuring successful revegetation. This liability period begins after the last year of augmented seeding, fertilization or irrigation--excluding husbandry practices that are approved by the regulatory authority. The purpose is to achieve a reasonable degree of certainty that the plantings have taken hold and can remain viable without further human tending. The success of revegetation is a component of the performance bond.

If the regulatory authority determines revegetation success is not achieved, the operator must augment the revegetation. Before the bond can be released, revegetative success measurements must indicate that reclamation meets ground cover requirements or other success standards.

b. Alternatives 1, 2, and 3

Action 13: OSM, in cooperation with the states and research community, would develop guidelines identifying state-of-the-science, best management practices (BMPs) for selecting appropriate growth media, reclamation techniques, revegetation species, and success measurement techniques for accomplishing post mining land uses involving trees.

A compendium of the "best science" in reclamation technology would be extremely useful to permit development, review and on-the-ground improvements. This action would compile and describe proven BMPs for the design and implementation of mining and reclamation activities, including the following:

- maximizing, to the extent economically practicable, commercial recovery of forest products prior to mining;
- selecting appropriate growth medium from available topsoil, weathered subsoil and underlying overburden, or topsoil substitute and development of the best reclamation plan to best support the intended post-mining land use (PMLU) and/or enhance natural succession or re-establishment of native riparian or wildlife habitat;
- reducing soil compaction of the growth medium, particularly where trees are intended;
- utilizing slash and non-harvested forested materials;
- selecting tree and shrub species suitable for erosion control, the final-graded spoil and the approved PMLU;
- creating permit-specific or programmatic standards for measuring the success of tree and shrub stocking, and ground cover;
- maximizing use of available organics and native seed sources to promote natural succession or habitat enhancement; and
- using less competitive herbaceous ground cover to encourage tree growth and control erosion.

Some reclamation planning, design, and implementation topics that could be encompassed by a BMP guidance manual are illustrated below.

b.1. Forest Product Recovery and Organic Utilization

Surface owners and mine permit applicants have an inherent economic incentive to harvest viable timber products prior to initiating mining activities. Maximizing the commercial recovery of forest

products at proposed mine sites could serve to better meet demand for wood products and reduce the need for additional logging-related disturbances. This could minimize adverse impacts to fish, wildlife, and related environmental values. This action would provide BMPs in a guidance document to assist a landowner or permit applicant in maximizing the economic recovery of forest product and utilizing the organic materials remaining after logging to facilitate mine site reclamation. Typical practices for handling these organic materials include burning or burying within the mine site. Redistribution of these organic materials as mulch on the reclaimed mine site could be beneficial to revegetation and enhance wildlife habitat. Windrows at the edge of the mine, or as strategically placed "islands," provide niches for wildlife and/or organic nutrients to the soil and adjacent streams. This approach could accelerate natural succession because these materials may contain seeds and spores from native vegetation.

b.2. Revegetative Success and Growth Media for Forest PMLUs

A BMP manual would include clarification of methods for evaluating revegetation success to demonstrate compliance with 30 CFR 816.116(b)(3)(iii), which requires 80 percent of the trees and shrubs used for reclamation be in place for 60 percent of the bond liability period. This standard is sometimes criticized as not adequately ensuring long-term success for re-establishment of trees. SMCRA agencies would work with forestry experts and the research community to establish improved criteria as part of BMPs to ensure reforestation success for pine and/or hardwood forests. West Virginia worked with leading forestry experts to promulgate regulations that require practices identified in the most current research for salvaging topsoil, weathered subsoil, and overburden; and set target success yields for commercial forestry PMLU. Virginia and Kentucky state guidelines for reforestation also reflect the state-of-the-art in forestry reclamation. Similar criteria could be explained in the BMP manual to ensure long-term success of pine and hardwood commercial forest. The BMPs could describe alternatives for growth media where unmanaged woodlands is the PMLU.

b.3. Natural Succession

Natural succession is a progression from one habitat type to another without human intervention, extending from a disturbed state to a climax community such as mature forest. The BMPs could encourage special reclamation practices for large areas disturbed by surface coal mining. These practices would be designed to accelerate natural succession of native trees. One example of these practices is creating topsoil "islands" on broad reclaimed areas. Such islands would serve to inoculate the sterile spoil with the necessary microbial mass, provide a native seed bank, and reduce the time frames necessary for natural succession to occur by reducing the distances between the remaining seed source (the adjacent undisturbed forestland) and the large open expanses of the disturbed area.

b.4. Technology Transfer and Outreach

This action also recommends continued technology transfer and promotion of OSM reforestation initiatives. Since 1998, OSM and the state SMCRA regulatory authorities have been working with the coal and timber industry, academia, landowners, and other government agencies to promote the economic, environmental, cultural, and aesthetic benefits of growing trees on mined lands. Incentives for re-establishing trees on active or AML lands, such as offsetting "carbon credits," are among the concepts under consideration. As a result of this outreach, several states have developed written guidelines identifying methods to assure success when growing trees as part of the approved

PMLU. This action would endorse the initiative and recognize the need for continued work with all stakeholders through symposia, research, and experimental practices to identify the best techniques for successful reforestation.

Action 14: If legislative authority is established by Congress or the states, then SMCRA regulatory authorities will require reclamation with trees as the post mining land use.

Legislation could change SMCRA or similar state statutes to authorize SMCRA regulatory authorities to require reclamation with trees as the post mining land use. This change may be predicated on the condition that forestry was the prevalent land use prior to mining. Any such legislation might provide for an exception to this requirement when an applicant demonstrates that uses other than forestry would provide greater environmental benefits.

9. Air Quality

Surface mining involves a number of activities that can impact air quality or generate noise. Blasting activities are a particular concern, in that they can produce particulate matter, fumes, and potentially damaging low-frequency noise and pressure waves. Equipment operation in the disturbed areas of mine pits, backfill areas, and haul roads can generate airborne particulate matter. Wind over open areas of mine sites and truck haulage of coal on public roads also produces airborne particulate matter, or "fugitive dust".

Fugitive dust usually refers to the particulate matter that is not discharged to the atmosphere in a confined flow stream. Common sources of fugitive dust include unpaved roads, agricultural tilling operations, aggregate storage piles, and heavy construction operations. The dust-generation process is caused by two basic physical phenomena: 1) pulverization and abrasion of surface materials by application of mechanical force through implements (wheels, blades, etc.); and 2) entrainment of dust particles by the action of turbulent air currents, such as wind erosion of an exposed surface. Fugitive dust can also be caused by re-entrained dust, which is put into the air by vehicles driving over dirt roads (or dirty roads) and dusty areas. The emission rates of fugitive dusts are highly variable and dependent on the prevailing atmospheric conditions, including wind speed and direction.

Applicable statutory provisions are summarized in the human and community programmatic review presented in Appendix B. Performance standards for the protection of air quality are also discussed in Appendix B. A technical study on Mine Dust and Blasting Fumes is in Appendix G and a section titled "The Relationship of Surface Mining and Air Quality" is in Chapter III.V.

The objectives of a previous EPA study were to review available field measurements at surface mines, present a critical review of the available emission factors for surface mining activity, and make recommendations for further studies. The study found that mining activities such as drilling, blasting, removal, haul trucks, material handling and storage, truck loading and unloading, and dozer activities cause dust. Both drilling and blasting emissions are considered to be small contributors to particulate matter emissions, in comparison with other sources of emissions in this category. The most significant sources of emissions for this category of activities are identified as overburden removal and haul trucks. [EPA, 1991.]

A study commissioned for this EIS concluded that dust and fume emissions from blasting pose no potential health problems outside of the mining area. Visible and measurable fugitive dust rarely migrated more than 1,000 feet from the actual blast [Chapter III.V.2 and Appendix G].

a. No Action Alternative: The Regulatory Program Today

The Clean Air Act (CAA) controls air quality issues through the EPA and state implementation of the CAA and related state statutes. Air emissions associated with surface coal mining operations, such as fugitive dust, can be regulated under the State Implementation Plans (SIPs), state permitting programs, and select Federal and state regulations, depending upon the facility composition.

The CWA deals with air quality in NEPA compliance reviews. In addition, the COE must a analyze whether emissions of a criteria pollutant, attributable to a proposed permit for an action in either a nontattainment or a maintenance area, are consistent with the applicable SIP. If the COE determines that the total of direct and indirect emissions from the activities proposed under a permit will not exceed de minimis levels of direct emissions of a criteria pollutant or its precursors, then the activity is not subject to general conformity requirements [40 CFR Part 93.153].

SMCRA, at 30 U.S.C. 1265(b)(4), provides that "...all surface coal mining and reclamation operations must stabilize and protect all surface areas...to effectively control erosion and attendant air and water pollution."

a.1. Clean Air Act

The 1990 CAA is a Federal law covering the entire country. EPA establishes air quality criteria from a compilation of the latest scientific knowledge on the kind and extent of identifiable effects on public health and welfare expected from specific air pollutants for area, stationary, and mobile sources. Primary National Ambient Air Quality Standards (NAAQS) are promulgated, specifying the levels of air quality for each criteria pollutant required to protect public health and the environment. The goal of the CAA was to set and achieve NAAQS in every state by 1975. The CAA was amended in 1977, primarily to set new goals for achieving attainment of NAAQS, since many areas of the country had failed to meet the deadlines. The 1990 amendments to the CAA, in large part, were intended to meet unaddressed or insufficiently addressed problems such as acid rain, ground-level ozone, stratospheric ozone depletion, and air toxics. Secondary NAAQS are also promulgated to protect the public welfare from any known or anticipated adverse effects.

EPA and the states are responsible for CAA implementation regarding air quality. Under the CAA, states are required to develop State Implementation Plans (SIP) applicable to appropriate industrial sources in the state . The SIP should explain how each state will perform activities to comply attain, maintain and enforce each primary and secondary NAAQS. The SIP generally consists of a collection of regulations which the state will use to enforce the CAA. Each SIP is submitted to the EPA for approval and, once approved, becomes Federally enforceable. SIPs vary between states. Besides the development of source specific regulations, the SIPs were also required to contain a permitting program for major and minor sources [42 U.S.C. 7410].

Air emissions associated with mining operations (such as blasting, earth and rock removal, transport-related dust) are considered "fugitive emissions" under the CAA and its accompanying regulations. These emissions can be regulated under the state SIPs, state permitting programs, and

select federal and state regulations, depending upon the facility composition. The Federal government generally does not have the authority to regulate fugitive emissions which are not associated with a *permanent stationary source* [42 U.S.C. 7479]. Mountaintop mines are not permanent stationary sources; and, thus far, have not been considered to meet the criteria for *major source* air quality permits, i.e., defined for particulate matter as sources which emit at least 250 tons/year [42 U.S.C. 7661]. There are 42 state installed and operated air monitoring stations located in the EIS study area. Except for ozone, monitoring stations in the study area reported acceptable air quality for all criteria air pollutants in recent years. Stations monitoring ozone concentrations in Boyd and Greenup Counties (KY) reported multiple years where levels of ozone exceeded national ambient air quality standards. [http://www.epa.gov/air/data/]

States, do not typically issue air permits to mountaintop mining operations, nor do they currently require best management practices under CAA--although SMCRA indicates mining permits may contain control practices for some fugitive emissions. In practice, the state regulation of surface mining sources of fugitive dust is usually the responsibility of the state mining offices rather than the state air quality programs.

EPA, to protect human health, has established air quality standards for smaller-sized particulate matter (e.g., dust and other forms of particulate air pollution). There are two NAAQS for dust. One standard applies to particulate matter sized at 10 microns in diameter or smaller (PM-10). In 1997, EPA also promulgated a NAAQS for particulate matter sized at 2.5 microns or smaller (PM-2.5). The PM-10 and PM-2.5 NAAQS pertain to all dusts that fit the aerodynamic diameter requirements. This includes the fugitive emissions which may contain crystalline silica. The NAAQS does not include specific limits on silica itself. Most fugitive dust particles from surface mining operations generally exceed 10 microns.

a.2. SMCRA

SMCRA regulations provide controls for blasting, fill stability, revegetation, flooding, fugitive dust, and alternative post mining land uses in permit application review and approval and in mining and reclamation inspection and enforcement activities. SMCRA requires that the applicant comply with applicable air and water quality regulations as well as applicable health and safety standards. [30 U.S.C. 1258(a).] Generally, the OSM role in controlling air pollution is limited to pollution attendant to erosion [NWF v. Hodel, C.A. 84-5743 (U.S. Court of Appeals D.C. Circuit, January 29, 1988)]. The appeals court found that EPA has the authority under the CAA to regulate fugitive dust from surface mining operations. SMCRA performance standards require all exposed areas of surface coal mining operations to be protected and stabilized to effectively control erosion and air pollution attendant to erosion. This is usually accomplished through the application of mulch to reclaimed areas after backfilling and regrading, and the watering of unpaved haul roads [30 CFR 816.95].

b. Alternatives 1, 2, and 3

Action 15: Evaluate and coordinate current programs for controlling fugitive dust and blasting fumes from MTM/VF operations, and develop BMPs and/or additional regulatory controls to minimize adverse effects, as appropriate.

Under this action, EPA, OSM, state air quality agencies, and state mining agencies would identify the following:

- meteorological and physical conditions which can exacerbate dust or blasting fumes;
- state-of-the-art techniques currently used in the mining industry to control dust and fumes; and
- appropriate regulatory improvements to qualitatively assess and control emissions.

Coordination between these offices under this action would ensure that best management practices are implemented to minimize fugitive particulate matter which may contribute to statutory air pollution.

10. Flooding

The central Appalachian physiographic region is a highly-dissected plateau characterized by high, tree-covered hills and deep, narrow valleys. Large watersheds often feed streams with narrow valleys and small flood plains. In such rugged terrain, people live near or adjacent to the streams and rivers, which may flood during large rainfall events.

As with all types of surface mining, MTM/VF mining and reclamation alter the topography and drainage patterns. Mining also results in changes to the infiltration capacity of the ground, runoff variables associated with soil/ground cover complexes, and transpiration rates associated with the dominant vegetation. Surface coal mining involves the alteration of normal watershed flow paths by installation of roads, diversions, sediment retention basins, and large mining pits. These flow path modifications can change the travel time from pre-mining and provide runoff retention that can reduce peak flows downstream. The combination of these alterations can impact the amount of runoff from the mined area for a given storm event.

The agencies commissioned two flooding studies by the USGS, entitled "Comparison of Storm Hydrographs in a Small Valley-filled and Unmined Watershed, 1999-2001, Ballard Fork, West Virginia" and "Comparisons of Peak Discharges Among Sites with and without Valley Fills for the July 8-9, 2001 Flood in the Headwaters of Clear Fork, Coal River Basin, Mountaintop Coal-Mining Region Southern West Virginia." The USGS study of the July 2001 flood, based on reconstructive modeling, found that the peak discharge from the flood in paired watersheds with a recurrence interval of 10 years was less in a watershed with a reclaimed valley fill than in an unmined area. However, peak discharges from storms exceeding 25 year recurrence intervals in two other paired watersheds were greater in two watersheds with reclaimed valley fills than in two unmined watersheds. The USGS Ballard Fork study found that runoff from mined watersheds exceeded runoff from unmined watersheds when rainfall was greater than 1 inch per hour. The report also states that valley fills tend to store considerable runoff and release the storm water more slowly than watersheds without fills.

The COE and OSM completed a flood modeling study of the impacts of rainfall events on three individual valley fills, as well as the cumulative impacts of two fills on downstream flows. This modeling study used computer simulations to predict storms' peak discharges for several precipitation events during pre- and post mining scenarios. Modeling simulated different ground cover conditions (e.g., grassland versus tree cover) and different mine site reclamation (planned versus AOC+). Peak runoff was greater for AOC+ reclamation than for the company's planned configuration; runoff was less for forested cover than for grass. The models also calculated that the post mining peak flows would be higher than the pre-mining peak flows for the same storm events

for all scenarios run. However, the predicted increases in peak flow did not cause flows to leave the banks of the stream channel.

The Governor of West Virginia commissioned a task force to study severe flooding in southern West Virginia in 2001 and 2002. The task force directed a state technical team to prepare a report, "Runoff Analysis of Seng, Scrabble, and Sycamore Creeks," completed in June, 2002. A Kentucky study, "Joint OSM-DSMRE Special Study Report On Drainage Control" was completed in December, 1999. The studies were designed to determine whether mining caused increases in peak flow downstream from the mine sites; and if so, the extent to which peak flows were increased. The West Virginia study also evaluated the impacts of logging on peak flows. In general, these two studies concluded that mining does influence the degree of runoff, but that the extent to which a change in runoff may have actually caused or contributed to flooding were site-specific. Site-specific factors may include topographic influences, stream channel conditions, distance downstream from the mine site, man-made channel restrictions, etc. The West Virginia study recommended flood potential analysis for every permit.

An OSM review of citizen complaints and oversight studies in the EIS study area found that flooding was caused by mine sites that were not following or maintaining their approved drainage control plans. Studies prepared as part of this EIS and other available literature indicate that peak runoff increase or decreases below mining can occur. Site-specific analysis is required, based on many factors, including ground cover, site configuration, permanent or temporary drainage controls (diversions, sediment ditches or ponds, mining pits, or depressions), infiltration rates, percent disturbance, etc. A copy of these studies may be found in Appendix H. A discussion of the relationship of MTM/VF to surface runoff quantity and flooding is in Chapter III.G.

a. No Action Alternative: The Regulatory Program Today

Evaluating the potential for flooding is an important component in the decision to grant or deny SMCRA and CWA Section 404 permits, especially where the risk of flooding could adversely affect people downstream from the mining activity. Both OSM, SMCRA regulatory authorities, and the COE must address flooding in their permit considerations. In addition, Presidential Executive Order 11988, "Floodplain Management" requires Federal agencies to identify all actions involving construction in floodplains and provide for public review of such actions.

a.1. CWA

The COE is required to consider flood hazards and floodplain values in its public interest review [33 CFR 325(c)(1)]. The regulations state: "Although a particular alteration to a floodplain may constitute a minor change, the cumulative impact of such changes may result in a significant degradation of floodplain values and function and in increased potential for harm to upstream and downstream activities. In accordance with the requirements of Executive Order 11998, District Engineers, as a part of their public interest review, should avoid to the extent practicable, long- and short-term significant adverse impacts associated with the occupancy and modification of floodplains, as well as the direct and indirect support of floodplain development whenever there is a practicable alternative. For those activities which in the public interest must occur in or impact upon floodplains, the DE shall ensure, to the maximum extent practicable, that the impacts of potential flooding on human health, safety and welfare are minimized, the risks of flood losses are

minimized, and whenever practicable the natural and beneficial values served by floodplains are restored and preserved." [33 CFR 320.4(k)(2).]

There are many engineering and hydrologic/hydraulic models, equations, and procedures for assessing peak runoff and the choice of an appropriate model is dependent on factors such as geology, hydrology, topography and precipitation. Recognizing the choice of model is dependent on site-specific factors, a standardized methodology addressing flooding has not been identified by the COE Regulatory Branch as nationally applicable for CWA Section 404 applicants. The Huntington District of the COE has chosen to require applicants to evaluate the effects of a 100-year storm during "worst-case" conditions when mining and reclamation operations disturb the largest portion of permit area.

a.2. SMCRA

PHCs and CHIAs

The Federal regulations at 30 CFR 780.21(f) require the surface mining applicant to do detailed analyses of the impact of the proposed mining activity on hydrology within the permit and adjacent areas. Among other things, the applicant is required to furnish an analysis of flooding or stream flow alteration. The existing regulations do not specify the manner in which the permit applicant must perform the flood analysis. The methods required or used are left to the discretion of the individual regulatory authority or the applicant. SMCRA regulatory authorities have not typically specified a particular methodology for flooding evaluation because the engineering tools for analysis are varied due to applicability to differing site-specific conditions. Many applicants perform the requisite sediment control design and address the results of this 25-year storm design on downstream conditions. Other areas of the mine site may have diversions based on a 100-year storm. OSM published a hydrologic guidance document containing a section "Estimating Hydrologic Impacts," illustrating the wide variety of hydrologic analysis techniques that could satisfy the SMCRA requirement for determining the PHC, surface water quantity analysis, and CHIA. For a detailed description of PHCs, CHIAs, and the guidance document see Chapter II.C.7.b.

Surface-Water Quantity

Stream peak discharges at a particular site consist of ground water derived base flow and surface runoff resulting from precipitation or snow melt. Seasonal flow conditions refer to the fluctuation of flow over the course of a year. Low flow refers to the minimum discharges during the year that are wholly composed of base flow. For ephemeral streams, there is no base flow component; flows occur only in response to precipitation and snow melt runoff.

Surface-water discharge parameters most often included in hydrologic analyses are peak and low-flow frequencies and mean flow values. Although seasonal flow conditions generally do not include storm event peak flows, the PHC determination should indicate the impact of the proposed operation on flooding or stream flow alteration. Therefore, some analysis of storm event peak flows may be necessary for flooding evaluation. Peak flows and flooding may be reduced during mining due to the increased infiltration capacity of the reclaimed area and the storage capacity of water-retention structures. The level of detail and analytical method accepted by a particular state for PHCs is highly variable and may differ based on the sensitivity of environmental resources and site-specific hydrologic and geologic conditions.

Kentucky, Virginia, and West Virginia surface mining regulatory programs contain essentially the same requirements as OSM regulations. Like the PHC regulations, the CHIA regulations do not specify a standard method for analyzing cumulative effects, and the method of analysis is left to the regulatory authorities discretion. OSM is conducting flooding risk assessments as part of SMCRA regulatory oversight in the Appalachian region.

WVDEP has developed the Surface Water Runoff Analysis (SWRA) guidelines to evaluate mining proposals as they relate to flooding potential. Under these guidelines, WVDEP requires the applicant to demonstrate that mining and reclamation will not increase surface water runoff peaks during storm events over pre-mining conditions. In several instances, mining proposals were altered to take measures consistent with the guidelines so that modeled predictions result in no increase in peak runoff.

b. Alternatives 1, 2, and 3

Action 16: OSM, SMCRA state regulatory authorities, and the COE would develop guidelines for calculating peak discharges for design precipitation events and evaluating flooding risk. In addition, the guidelines would recommend engineering techniques useful in minimizing the risk of flooding.

It is difficult to generalize mining impacts on runoff. Due to site conditions, increases in peak runoff may not cause or contribute to flooding. Flooding results when stream banks overflow and cause hazards to persons or damage to property, roads, etc (i.e., increased peaks contained within a stream channel would not be considered flooding). This action is proposed with the objective of bringing consistency to the flooding potential analysis by applicants to satisfy both SMCRA and CWA Section 404 requirements.

This action involves OSM, state SMCRA agencies and COE, working with academia and other appropriate agencies, to identify acceptable methodologies for calculating peak discharges and evaluating downstream flooding risk. Modeling and other recommended approaches for peak runoff determinations could be discussed and the proper design storm event for evaluation could be suggested. The guidelines could address the following:

- hydrologic and hydraulic parameters considered in these computations or models (e.g., infiltration rates for spoil, runoff curve numbers or coefficients for disturbed and reclaimed lands, design storm types, antecedent moisture conditions, etc.);
- site conditions analyzed for peak discharge and downstream flooding risk, and establish flooding threshold criteria (e.g., the risk of flooding to structures such as homes, businesses, roads, utilities, etc); and
- efforts (e.g., states, COE, USGS) for considering surface water runoff analysis in an assessment of flooding risks for CWA and SMCRA purposes.

Development of a generally accepted approach to make this assessment could make the permit evaluation more efficient and be included in the MOA [Chapter II.C.1].

11. Threatened and Endangered Species

Mountaintop mining and valley fills could affect federally-listed endangered and threatened endangered (T&E) species or destroy or adversely modify critical habitat. The agencies recognize

that ESA compliance is required to facilitate conservation of these valuable resources. [Note: the obligation of the SMCRA authorities under the ESA is discussed in the preamble to the Federal Register 52 FR 4354, December 11, 1987.]

The ESA was passed in 1973 to conserve "the ecosystems upon which T&E species depend" and to conserve and recover listed species [16 U.S.C. 1531, *et seq*.]. Under the law, species may be listed as either "endangered" or "threatened" [50 CFR Part 17]. Endangered means a species is in danger of extinction throughout all or a significant portion of its range. Threatened means a species is likely to become endangered within the foreseeable future. The law is administered by the FWS.

Under Section 7 [16 U.S.C. 1538] of the ESA, any Federal agency proposing to undertake an action must review to determine if the action may affect T&E species or their critical habitat and if so, consult with the FWS. Federally listed threatened, endangered, and candidate species known to inhabit the EIS study area, as well as state species of concern, were identified through correspondence with the appropriate Kentucky, Tennessee, Virginia, and West Virginia state agencies, plus FWS field offices with jurisdiction over federally listed species in the four states.

This EIS is providing new information on the extent to which MTM/VF may affect listed species and changes to existing SMCRA and CWA programs are being considered. As a result, the Federal agencies are conducting an informal consultation with FWS to determine what effect the proposed action may have on the Federally listed species or critical habitats in the study area. EPA volunteered to lead the consultation process on behalf of all of the EIS agencies and is in the process of writing a Biological Assessment (BA) that would identify any T&E species likely to be adversely affected by the proposed action. The preliminary findings of this effort indicate that several of the listed species cited in Appendix F are present in the EIS study area and may be affected by MTM/VF to an extent not previously considered, and any such effects may be changed by proposed programmatic actions. Measures to avoid adversely affecting the listed species would be considered in the BA. Information about the findings of the BA and the informal consultation would be provided in the final EIS.

Since T&E species or their critical habitats may be affected in the impact area, the ESA requires consultation or coordination in assessment of the preferred alternative. If the ESA assessment concludes that the preferred alternative would not likely adversely affect T&E species or critical habitat and the FWS concurs, no further action is required. If after review of the BA, the FWS cannot concur in this finding, formal consultation under ESA Section 7 is required.

a. No Action Alternative: The Regulatory Program Today

The ESA requires Federal agencies to consult with the FWS to ensure that the actions they authorize, fund, or carry out will not jeopardize T&E species. The Federal agency makes the initial determination of whether a proposed action may affect T&E species. The Federal agency may choose to enter into informal consultation with the FWS or enter directly into formal consultation. If the Federal agency determines during informal consultation that the action or the action as modified is not likely to adversely affect T&E species or critical habitat and FWS concurs in writing, then the consultation process is terminated.

If the Federal agency determines that the action is likely to adversely affect T&E species, it initiates formal consultation with the FWS. The FWS then prepares a Biological Opinion (BO), which will determine whether the action will or will not jeopardize T&E species or adversely modify critical habitat; identify the nature and extent of the effects of the action on listed species and critical habitat; determine the amount or extent of anticipated incidental take of listed species; and provide mandatory reasonable and prudent measures to minimize the impacts of incidental take to the listed species. In the relatively few cases where the FWS concludes at the end of a BO that the proposed action will jeopardize threatened and/or endangered species, the FWS must issue reasonable and prudent alternatives about how the proposed action could be modified to avoid jeopardy to T&E species or adverse modification to critical habitat [50 CFR 402]. Although candidate species receive no statutory protection under ESA, Federal agencies are encouraged to form partnerships to conserve these species because they are by definition, species that may warrant future protection under ESA [16 U.S.C. 1535].

In the case of CWA Section 404 authorization for valley fills, ESA consultation occurs between the COE and FWS. The consultation process is the same for general permits and IPs. Neither general nor IPs may authorize activities that would jeopardize the continued existence of a T&E species or destroy or adversely modify the critical habitat of such species [33 CFR 330.4(f)]. General Condition 11 of all NWPs requires that applicants notify the COE if any listed species or designated critical habitat might be affected or is in the vicinity of the proposed work, or if the proposed work is located in designated critical habitat; requires that the permittee not begin work on the activity until notified by the COE that the requirements of the ESA have been satisfied and that the activity is authorized by NWP; and states that the NWP does not authorize the taking of any T&E species.

In the case of SMCRA authorization for surface coal mining operations, FWS and OSM completed ESA consultations during the development of SMCRA regulations and at the time of OSM delegation of state SMCRA programs in the late 1970s and early 1980s. In 1994, because additional T&E species had been listed, and the provision of incidental take did not exist at the time, OSM and FWS reinitiated consultation. The consultation resulted in a BO issued by FWS in 1996. The 1996 BO stated that there is no jeopardy to T&E species if mining is conducted under a properly-implemented SMCRA regulatory program (i.e., OSM Federal or state-delegated programs). The BO also emphasized the use of species-specific measures in individual mining permits to minimize potential take of T&E species or adverse modification of critical habitat.

The conclusions reached by the FWS in the 1996 BO were based, in part, on assumed compliance with the regulatory requirements of SMCRA pertaining to the protection of fish and wildlife and related environmental values [including, but not limited to 30 CFR 772.12, 773.12, 773.13, 774.13, 774.15, 780.16, 784.12, 815.15, 816.97, and 817.97]. In addition, to ensure that the impacts of incidental take [see definition of “take” and related term “harm” in 16 U.S.C 1534 and 50 CFR 17, respectively] of listed T&E species would be minimized, and to exempt SMCRA state and Federal regulatory authorities from the prohibitions of Section 9 of the ESA, the FWS BO contained terms and conditions that set forth certain procedural requirements for T&E species. These included requirements that the regulatory authority would: 1) work with FWS to develop species-specific measures to minimize anticipated incidental take; 2) whenever possible, quantify take resulting from activities carried out under SMCRA; and 3) provide FWS with a written explanation whenever the authority decides not to implement species-specific measures recommended by FWS, and seek higher level review when concurrence between FWS and the authority cannot be reached. The BO provides that the SMCRA regulatory authorities [pursuant to 30 CFR 774.11or its state counterpart]

would require reasonable revision of a permit, when necessary, at any time to ensure compliance with the ESA.

In 1998, FWS and OSM agreed that more specific guidance was needed to fully implement the 1996 BO. In 2002, FWS and OSM developed a training course to clarify agency authorities and applicant responsibilities, and to streamline coordination between the SMCRA regulatory authority and FWS. This training course is designed to inform state and Federal agencies about the requirements of the ESA and the 1996 BO, and foster a cooperative working relationship. Improved coordination should enhance listed species protection.

a.1. Migratory Birds

In addition to consultation under the ESA, Federal agencies must coordinate with FWS under other processes such as Executive Orders (EO). Some migratory birds are listed T&E species, however all migratory birds are subject to EO 13186. The President signed EO 13186 on January 10, 2001, directing Federal agencies to conserve migratory birds [http://migratorybirds.fws.gov]. This EO directs each Federal agency taking actions having or likely to have a negative impact on migratory bird populations to work with the FWS to develop an agreement to conserve those birds. The protocols developed by the consultation are intended to guide future agency regulatory actions and policy decisions; renewal of permits, contracts or other agreements; and the creation of or revisions to land management plans. Agencies are expected to take reasonable steps that include restoring and enhancing habitat, preventing or abating pollution affecting birds, and incorporating migratory bird conservation into agency planning processes whenever possible. By January 2003, Federal agencies were to have developed and implemented a Memorandum of Understanding (MOU) with FWS for the conservation of migratory bird populations. As of publication of this EIS, MOUs with the Federal EIS agencies are still in draft form. Because the EO does not apply to actions delegated to states, it has limited applicability in SMCRA permitting actions in all of the study area except Tennessee. Provisions of the COE and EPA MOUs implementing this EO would apply to the study area.

b. Alternatives 1, 2, and 3

Action 17: Based on the outcome of ongoing informal consultation, FWS, EPA, COE, OSM and their state counterparts would identify and implement program changes, as necessary and appropriate, to ensure that MTM/VF is carried out in full compliance with the Endangered Species Act.

To assure compliance with the ESA, this action envisions development of species-specific procedures and protective measures to minimize adverse effects for listed species that occur in the steep slope mining region. These actions would include survey protocols, monitoring requirements (e.g., water quality and quantity), protective restrictions (e.g., buffer zones, seasonal restrictions), and prohibitions (e.g., operations that would jeopardize the species). The species-specific procedures and protective measures can be used to develop area-wide plans that would assist mining companies in preparing their mining plans. For example, baseline information on species presence, standardized protective measures, and monitoring of potential cumulative impacts can be developed on a regional or watershed scale that would assist reviews of individual projects.

D. ALTERNATIVES CONSIDERED BUT NOT CARRIED FORWARD IN THIS EIS

In addition to the alternatives in Chapter II.C, the agencies assessed several other sets of alternatives for this EIS. Inasmuch as valley fill size affects mine feasibility and environmental impacts, several alternatives considered approaches for restricting the size of valley fills in waters of the U.S. One set of alternatives [Chapter II.D.1.a] limited valley fill sizes based on the type of stream segment filled (ephemeral, intermittent or perennial), while another set restricted fill size based on the watershed size (35, 75, 150, 250 acres) that could be filled [Chapter II.D.1.b]. Another set of alternatives considered would use the proposed fill size to determine which applications must initially undergo IP review versus NWP 21 authorization [Chapter II.D.1.c]. This set of alternatives was based on past mining practices and COE regulatory branch workload management.

Several sets of alternatives were based on protecting particularly high value stream qualities using features of the CWA program, such as "advanced identification," "advanced veto," designating "special aquatic sites," or an outright prohibition of fills in waters of the U.S. based on interpretation of the CWA "anti-degradation" policy [Chapter II.D.2 and II.D.3]. Other alternatives evaluated used cumulative impact measures to limit the size, location, and number of valley fills in a given cumulative impact area [Chapter II.D.1d].

1. Restricting Individual Valley Fills

Two studies performed in conjunction with the EIS confirm that mining viability is directly related to available fill size and that very small fills preclude mining substantial coal resources [Appendix G: Mine Tech Team and Economics Studies]. However, because of direct stream impacts from different fill sizes, regulatory mechanisms were considered for restricting fill sizes to reduce direct impacts. Various alternatives included fill sizes constrained by ephemeral, intermittent, and perennial stream segments; as well as fill sizes limited by the watershed acreage above the valley fill. In addition, a number of alternatives related to cumulative impacts from MTM/VF were considered.

a. Limiting Individual Valley Fill Sizes by Type of Stream Segments

The CWA and SMCRA regulatory programs recognize stream classifications defined by flow characteristics, including ephemeral, intermittent, and perennial segments [30 CFR 701.5 for SMCRA; NWP renewal at 67 FR 2094 implementing 33 CFR 330]. The identification of stream segments was included in the NWP program because of limitations set on the length of stream impacted under certain NWPs are based on whether the segment impacted is ephemeral, intermittent or perennial. The definition of stream segment types and methodologies to locate them are discussed in Chapter II.C.2. The stream segment alternatives considered the following:

- Restricting fills to ephemeral stream segments;
- Restricting fills to intermittent and ephemeral stream segments; and
- Allowing fills in ephemeral, intermittent, and perennial stream segments.

These alternatives were based on the concept that fills confined to stream segments in the upper reaches of watersheds would likely have less adverse aquatic impacts than fills placed lower in the

watersheds. This presumed that the aquatic ecosystem where flow only occurs in response to rainfall or where stream base flow may not persist year round is not as well-established as the aquatic ecosystem farther down the watershed where there is a greater stream base flow.

From a ecological standpoint, however, some stream segments in the upper reaches of watersheds can be important aquatic habitats. Restricting fills to the uppermost stream segments does not recognize the importance of some upper stream segments as ecologically established aquatic habitats. Because existing data do not establish a scientific basis for categorically limiting fills to specific stream segments, this EIS proposes to continue individual, site-specific data collection and study to evaluate the ecological importance of upper stream reaches.

The CWA Section 404 program is jointly administered by the COE and EPA. Use of this program to limit valley fill placement within certain stream segments was considered to implement this set of alternatives. However, the COE cannot prohibit fills in advance of an application. Instead of general prohibitions using stream segments, the COE uses the CWA Section 404(b)(1) Guidelines to approve or deny fills in waters of the U.S. [Chapter II.C.1.a.1]. Precluding valley fills in geographically defined waters of the U.S. may be determined by EPA using specific criteria in CWA Section 404(c) [Chapters II.C.1.a.1 and II.D.3.c.]. Continued data collection would be used by the COE to determine the feasibility of establishing cumulative and individual impact thresholds restricting valley fills based on stream segment, watershed size, quality of the aquatic resource or other characteristics [Chapters II.C.6 and II.C.7].

Use of the OSM SBZ rule was considered to implement the alternatives establishing valley fill restrictions for certain stream segments [30 CFR 816/817.57]. The existing SBZ rule provides that no land within 100 feet of a perennial or intermittent stream be disturbed by surface mining activities unless the SMCRA regulatory authority specifically allows mining activities closer to, or through, such a stream. The specific conditions under which the SMCRA authority may allow such activity and other aspects of the SBZ zone rule are discussed in Chapter II.C.3.a.2. In order for a revised SBZ rule to prohibit fills in stream segments, it would be necessary to identify where stream segments begin and end.

SMCRA Section 702(a) indicates that nothing in SMCRA shall be construed as superceding, amending, modifying, or repealing the CWA [30 U.S.C. 1292(a)(2)]. That is, OSM cannot establish requirements for activities affecting waters of the U.S. that would be inconsistent with existing CWA requirements allowing valley fills. However, OSM may establish regulatory standards on matters where the CWA is silent, but where the CWA program contains existing standards, OSM must defer to the CWA program to ensure nationwide consistency [In re Surface Mining Regulation Litigation America Mining Congress et al., 452 F.Supp. 327, (D.D.C. 1978); 627 F.2d 1346 (D.C.Cir. 1980)]. The CWA Section 404 program regulates aquatic impacts from valley fills in waters of the U.S. and OSM cannot apply the SBZ rule in a way that would supercede or modify the CWA program standards. To do so would not only violate SMCRA Section 702, but would also be inconsistent with SMCRA Section 515(b)(22) where Congress acknowledged the necessity of valley fill construction in streams [30 U.S.C. 1265(b)(22)].

b. Limiting Individual Valley Fill Sizes by Watershed Size

A set of alternatives considered restricting valley fills to certain watershed sizes. These alternatives would have established watershed sizes as a surrogate for stream segments (i.e., ephemeral,

intermittent, perennial flow). The rationale was that smaller fills confined to smaller watersheds would generally have less aquatic impacts than larger fills placed in larger watersheds. The agencies considered implementing the watershed restrictions under the CWA program, with subsequent revision of the OSM stream buffer zone rule to assure consistency.

This set of alternatives was explored in consideration of: 1) the USGS field study of the median watershed sizes for 33 ephemeral and 37 intermittent/perennial stream segments in West Virginia; and 2) preliminary information from economic studies designed to assess the impact of coal recovery and production from restricting valley fills to different size watersheds (35-, 75-, 150-, and 250-acre watersheds, and unconstrained by watershed size). These limited data indicated that the ephemeral and intermittent stream segments are located in various size drainage areas, but very likely to occur in watersheds ranging from 0-75 acres. The field data indicated that watershed sizes for the beginning of perennial stream segments are also variable, but generally expected in watersheds from 75-250 acres.

The preliminary economic studies suggested more significant impacts to full coal resource recovery and production in West Virginia when fills were restricted to watersheds below 75 acres. The economic studies did not show as significant an impact on coal resource recovery and production in West Virginia when fills were restricted to 250- or 150-acre watersheds (i.e., as compared to the unconstrained fill scenario).

This set of alternatives was rejected, in part, because the stream segment information was only collected in West Virginia on a limited number of tributaries and may not be representative nor statistically valid basis for a watershed size surrogate. Also, the economic study results were subsequently determined to have limitations and not suited for establishing alternatives as detailed in Appendix G. Finally, the environmental studies performed for this EIS did not produce data sufficient to provide a suitable basis for differentiating the indirect effects from MTM/VF and other disturbances, as described in more detail below, discussed in Chapter II.C.4, and presented in summaries and study results in Appendix D. This EIS proposes to continue data collection and analysis to determine if scientifically-valid causal relationships can be identified. Continued data collection would be used to determine the feasibility of establishing cumulative and individual impact thresholds restricting valley fills based on stream segment, watershed size, quality of the aquatic resource or other characteristics [Chapters II.C.4, II.C.6 and II.C.7].

c. Watershed Fill Restrictions Based on Past Mining Practice and COE Workload Management

Another set of alternatives considered establishing "minimal impact" thresholds based on watershed sizes, below which CWA Section 404 applications could be processed using NWP 21. A basis for this alternative set was selection of watershed sizes that encompassed the majority of past mining activities. This alternative concept would operate under an approach similar to the existing NWP 21. That is, since MTM/VF proposals undergo SMCRA review, and since sufficient mitigation would be required under the NWP 21 to offset unavoidable impacts, the NWP 21 process would be an appropriate vehicle for authorizing fills within a certain watershed size. The NWP permit process is founded on the principle that those activities (individually and cumulatively) with no more than minimal impact should be processed with a more streamlined COE review. The NWP program also assists the COE in cost-effective, timely processing of applications to avoid permitting backlogs.

The Valley Fill Inventory evaluated the watershed size in the EIS study area for the period 1985-2001 [Chapter II.K.2-5 and Table II.D-1, below]. The inventory included the following: 1) fills constructed in the EIS study area through 1999; and 2) updated for 1999-2001 to include fills either constructed or approved in the study area. Ninety-seven percent (6494 of 6698 fills) of valley fills in the inventory were in watersheds below 250 acres. Almost 76% of the fills in the inventory were in watersheds less than 75 acres (5071 of 6698 fills). Three percent (204 of 6698 fills) exceeded 250-acre watersheds.

This set of alternatives, based on the fill inventory statistics, considered using the 75- and 250-acre watershed sizes as possible thresholds for processing NWP 21 applications. An additional rationale for these alternatives was that the 250-acre watershed size generally approximates the point at which more important aquatic resources are present. The USGS survey of 33-37 stream segments conducted for this EIS indicated that watersheds much smaller than 250-acres could include perennial flows. The 75-acre threshold was another watershed limit alternative considered based on the fill inventory. Under such a 75-acre threshold, if in place since 1985, around 1700 valley fill proposals would have required IP processing; use of the 250-acre threshold during the same time frame would have required just over 200 IPs.

Table II.D-1
Valley Fill Watershed Sizes (1985-2001)

Year	Kentucky			Tennessee			Virginia			West Virginia		
	< 75 acre	75-250 acre	> 250-acre	< 75 acre	75-250 acre	> 250-acre	< 75 acre	75-250 acre	> 250-acre	< 75 acre	75-250 acre	> 250-acre
1985	519	52	7	1	1	0	13	4	1	76	44	11
1986	378	38	5	2	2	0	21	6	2	24	14	4
1987	432	72	5	8	0	0	25	2	0	30	3	0
1988	289	73	14	4	2	0	25	8	1	65	22	2
1989	275	42	5	1	0	0	19	6	2	91	33	5
1990	216	41	6	1	0	0	27	8	1	27	15	3
1991	308	55	7	4	1	0	45	9	2	33	20	5
1992	262	76	8	4	1	0	20	8	1	69	25	5
1993	253	55	6	0	0	0	14	7	5	25	24	4
1994	138	49	6	0	0	0	30	4	1	28	20	6
1995	165	64	4	0	0	0	16	11	0	47	35	10
1996	193	63	7	0	1	0	10	12	1	216	32	6
1997	136	56	6	1	1	0	25	7	0	51	42	4
1998	116	47	7	6	0	0	18	15	0	4	8	7
1999	104	47	6	10	1	1	17	8	1	19	7	1
2000	972	34	2	2	0	0	17	14	4	15	23	0
2001	121	22	1	0	0	0	2	5	0	51	26	0
Total	**4002**	**886**	**108**	**44**	**10**	**1**	**344**	**134**	**22**	**681**	**393**	**73**

The *Bragg* settlement agreement contained a general 250-acre minimal impact threshold for CWA Section 404 NWP 21 processing of MTM/VF proposals in West Virginia. In complying with the *Bragg* settlement terms, the COE retained discretion (based on site-specific aquatic conditions) to require the IP process for fills in watersheds less than 250 acres; or, to process fills in watersheds more than 250 acres under the NWP 21. The COE also evaluates whether multiple valley fills on a project, or multiple mining proposals in a particular watershed, exceed the minimal impact threshold and thus require an IP review. Since the December 1998 *Bragg* settlement agreement fills in watersheds less than 250 acres have mostly been authorized by NWP 21 in West Virginia. Between March 1999 and February 2002 in West Virginia, there have been 5 individual permit applications (with fills in watersheds greater than 250 acres), compared to the 81 projects approved using NWP 21.

Currently, there is insufficient data from which to draw a scientific conclusion for selection of a particular watershed size as a threshold between IP and NWP 21 processing. The CWA Section 404 program was intended to evaluate whether or not proposed activities cause significant adverse effects to the aquatic environment. As described in Chapter II.C.6.a.1, Chapter II.C.7 Action 12, and 67 FR 2042, watershed size is not the only factor considered in making adverse effect determinations and evaluating the appropriate CWA Section 404 process for MTM/VF applications. The COE favors site-by-site functional assessments to determine the impacts of each project proposal and mitigation in waters of the U.S. Significant aquatic resources may exist in small watersheds and significantly impaired waters may exist in larger watersheds. Thus, use of alternatives setting "one-size-fits-all" thresholds *in lieu* of stream functional assessment protocols were dropped from consideration.

As discussed below in II.D.5, this EIS found insufficient scientific basis to date for restricting fill size based on type of stream segment, watershed surrogates for stream segments, past mining practice, or COE workload management. However, the 250-acre threshold established in the *Bragg* agreement could be the administrative basis for the continuing use of NWP 21 until such time as sufficient scientific data may be available to establish a specific threshold. The COE proposes in Action 9 to compile data collected through application of the stream assessment protocol to evaluate whether programmatic "bright-line" thresholds are feasible [Chapters II.C.6 and II.C.7].

d. Cumulative Impact Restrictions

A number of alternatives with restrictions for MTM/VF based on cumulative impacts to waters of the U.S. were considered and dismissed. The CWA and SMCRA require, in addition to the individual impacts of MTM/VF proposal, that the cumulative effects of multiple MTM/VF proposals also be evaluated. Cumulative impacts are discussed in Chapter II.C.7 and Action 12. The alternatives considered were based on the influence of headwater streams on the environmental resources of the watershed. The alternatives explored:

- preserving 50% of headwater streams by prohibiting fills in one out of every two first order streams;
- preserving a stream length equal to the length of stream impacted by fills;
- requiring an IP for any project with more than 4 valley fills; and
- requiring an IP for any project that would result in the loss of more than 10% of the stream length in any given watershed or CIA.

Each of these restrictions was based on the general assumption that limiting the loss of headwater streams conserves the health of the watershed ecosystem. The existing data do not show that an across-the-board cumulative impact threshold could replace case-specific evaluations of all MTM/VF and other disturbances within a defined CIA/watershed [see additional discussion in Chapter II.D.5, below]. However, the EIS proposes an action to build a database to determine if a scientific basis for cumulative impact thresholds can be identified in the future [Chapter II.C.7, Action 12].

2. Fill Restrictions Based on Identification of High-Value Aquatic Resources

Several provisions of the CWA regulatory program promote protection of aquatic resources with particularly high value. Alternatives using existing CWA program features to conserve these types of aquatic environments were evaluated and are presented below.

a. CWA Advanced Identification (ADID) of Potential Fill Sites

One alternative would have established a blanket designation of all headwater streams in the EIS study area as "generally unsuitable" for valley fills. Such designations for specific geographically-defined waters of the U.S. can be an outcome of the Advanced Identification of Disposal Sites (ADID) process in the CWA Section 404(b)(1) Guidelines [40 CFR 230.80]. Under this provision, designating a fill site as generally unsuitable in advance of a project- specific CWA Section 404 permit application is based on the likelihood that fills proposed in these areas would not comply with the CWA Section 404(b)(1) Guidelines.

This designation would not prohibit the issuance of a CWA Section 404 permit; rather, it is a presumption that must be overcome with a demonstration, through data collection and alternative analyses, that the proposed fill would comply with the CWA Section 404(b)(1) Guidelines. Such designations may be useful to: 1) prospective permit applicants in setting regulatory expectations; and 2) permitting agencies by providing site-specific for evaluation of potential applications.

The ADID process has not been used to designate a broad class of waters such as Appalachian headwater streams as generally unsuitable for fill. Because the ADID process involves exhaustive site-specific data collection and analysis, as well as thorough agency and public participation, pursuing such a designation for such a broad geographic area would not be practicable. It is not feasible to collect data and assess every headwater stream in the MTM/VF region. Without these site-specific efforts for each headwater stream, such a designation for this category of waters would be arbitrary. Consequently, this alternative was dismissed from further consideration.

However, individual ADID efforts for specific geographic areas within the study area would prove useful in the regulatory program for MTM/VF activities. Thus, the alternatives carried forward for detailed analysis include the use of ADIDs as an action in circumstances that would assist the regulatory program in protecting important aquatic resources [Actions 1.2 and 1.3]. EPA and the COE intend to explore use of this ADID approach to identify specific locations or watersheds warranting careful consideration.

b. CWA Special Aquatic Site Designation

Another alternative assessed was the designation of all headwater streams in the EIS study area as "special aquatic sites". This action would require rule-making by EPA to expand the existing list of special aquatic sites in the CWA Section 404 (b)(1) Guideline regulations at 40 CFR 230.3(q). The Guidelines currently identify aquatic habitats such as wetlands, mud flats, and riffle/pool complexes as special aquatic sites.

If an applicant proposes to place fill in a "special aquatic site," and that fill material can be placed elsewhere to fulfill the project's basic purpose (i.e., the fill is not "water dependent" as is fill associated with, for example, a boat ramp), then the applicant for an IP is required to overcome two rebuttable presumptions. The first presumption is that practicable alternatives are available that do not involve special aquatic sites, unless clearly demonstrated otherwise. The second presumption

is that all practicable alternatives to the proposed fill that do not involve a discharge into a special aquatic site would have less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise.

This alternative was dismissed from further consideration based on the fact that some stream features (e.g., riffle/pool complexes or wetlands) in the EIS study area are already designated as special aquatic sites. Headwater streams in the Appalachian Highlands often exhibit riffle/pool complexes and other aquatic habitats that are categorized as Special Aquatic Sites subject to the provisions in the CWA Section 404(b)(1) Guidelines. These sites may warrant comprehensive functional assessments of the stream environment and more rigorous alternatives analyses as part of the permit application process; and the COE may rely on the results of these evaluations to deny valley fill permit applications or employ them to develop measures to minimize adverse environmental effects of those permits issued. Therefore, the designation of headwater streams as special aquatic sites (e.g., because of the presence of riffle/pool complexes) would likely have no additional regulatory effect in practice. An applicant for an IP with fills proposed in special aquatic sites would be required to rebut the two presumptions previously discussed.

c. Advance Veto

This alternative was based on a premise that Appalachian headwaters streams would be preserved in perpetuity with an "advanced veto" by EPA. The alternative was based on the presumption that all headwaters stream are of high value to the aquatic ecosystem, warranting protection. EPA can issue an advance CWA Section 404(c) veto for a specific geographic area of aquatic resources prior to the COE receipt of a CWA Section 404 permit application. EPA also has the authority under CWA Section 404(c) to veto a single COE CWA Section 404 permit during or after review. EPA vetoes can be initiated based on unacceptable significant adverse impacts to waters of the U.S., including cumulative impacts. Like ADIDs, advanced vetoes require substantial data collection, analysis, and public participation and such a designation for a broad geographic area would not be practicable as an alternative in this EIS. EPA may initiate the veto option at any time with actions unrelated to this EIS. Regardless of the alternatives considered in this EIS, EPA retains the ability to exercise its CWA Section 404(c) authority where it finds that mountaintop mining would have unnaceptable adverse effects on certain aquatic resources.

3. Fill Prohibition

An alternative to prohibit valley fills in waters of the U.S. was considered. The alternative was based on an interpretation that placement of valley fills in streams is contrary to the EPA anti-degradation policy of maintaining and protecting existing water uses. The anti-degradation policy is discussed in Chapter II.C.4.a.1. However, CWA Section 404(a) authorizes the COE to regulate fills in waters of the U.S. EPA has interpreted that the antidegradation policy is satisfied with regard to fills if the discharge did not result in "significant degradation" to the aquatic ecosystem as defined under 40 CFR 230.10(c) of the CWA Section 404 (b)(1) Guidelines [USEPA, 1994]. Moreover, the CWA Section 404 program, including the anti-degradation provisions, is inherently case specific and not amenable to a complete prohibition on fills in waters of the U.S. Consequently, this alternative was dismissed.

4. Summary of Fill Restriction Alternatives

Scientific data collected for this EIS do not clearly identify a basis (i.e., a particular stream segment, fill or watershed size applicable in every situation) for establishing programmatic or absolute restrictions that could prevent "significant degradation". The data indicate that impacts may (or may not) be linked to the presence of mining, and not necessarily related to the size of fills. The direct impact of a large fill is different than a smaller fill, but it appears the indirect effect downstream may be similar, regardless of fill size.

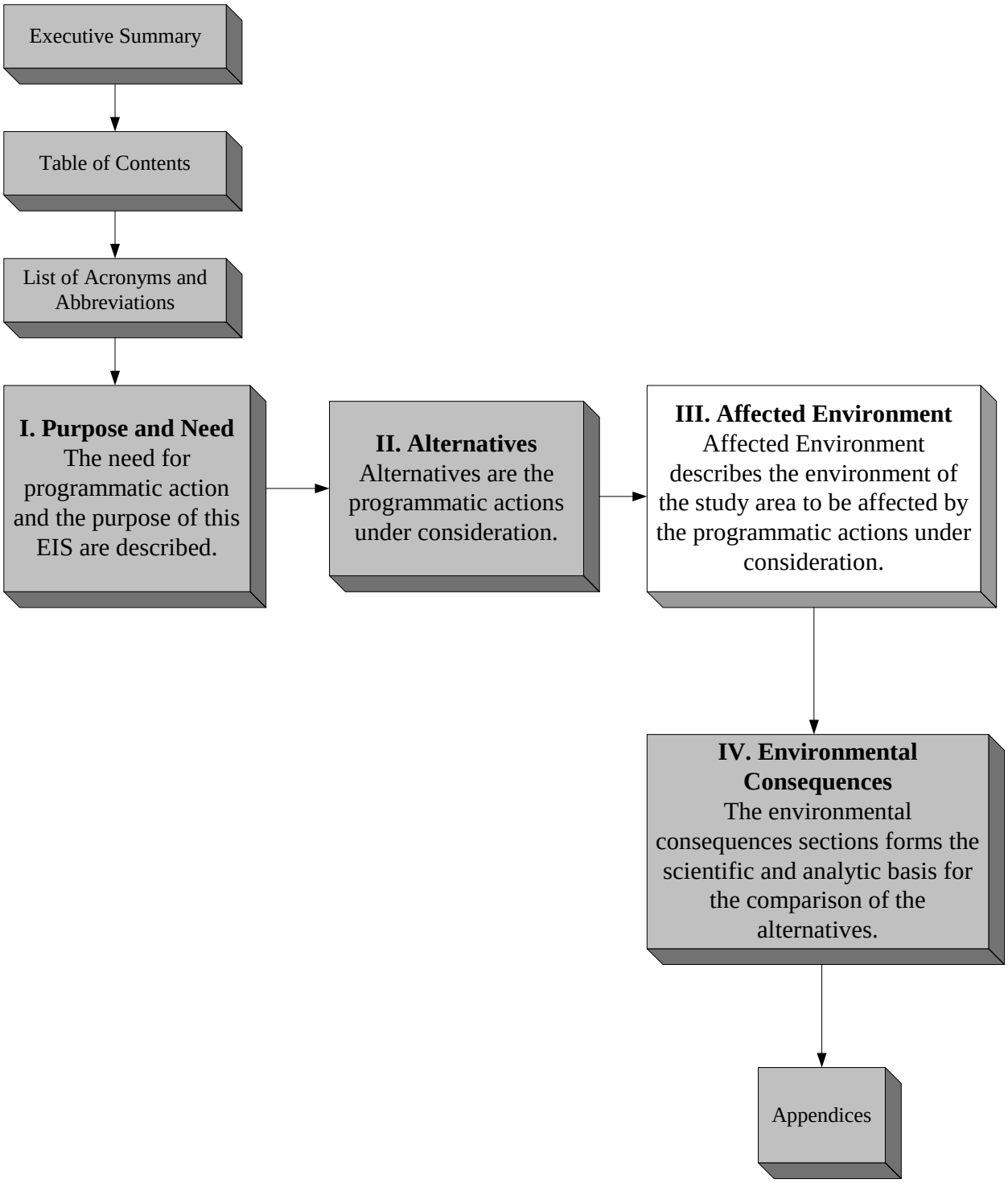
The chemical and biological studies conducted for this EIS and the statistical analyses of those studies document that streams with both valley fills and residences in their watersheds appeared to be impacted more than streams with only valley fills and no residences in their watersheds. Biological conditions in the streams with only valley fills represented a gradient of conditions from poor to very good; streams with valley fills and residences were most impacted. Impacts could include several stressors, such as valley fills, residences, and/or roads. Therefore, a causal relationship between the impacts and particular stressors could not be established with the available data. Further, the EIS studies did not conclude that impacts documented below MTM/VF operations cause or contribute to significant degradation of waters of the U.S. [40 CFR 230.10(c)].

The overall aquatic impacts attributable to fills is highly site-dependent and a "one-size-fits-all" fill restriction standard is not justified at this time. The CWA Section 404(b)(1) Guidelines are the substantive criteria used to evaluate the placement of fill material into waters of the U.S. and the sequence of steps are summarized below:

- site-specific inventory of aquatic resources
- prediction of project impacts to those resources
- considering upland alternatives to avoid the resources
- if avoidance is not possible, minimizing impacts
- adequate mitigation to offset the unavoidable impacts

Details on the requirements of the existing CWA Section 404 program and action proposals for rule making, development of policies, guidance, etc. are discussed in Appendix B and Chapter II.C.

Chapter III. Affected Environment



III. AFFECTED ENVIRONMENT AND CONSEQUENCES OF MTM/VF

This chapter includes a description of the physical setting, Appalachian lotic and lentic aquatic systems, relationship of surface mining and water quality, Appalachian forest communities, Appalachian microhabitats, threatened and endangered species, coal mining methods, mountaintop mine characteristics, excess spoil disposal, and economic information. Supporting information is provided in the appendices.

THESE ECOREGIONS ARE UNIQUE IN THE WORLD BECAUSE THEY COMBINE CHARACTERISTICALLY NORTHERN SPECIES WITH THEIR SOUTHERN COUNTERPARTS, AND THUS BOAST ENORMOUS RICHNESS AND DIVERSITY

A. DESCRIPTION OF THE STUDY AREA

Figure III.A-1
Study Area

The Appalachian Coalfield Region encompasses the coal-bearing areas of Pennsylvania, Ohio, Maryland, North Carolina, Georgia, West Virginia, Virginia, eastern Kentucky, Tennessee, and Alabama. The Bituminous Coal Basin lies within the Appalachian Plateau physiographic province, extends in a northeast to southwest direction along the Appalachian Mountains, and encompasses the most historically important coal mining areas of the Appalachian Coalfield Region (USDOI OSM, 1983). The study area is located within the Appalachian Coalfield Region of the Appalachian Plateau physiographic province and Bituminous Coal Basin. As the name implies, this region is known for the substantial deposits of coal that lie beneath the surface. Consistent with the EIS purpose, the study area includes watersheds where excess spoil fills, otherwise known as valley fills, have been constructed or are likely to be constructed in the future.

Physically, two factors must be coincident in order for mountaintop mining to occur and for excess spoil to be generated: steep terrain and sufficient contiguous coal reserves located close enough to the tops of mountains and ridges to justify large scale mining. In West Virginia, this close combination exists in the southern half of the state and is most frequently aligned with the existence of the Coalburg coal seam. In Kentucky, Virginia and Tennessee, this combination of factors also exists but delineation is not quite as simple because of more complex geology. The study area is approximately 12 million acres and extends over portions of West Virginia, Kentucky, Virginia, and Tennessee [Figure III.A-1 - Study Area].

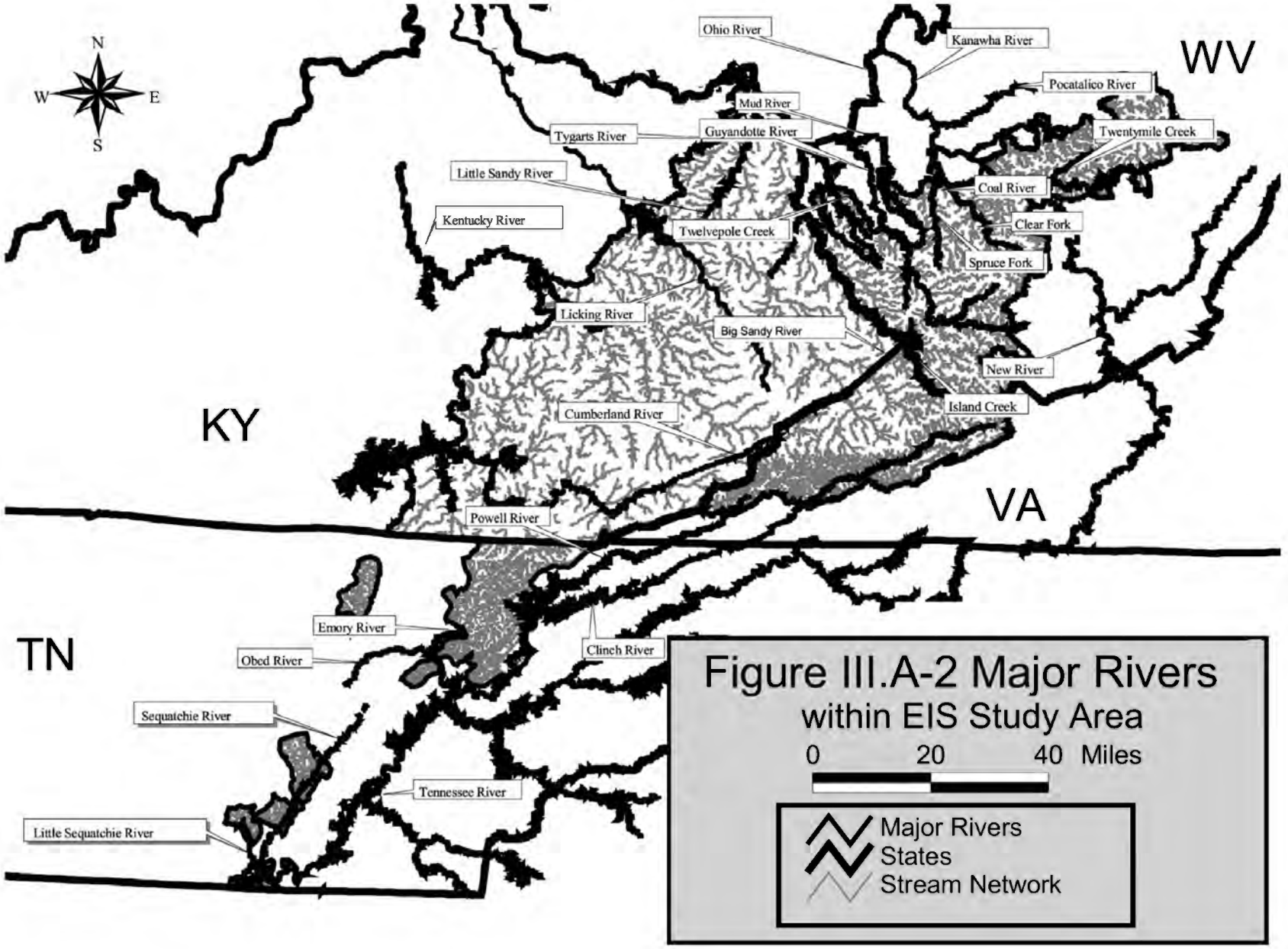
The rugged terrain of this region is generally characterized by steep mountain slopes, confined river valleys, and narrow ridge tops. The geologic processes and climatic conditions responsible for the formation of these land forms, have as a result, helped to determine the past and present land use and land cover of the region. The regional topography, and the coal it contains, have been significant driving forces behind human settlement and development patterns throughout the region. The very

history of the region has been shaped by coal, and the region itself marked by the continuous attempts to extract it. Federal law also requires the maximum utilization of the natural resource so that disturbing the land in the future will not be necessary.

THE RUGGED TERRAIN OF THIS REGION IS GENERALLY CHARACTERIZED BY STEEP MOUNTAIN SLOPES, CONFINED RIVER VALLEYS, AND NARROW RIDGE TOPS

Settlement patterns in the Appalachian Coalfield Region were constrained by the dominant topographic features of the area, such as rivers, streams, mountains, and valleys. Communities settled along rivers and within valleys primarily for transportation and agricultural purposes. The coal deposits, as well as the physical limits to other types or forms of development, have defined the locations and extent of settlement and distribution. Within the study area, there is a relative scarcity of land suitable for agriculture and conventional residential, commercial, and industrial development. As a result, the limited settlement and development of the region has occurred almost exclusively on valley floors along stream and river courses. The current road and rail transportation networks generally follow the network of streams. Although the land was largely unsettled, there was significant timber cutting, and today's forests are largely second and third growth. Private and public forests provide lumber and pulpwood, recreational opportunities, wildlife habitat, and the opportunity for harvesting non-traditional forest products.

Water is relatively abundant throughout the study area. Figure III.A-2 depicts major rivers within the study area. Most of the major rivers and tributaries in the United States east of the Mississippi originate in the mountains of the Appalachian regions (USDOI OSM, 1999a). Outside of urban areas, shallow groundwater wells provide most of the water for domestic use (Heath, 1984). Vital to the health of an aquatic ecosystem is the quality of its water.


N
W
E
S
Ohio River
Kanawha River
WV
Pocatalico River
Mud River
Tygarts River
Guyandotte River
Twentymile Creek
Little Sandy River
Coal River
Kentucky River
Twelvepole Creek
Clear Fork
Spruce Fork
Licking River
Big Sandy River
New River
Island Creek
KY
Cumberland River
VA
Powell River
Emory River
TN
Clinch River
Obed River
Sequatchie River
Tennessee River
Little Sequatchie River
Figure III.A-2 Major Rivers
within EIS Study Area
0
20
40 Miles
Major Rivers
States
Stream Network

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The regional history of coal mining extends back well over a century. Remnants of earlier mining operations, as well as mines which are in operation today, have influenced the natural environment of the region. Of particular environmental concern are those resources which have the most potential for being significantly affected by the adverse impacts of coal mining. For example, the rivers and streams, and the aquatic ecosystems they maintain. An aquatic ecosystem is composed of three components: the biological, the chemical, and the physical, and any or all of them may be impacted by mining activities.

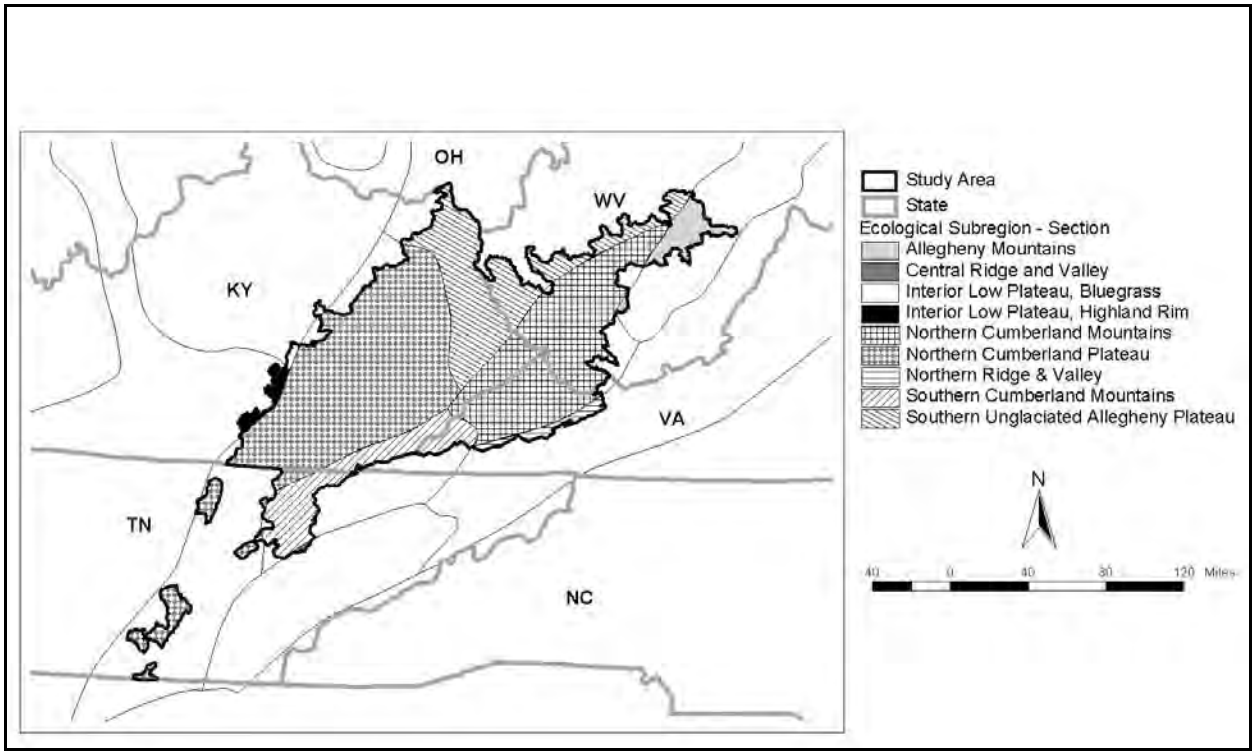
To assess the programs that monitor and govern the impacts that mining may have on aquatic and terrestrial ecosystems, it becomes necessary to consider and discuss issues in "natural" terms. By identifying and organizing environmental issues within natural boundaries, instead of partitioning areas based on arbitrary political boundaries such as state or county lines, natural resources may be considered within their own context. Two such "natural" categories of division are watersheds and ecoregions.

Watersheds are a clearly-defined unit of land that represents the area drained by a stream and all its tributaries. A watershed can include lakes, rivers, wetlands, streams, the surrounding landscape, and may also include ground water recharge areas. The watershed approach is useful because it focuses more specifically on drainage patterns, water quality, and aquatic ecosystems. The use of ecoregions and watersheds as "natural" units of area can depend highly on the scale of observation. For example, an ecoregion may contain countless small watersheds, while conversely, a large watershed (such as the Ohio River) may contain many ecoregions. For the purposes of classification, the study area watersheds are referred to individually by their 11 digit Hydrological Unit Code (HUC) assigned by the United States Geological Survey (USGS). For example, the Clear Fork watershed is located entirely within Raleigh County, West Virginia. The watershed consists of the Clear Fork itself, all the tributaries that flow into and contribute to the Clear Fork, and all the surrounding land from which the runoff and groundwater flow into the Clear Fork and its tributaries. Beginning at the highest points which surround the Clear Fork, headwater streams form which serve as the surface collection points for all surface and ground water within the watershed. As these headwater streams flow downhill, they join other headwater streams to form larger tributaries. Depending on their relative size and prominence, tributary streams may or may not be named. Further information on representative streams is provided in section III.C. of this EIS.

Ecoregions are areas of relatively similar landscapes. Across an ecoregion, one will find that climate patterns, physiography, geology, soils, and vegetation vary little. Ecoregions can be further subdivided into subregions, landscapes, and land units, each at a different planning and analysis level scale. Analysis at the ecological subregion level is of considerable value when the purpose is for strategic, multi-forest, statewide, and multi-agency assessment because several variables are considered when defining the boundaries of each ecological subregion (USDA, U.S. Forest Service 2002). The ecological units of an ecological subregion analysis are termed *sections*. Within an ecological subregion section geomorphology, lithology, soils, vegetation, fauna, climate, surface water characteristics, disturbance regimes, land use, and cultural ecology are generally similar.

The study area is located within portions of nine ecological subregion sections [See Figure III.A-3 - Ecological Subregion Sections]. Characteristics of each ecological subregion section of the study area are summarized in Table III.A-1 - Ecological Subregion Section Characteristics.

Figure III.A-3
Ecological Subregion Sections



Ecoregional analysis at a national level has highlighted the biological significance of the Appalachian ecoregions. These ecoregions are unique in the world because they combine characteristically northern species with their southern counterparts, and thus boast enormous richness and diversity. That, in combination with relatively mild environmental conditions, have provided a perfect setting for the evolution of unique species of plants, invertebrates, salamanders, crayfishes, freshwater mussels, and fishes. These species include great numbers of organisms, including terrestrial, aquatic, and plant species, which are supported by the Appalachian ecoregions (Stein et.al., 2000). The southern Appalachians have one of the richest salamander faunas in the world (Petranka 1998, Stein et.al., 2000). The Appalachian ecoregion forests represent some of the last remaining stands of a forest type that was once widespread in the northern hemisphere. These rich deciduous forests have been profoundly altered over the past few centuries and are becoming increasingly threatened.

Table III.A-1
Ecological Subregion Section Characteristics

Ecological Subregion	Geomorphology (Province)	Natural Vegetation (Forest Type)	Climate (Mean Annual)
Allegheny Mountains	Appalachian Plateaus	Northeastern Spruce-Fir Northern Hardwoods Mixed Mesophytic Oak-Hickory-Pine	Prec: 46-60" Temp: 39-54°F
Central Ridge and Valley	Ridge and Valley	Appalachian Oak	Prec: 36-55" Temp: 55-61 °F
Interior Low Plateau, Bluegrass	Interior Low Plateaus	Oak-Hickory	Prec: 44" Temp: 55 °F
Interior Low Plateau, Highland Rim	Interior Low Plateaus	Oak-Hickory	Prec: 44-54" Temp: 55-61 °F
Northern Cumberland Mountains	Appalachian Plateaus	Mixed Mesophytic Appalachian Oak Northern Hardwoods	Prec: 40-47" Temp: 45-50 °F
Northern Cumberland Plateau	Appalachian Plateaus	Mixed Mesophytic Appalachian Oak	Prec: 46" Temp: 55 °F
Northern Ridge and Valley	Ridge and Valley	Appalachian Oak Oak-Hickory-Pine Northern Hardwoods	Prec: 30-45" Temp: 39-57 °F
Southern Cumberland Mountains	Appalachian Plateaus	Appalachian Oak Mixed Mesophytic	Prec: 46" Temp: 55 °F
Southern Unglaciated Allegheny Plateau	Appalachian Plateaus	Mixed Mesophytic Appalachian Oak	Prec: 35-45" Temp: 52 °F

Source: U.S. Forest Service, USDA, 2002

B. PHYSICAL SETTING

1. Physiographic Province

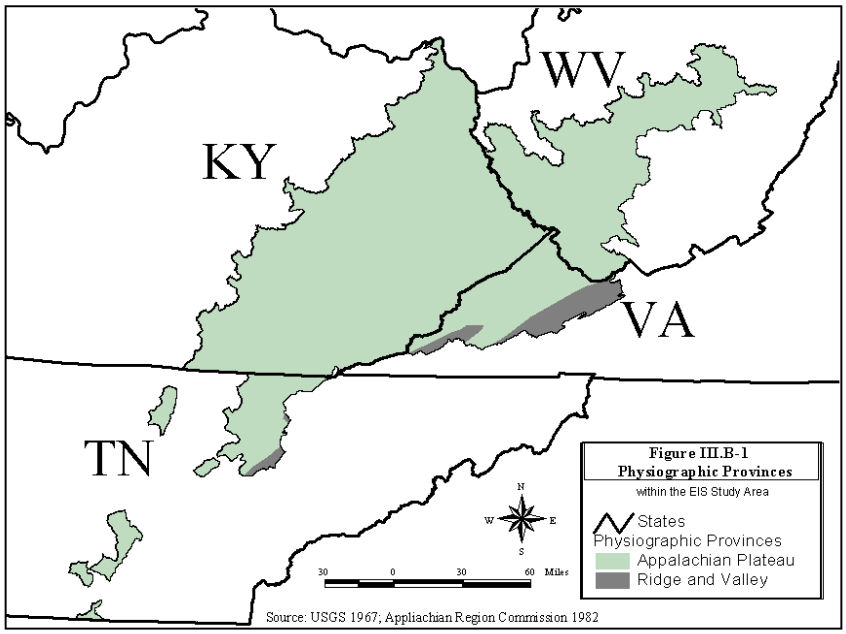
Physiographic provinces are a useful means of grouping land forms. The definition of a physiographic province is a geographic region in which climate and geology have given rise to an array of land forms that are notably different from those of surrounding regions. The feasibility and methods of coal mining in a given region are highly dependent on geologic conditions and land forms, so physiographic provinces are also useful in grouping the extent and various styles of mining within the Appalachian coalfields.

The Appalachian mountains form a wide belt (exposed width between 93 and 373 miles) that trends from Newfoundland to Alabama. The Appalachian mountains can be divided into three sections: (1) a northeastern section covering northern Maine and the maritime provinces of Canada; (2) a New England section covering portions of Vermont, New Hampshire, and New York; and (3) the Appalachian Highlands. The Appalachian Highlands section is comprised of the Ridge and Valley Physiographic Province and the Appalachian Plateau Physiographic Province. As shown on Figure III.B-1, the majority of the study area for this EIS is within the Appalachian Plateau Province.

The Allegheny Front separates the Appalachian Plateau Province from the Ridge and Valley Province. The Allegheny Front is a zone of transition between the tightly folded strata of the Ridge and Valley Province and the nearly horizontal sedimentary rocks of the Appalachian Plateau Province.

The Ridge and Valley Province is characterized by northeast-southwest trending mountains and valleys. In general, the valleys and lowlands are underlain by shales and limestones, and the ridges are composed of more resistant sandstones and conglomerates.

The Appalachian Plateau Province of the Appalachian Highlands includes the Pocatalico River, Coal River, New River, and the main stem of the Kanawha River drainage basins. It also includes small parts of the Ohio River and Bluestone River drainage basins. Differential stream erosion and repeated regional uplifts have given the plateau a rugged topography characterized by high, rounded or flat-topped ridges, rolling hills, steep valley slopes, and narrow valley floors.



2. Geology

Since coal mining involves the extraction of a geologic deposit, geologic conditions are an important factor in determining the extent and practicality of coal mining on a given site. Geologic considerations for coal mining include the depth, sequence, and thickness of coal seams, coal quality, and physical nature of the overburden (soil and rock that overlies coal) above and interburden (rock in between coal seams). The volume of excess material generated corresponds directly to the swell factors of the rock, which make up the overburden. Therefore, the potential for generating larger volumes of earth is greater with coarser-grained rocks, such as sandstone which has a higher swell factor than with finer-grained rocks, such as shale which has a lower swell factor. The chemical nature of coal and overburden, particularly with regard to pyrite content and the potential for acid mine drainage formation, is also a geologic consideration. These factors are influenced by the original conditions under which the coal deposits were formed, referred to as their environment of deposition, and subsequent deformation by tectonic processes. This section provides a brief overview of the history of formation of the Appalachian coalfields, and a summary of the general geologic conditions found in the four states of the study area. Detailed descriptions of the coalfield environment of deposition, tectonic history, chemical factors controlling acid mine drainage formation, and coal-bearing rock units are contained in Appendix C of this EIS.

a. Regional Geologic History

The Appalachian coalfields were formed during a long period of mountain building along the area of the modern east coast, with the coal beds deposited primarily from 300 to 250 million years ago. Sediments shed from these ancestral Appalachian mountains as they eroded were carried to a large inland sea occupying much of the area of the Appalachian mountain states and known as the Appalachian Basin. Large swamps formed along the margins of this sea and decayed plant matter, or peat, built up within them over time. As sea levels fluctuated, these coal swamps migrated with the shoreline and were buried by additional sediments carried from the mountains. Long-term burial pressures then converted the peat deposits into coal. This coal swamp migration and burial formed multiple layered coal seams typifying the Appalachian coalfields today.

Toward the end of the mountain building period, the collision of the North American and African continents deformed the eastern portion of the Appalachian Basin and produced the steeply folded bedrock characteristic of the Valley and Ridge Province. Further west, the Basin was only slightly deformed, producing gentle anticlines and synclines in the Appalachian Plateau Province. Over time, both the eastern mountains and the basin area were worn flat by erosion and buried by additional sediments. Regional uplift of the eastern states then re-exposed the coal-bearing bedrock to erosion, producing long valleys and ridges in the tightly folded bedrock of the Valley and Ridge Province. The erosion created deeply incised dendritic stream valleys in the relatively flat-lying bedrock of the Appalachian Plateau Province. In the Valley and Ridge Province, uplift and weathering eroded away the coal deposits from much of the area, with the remaining steeply-dipping coal seams more suited to underground mining methods. The same uplift and erosion in the Appalachian Plateau Province resulted in shallow, flat-lying exposures of coal-bearing bedrock that are amenable to surface mining within the study area.

b. State Geology Summaries

The following provides a basic description of the location, form, and structural features of the coal-bearing rocks within the study area.

b.1. Kentucky

Kentucky possesses two major coalfields at the eastern and western ends of the state, separated by a large area of older rocks exposed in a structure known as the Cincinnati Arch (USDOI OSM, 1998a). MTM/VF mining occurs in the eastern coalfield, where coal-bearing rocks underlay approximately the eastern quarter of the state and form a broad, shallow trough or synclinal basin (Kiesler, USGS 1983). Bedrock dips at 5° or less along the margins of the trough and is essentially flat-lying in the central portion of the trough (Kiesler, 1983). Upper Mississippian and Pennsylvanian coal-bearing rocks thicken towards the southeast, reaching their maximum thickness at the southeastern margins of the basin along a structure known as the Pine Mountain Thrust Fault zone. Coal units are disrupted and offset along this fault zone.

b.2. Tennessee

The Tennessee coalfields are in the east central portion of the state and trend northeast to southwest from Kentucky to the Alabama border. As with Kentucky, these coalfields form a broad, shallow trough or synclinal basin that is bounded to the west by a structure known as the Highland Rim escarpment and to the east by the Ridge and Valley Province. These coalfields are generally divided between the northern steep-slope areas of the Cumberland Mountains and the southern, flatter Cumberland Plateau, where area mining dominates (USDOI OSM, 1998b). Bedrock units primarily have a shallow southeasterly dip and thicken to the southeast near the basin's trough adjacent to the Valley and Ridge Province (Gaydos, 1982).

b.3. Virginia

With the exception of a small region in south-central Virginia which is not mined, coal-bearing rocks are present only at the westernmost end of Virginia and are contiguous with the Kentucky and West Virginia coalfields. These are relatively flat-lying rocks bounded on the northwestern and southeastern basin margins by the thrust-faulted and uplifted rock units (Rader, 1993 and Harlow, 1993). Along the northwestern coalfield margin is the Pine Mountain Thrust fault. The southeastern margin is bounded by a series of thrust faults. The Russel Fork fault divides the basin into two regions: (1) the relatively flat-lying rocks northeast of the fault and (2) the gently folded and faulted rocks located southwest of the fault that were moved as part of the Pine Mountain thrust sheet (Harlow, 1993). The rocks of both regions are nearly flat-lying and have an average northwesterly regional dip of 1.4 percent. Due to steep topography, Virginia mines are predominantly underground or contour surface operations, with a limited number of mountaintop removal and area-type operations (USDOI OSM, 1997).

b.4. West Virginia

Coal-bearing rocks underlay much of central West Virginia, extending into Ohio, Pennsylvania, and Maryland. One structural fold known as the Hinge Line separates the Dunkard and Pocahontas Geologic Basins of West Virginia. These basins are characterized by differences in the total thickness of their rocks, as well as by the orientation and distribution of their ancient swamps, lacustrine marine environments, and alluvial deposits (Arkle, 1974). The Dunkard and Pocahontas Basins approximately coincide with the northern and southern coalfields (younger and older mining districts, respectively) of West Virginia. The various formations of sedimentary rocks exhibit local differences in strata north or south of the Hinge Line in response to different depositional environments. For example, the Allegheny and Conemaugh formations in the Dunkard Basin represent a sequence of marine and coastal environments, including deltaic, offshore, and alluvial depositional conditions. In the Pocahontas Basin, these formations predominantly include the alluvial facies of non-marine sandstone, shales, and channel deposits that generally include only limited coal seams. Due to steep topographic conditions, contour, area, mountaintop-removal, and multiple-seam mining operations are the most common methods of surface mining in the state (USDOI OSM, 1998c).

3. Soils

Soils are a critical natural resource and essential for plant life in the natural environment. This resource is a particular concern for surface mining because, by definition, the practice will remove surface materials overlying the coal, including any soil present on the existing land. SMCRA requires that mine operations either preserve and replace soils on the reclaimed land surface to restore their vegetative cover or use an acceptable soil substitute. As discussed in Section III.J, surface mining operations use two methods to restore a vegetative growth substrate to reclaimed mine lands: topsoil removal and redistribution, and topsoil substitution. Both methods result in surface conditions markedly different from those present prior to mining. This section provides background on soils in general and the specific types of soils found within the study area.

a. Soil Characteristics

Because of their importance to agriculture, soils have long been studied to determine their characteristics and the factors that govern their formation and productivity. The following provides a brief overview of the soil formation process, soil profile, and the soil classification system.

a.1. Soil Formation

Soils are a fragile natural resource that require very long periods of time to form, most on the order of thousands to tens of thousands of years or longer. All soils are developed as a result of the interactions between five formation factors: (1) parent material, (2) climate, (3) living organisms, (4) time, and (5) topography. In the study area, the dominant formation factors have been topography, parent material, and time. Parent material is the bedrock, collovium (material moving down hillsides in response to gravity), or alluvium (material deposited by rivers and streams) on which a soil forms. Physical and chemical weathering and biological activity are the processes that form soils on the parent material, the rate of both being related to climate. Weathering is faster in warm, wet climates than in cold, dry climates. Soil

formation is an ongoing process, with weathering continuing to attack underlying parent material to form more soil, therefore, the longer that a parent material is exposed to the elements, the greater the weathering and the thicker the soil.

a.2. Soil Profile

Most soils show a distinct layering with individual layers referred to as horizons. There are many internal subdivisions that soil scientists use to characterize soil horizons, but the three basic groupings are called the A, B, and C Horizons. The A Horizon is the surface soil layer usually referred to as topsoil. It is the most weathered portion of the soil column and in vegetated areas will typically have a cover of decayed plant matter and high organic content known as the O Horizon. The B Horizon often referred to as the subsoil, typically contains less organic matter than the A Horizon and more clay. The C Horizon is the slightly weathered or unweathered parent material underlying the B Horizon. The individual horizons represent the downward progression of weathering in the soil formation process, and boundaries between them may be very distinct to very subtle depending on the nature of the soil. In general, older soils will have better developed horizons than younger soils.

a.3. Soil Classification

Soils are classified in the United States by a well-defined taxonomy, with a distinct hierarchy that follows from order, sub-order, great group, subgroup, family, and finally to series. There are twelve soil orders in the US, and in the study area the Inceptisol and Ultisol orders dominate. Inceptisols are immature soils that have weakly expressed horizons and retain a close resemblance to their parent material. They may form from highly resistant parent material or in alluvial floodplains, occur on extreme landscape positions, such as steep slopes and depressions, and have geomorphic surfaces so young as to limit soil development. Ultisols form in humid regions from parent material that has not been affected by glaciation, and thus develop on landscapes that are geologically old compared to glaciated areas. They are highly weathered soils that have a low nutrient content and base status.

b. Study Area Soils

To characterize the soils across a wide region such as the Appalachian coalfields, it is necessary to use soil series associations, rather than list specific soil series. For this study, two primary sources of information were used to collect pertinent data: the USDA, Geological Survey Series on the Hydrology of the Eastern Coal Province (Areas 1 to 23), and the USDA, Natural Resource Conservation Service (formerly Soil Conservation Service) County Soil Surveys.

Important points necessary to note when discussing MTM/VF region soil resources include:

- Historically, soil data have been collected and analyzed primarily for agricultural purposes, with less attention given to soils with lower attached economic value.

- Soil is an extremely heterogeneous material with high degrees of variability possible in its physical properties over a short distance. This is especially true with the non-agricultural

soil associations where many different soils with different properties are lumped together.

- The rugged topography of the MTM/VF region has made data collection difficult, and its low agricultural use has made it an area less studied than more intensively farmed regions.

b.1. Distribution

Soils typically encountered in the study area are predominantly colluvial in nature. Soil associations are shown in Table III.B-1 for the study area. These associations/complexes are typified as occurring on steep side slopes of higher mountains and formed on residuum or creep material from acidic sandstone, siltstone, and shale. These soils are very thin, with a typical topsoil layer of only 0 to 3 inches over varying amounts of colluvial material/subsoil ranging from 1.5 to 5 feet thick before reaching bedrock. These thin steep side hill colluvial soils' productivity and erodability can be increased and decreased, respectively, with proper planning. The presence of deeper colluvial and residual weathered deposits on southwest slopes that face the prevailing weather patterns make the region susceptible to land slides. A dominant land use in parts of the study area is forestry, which, depending on if and when it was last harvested, may have adversely affected the thickness of the topsoil layer.

Table III.B-1
Summary of Major Soil Associations in the Study Area

State	Hydrology Area Number	Primary Soil Associations
West Virginia	9	Clymer-Dekalb-Jefferson
West Virginia	9	Dekalb-Gilpin-Ernist
West Virginia	9	Gilpin-Ernist-Buckhanon
West Virginia	9	Clymer-Gilpin-Upshur
West Virginia	9	Gilpin-Dekalb-Buckhanon
West Virginia	12	Clymer-Dekalb-Jefferson
West Virginia	12	Clymer-Gilpin
West Virginia	12	Clymer-Gilpin-Upshur
West Virginia	13	Clymer-Dekalb-Jefferson
Kentucky	13	Jefferson-Shelocta
Kentucky	13	Dekalb-Berks-Weikert
Kentucky	14	Jefferson-Shelocta
Kentucky	14	Lathan-Shelocta
Kentucky	14	Jefferson-Dekalb
Kentucky	15	Jefferson-Shelocta
Kentucky	15	Lathan-Shelocta
Kentucky	15	Jefferson-Dekalb
Kentucky	15	Shelocta-Gilpin
Tennessee/ Kentucky	17	Muskingum-Gilpin-Jefferson/ Lathan-Shelocta
Tennessee/ Kentucky	17	Ramsey-Hartsells-Grimsley-Gilpin/ Jefferson-Shelocta
Tennessee	18/20	Ramsey-Hartsells-Grimsley-Gilpin
Tennessee	18/20	Muskingum-Gilpin-Jefferson
Virginia	13/16	Berks-Pineville-Rock Outcrop
Virginia	13/16	Kimper-Shelocta-Hazelton
Virginia	16	Berks-Weikert-Ladig
Virginia	13/16	Wallen-DeKalb-Dry Pond

State	Hydrology Area Number	Primary Soil Associations
Virginia	13	Jefferson-Wallen-Gilpin
Virginia	13/16	Fredrick-Carbo-Timberville
Virginia	16	Groseclose-Litz-Shottower
Virginia	16	Mommaw-Jefferson-Alonzville
Virginia	16	Murrill-Westmoreland-Frederick
Virginia	16	Carbo-Chilhowie-Frederick
Virginia	16	Catache-Berks-Shouns

source: http://www.va.nrcs.usda.gov/soils

Not appearing on Figure III.B.1 are the narrow bands of valley soils along the flood plains, which are both colluvial and alluvial in nature. The unconsolidated materials forming these soils can range from a depth of 5 feet along narrow streams to100 feet along large rivers. The soils in these locations often are inceptisols showing only limited horizonation. These soils are typically very productive and can qualify as prime farmland soils.

4. Soil Productivity

This portion of the environmental impact statement (EIS) addresses soil quality and forest productivity at reclaimed mountaintop mine sites and is based on a technical study performed by OSM to support the EIS. This study involved collecting available published literature, papers presented at conferences and symposiums, interviews with prominent researchers, and documenting the collective knowledge and experience of the Soil Quality and Forest Productivity team members.
Several milestones were identified in the work plan and accomplished as shown:

1) examine soil properties--evaluated on the basis of the literature and team experience
2) evaluate the effectiveness of current sampling and testing protocols--evaluated on the basis of the literature and team experience
3) establish the effectiveness of current reclamation methods--dropped from consideration as inappropriate within the study time frame
4) evaluate long-term indices for determining forest productivity on reclaimed mined lands--evaluated on the basis of the literature, team experience and interviews with researchers
5) interview prominent researchers--accomplished
6) review regulations--accomplished
7) determine which factors limit tree production on mined lands--accomplished
8) conduct field verification of site conditions if the information gathered warrant such investigations–this task was not warranted, given the experience of the team

The study report outline is based on the activities described above. Four major topic areas were identified:

1) Review and identify applicable regulations--This is not simply a restatement of the regulations, but an assessment of whether the rule has positive or negative effects on the reclamation of mined lands;
2) Mine soil forest relationships–A technical perspective on different mining techniques use to create a growth media conducive to reforestation;
3) The third topic deals with the effect of mycorrhizal relationships on planting stocks–Evidence supports inoculating tree stock with mycorrhiza in order to improve the growth and survival of planted trees. Other researchers argue that native organisms found in topsoil are important to tree growth. The study will look at this issue and report the results;
4) The fourth topic is about planting trees on mined lands. Here again, the idea is to extrapolate from existing literature a brief description of the state-of-the-art, risks, hazards, and probable replanting rates in an attempt to identify changes that could be implemented to encourage planting of more trees.

There are also other factors that influence tree planting on mined lands that will only briefly be mentioned here. The stability of growth media placed on backfill must be considered when selecting reclamation techniques. Although this factor deals with topsoil/substitute placement, it is more of an engineering issue. Cost is another consideration that will have a great influence on whether or not changes will be made that allow increased, more effective tree reclamation to occur on mine sites. The challenge is to find more cost effective ways to create new forest on mined lands.

a. Applicable Regulations and Observations on Implementation

SMCRA, OSM regulations, and state regulations (which must be as effective as OSM regulations), contain elements that may work at cross purposes. For example, when regulatory authorities strictly enforce erosion control regulations as a means of protecting water quality, there is a strong tendency for operators to use quick-germinating, vigorously-growing grasses and legumes to stabilize the soil and prevent erosion. Such vigorous herbaceous vegetation, however, has the unfortunate side effect of discouraging tree establishment. Additionally, in most of Appalachia, grass and legume stabilized areas are considered adequately vegetated to meet the requirements for the pasture land use. Thus, an operator could obtain bond release without further revegetation work. A further disincentive to reforestation is the fact that grass/legume mixtures commonly used in reclamation tolerate a wide range of soil chemical conditions, as well as the excessively compacted soils, that typify reclamation in Appalachia. Thus, the use of grasses and legumes serves as the low cost, low-risk option for bond release. Even when the reclamation plan calls for the planting of trees, excessive compaction of the rooting medium, which severely reduces tree growth, is the norm.

The following sections use West Virginia soil handling regulations to illustrate barriers to effective reforestation. The other steep slope Appalachian regulatory programs contain similar provisions but, for brevity, will not be restated here.

38CSR2.14.3 Topsoil

14.3a. Removal. Prior to disturbance of an area, topsoil shall be removed from the area to be disturbed in a separate layer and if not immediately redistributed, it shall be segregated and stockpiled in a separate stable location as specified in the preplan. Stockpiled topsoil shall remain in place until used for redistribution unless otherwise approved by the Director. Stockpiled topsoil shall be protected from excessive compaction. Where the removal of vegetative material, topsoil or other materials may result in erosion, the Director may limit the size of the area from which these materials are removed at any one time.

Historically, Post Mining Land Uses (PMLU)in the mountaintop mining area of West Virginia were predominantly grasslands, which led to the soils rarely being salvaged. The soils were generally characterized by permit applicants as too thin and/or too poor in quality to justify salvaging for the PMLU.

14.3.b. Redistribution. Prior to redistribution of topsoil, the regraded land shall be treated, if necessary, to reduce the potential for slippage of the redistributed material and/or to enhance root penetration. Topsoil and other materials shall be redistributed in a manner that prevents excess compaction and that achieves an approximate uniform, stable thickness, consistent with the approved postmining land uses, contours, soil density, and surface water drainage system. Immediately after redistribution all topsoil areas shall be protected from wind and water erosion.

Excessive compaction is a well-known impediment to revegetation in Appalachia and other coal regions of the country. As noted above in 14.3.b, the conflict between not over compacting soils and stability or soil erosion is a concern. That is, soil and soil substitutes are often compacted to the point of seriously reducing root penetration when the objective is to maximize stability or reduce erosion of those soils. The negative impact of this compaction on biomass production is greater for trees than for grasses and legumes.

14.3.c. Top Soil Substitutes. Any substitute material used for top soiling must be capable of supporting and maintaining the approved postmining land use. This determination of capability shall be based on the results of appropriate chemical and physical analysis of overburden and topsoil. These analyses shall include at a minimum depth, thickness and areal extent of the substitute structure or soil horizon, pH. Texture class, percent coarse fragments and nutrient content. A certification of analysis shall be made by a qualified laboratory stating that:

14.3.c.1 The proposed substitute material is equally suitable for sustaining vegetation as the existing topsoil;

14.3.c.2. The resulting soil medium is the best reasonably available in the permit area to support vegetation;

14.3.c.3. The analyses were conducted using standard testing procedures.

14.3.d. Soil Amendments. Nutrients and soil amendments in the amounts determined by soil tests shall be applied to the redistributed surface soil layer so that it supports the approved postmining land use and meets the revegetation requirements of Section 9 of this rule. These tests shall include nutrient analysis and lime requirement tests. Results of these tests shall be submitted to the Director with the final planting report as required by this rule.

In practice, selective overburden handling in the mountaintop mining area of West Virginia is conducted so as to prevent the deposition of acid toxic materials on the surface. The predominant PMLU has included a bias towards salvaging fine-textured, high pH soil materials that provide favorable chemical conditions for the growth of grasses and legumes, but have a negative impact on forest regeneration.

Approval for use of a topsoil substitute material requires a waiver, as described in 14.3.c above, and must support the PMLU. Most permits requesting the use of a topsoil substitute will indicate thin soils [III.B.1] as a reason for not saving topsoil. The permit will explain, using language something to the effect that "slopes are steep with only a thin layer of topsoil that would not be practical to save following clearing and grubbing." Furthermore, the permit will state that "the quality of the topsoil is poor with very little capacity for supplying plant nutrients." This may provide poor soils for grasses and legumes, but support a mixed hardwood climax forest. What is described as poor for one land use may be ideal for another land use.

Topsoil has nearly all of the living matter that makes the collection of sand, silt, and clay a living soil capable of sustaining plant life. It is not just soil pH and nutrients that makes a medium suitable for plant growth and development. This is the reason why the surface mining act and State regulations at 38CSR2.14.3.a. require the saving of topsoil. Recognizing that all topsoil is not created equally, topsoil substitutes are permissible, provided the new material can be shown to be as good as or better than the original topsoil.

The West Virginia surface mining law, at §22-3-10.(2)(B), and other steep slope state counterparts require an evaluation of the land's capability to support a variety of uses prior to any mining. §22-3-10.(3) and other states' similar provisions require that, relative to mined land use following reclamation, the permit include a discussion of the utility and capacity of the reclaimed land to support a variety of alternative uses.

b. Mine Soil/Forest Relationships

Prior to the passage of SMCRA, most surface-mined land in the east and midwest was reclaimed with trees. The quality and productivity of these lands varied, but, in general, reforestation was successful, and commercially valuable forests were created (Andrews et al., 1998). With the implementation of SMCRA-based rules and regulations, the percentage of land reclaimed to forest dropped significantly. The rules, as typically interpreted and enforced, resulted in intensely-graded landscapes with erosion control provided by herbaceous vegetation. In this post-SMCRA environment, reforestation was difficult and productivity of those lands reforested was disappointing.

The reclamation literature, extending from well before the passage of SMCRA, up to the present, presents a clear picture of the factors responsible for the success or failure of reforestation efforts. OSM has recently initiated a program to promote reforestation and eliminate regulatory barriers to establishing trees on reclaimed sites. The goal is to create a regulatory process that will result in successful reforestation; that is, result in the establishment of forests that are productive and economically viable for timber production.

Deep rocky soils with the appropriate chemical composition can be produced through mining and reclamation, and will support forests that are more productive than those supported by the thin natural soils typical of the Appalachian mountains. However, the mine soils that support good forest growth vary chemically over a more limited range than those that will support a good stand of herbaceous vegetation. Trees also are more sensitive than herbaceous vegetation to the negative impacts of excess compaction.

Ashby et al., 1984, states that "mine soils with differing contents of coarse fragments may have productivity equal to or greater than pre-mining soils." Indeed, a relatively small percentage of soil fines distributed through a matrix of rocky material that is not excessively compacted can function as an excellent substrate for tree growth. The "increased rooting depth on loose mine soils appears to compensate more than adequately for loss of soil volume due to stones." Additionally, appropriately constructed mine soils may have higher water infiltration rates and lower erosion rates than replaced soils. Ultimately, it is the water and nutrient supplying capacity of the rooting medium that translates into plant productivity.

Research in Appalachia on reforestation of mined lands in the post-SMCRA environment portrays the actual accomplishments and has assisted in refining the requirements for mine soils that will support productive forests. The productivity of mine soils produced post-SMCRA is characteristically reduced by excessive compaction. These soils may be further reduced in value for forest growth due to lack of selection of appropriate substrate materials or selection of fine textured materials with a high pH (which are more favorable for supporting herbaceous vegetation). However, the technology exists to produce high-quality forest soils. Burger, et al., 1998 describe this technology and identify policies designed to encourage its use. They state:

> Research by reclamation forestry groups throughout the Appalachian and Midwestern coalfields has shown that productive mine soils and forests can be restored by using a "forestry reclamation approach," described in Virginia Cooperative Extension (VCE)

Publications 460-123 (Burger and Torbert, 1992) and 460-136 (Torbert et al., 1994). The forestry reclamation approach basically entails:

1. Replacing 3 to 4 feet of surface soil and/or weathered, sandstone overburden (taken from the surface 10 feet) for the new reclaimed soil and sub-soil medium;

2. Loosely grading noncompacted topsoil or topsoil substitutes that include, when possible, woody debris and native seeds;

3. Using native and non-competitive domestic ground covers (tree-compatible) that quickly protect the site, encourage native forest plants and animals, and enhance forest succession; and

4. Planting nurse trees for wildlife and mine soil improvement, and planting valuable crop trees for their commercial value to the landowner and adjacent communities.

This forestry reclamation approach has been used operationally and has proven successful. In addition, the approach described above can cost the mine operator $200 to $500 less per acre than traditional reforestation practices, due to reduced grading costs and less expensive ground cover seed mixtures. This approach has been approved by the Virginia Department of Mines, Minerals, and Energy in a July 9, 1996, memo on reforestation guidelines. Approximately 80% of Virginia's operators/landowners are now opting for a post-mining land use of forestry. New reforestation reclamation guidelines have also been approved as a reforestation initiative by the Kentucky Department for Surface Mining and Reclamation and Enforcement in Reclamation Advisory Memorandum #124 (KY DSMRE, 1997). In West Virginia, this approach is consistent with regulatory agency criteria for approving reclamation plans to achieve a forestry post-mining land use.

Foresters judge soil quality based on the average height of trees at a given "index age," such as trees of age 25 or 50 years. Site index has a dramatic effect on the value of timber produced (Burger, et al., 1998). In Table III.B-1, reclamation technique is related to white pine productivity and stand value at 30 years.

c. Effect of Site Index on Timber Value: Oak

White pine was used in the analysis shown in Table III.B-1 because of its predominant use on post-law mined land. Although total wood volume would be less for hardwoods, the same general relationships between site quality and value per acre would hold true. A site with a white pine site index of 55 (age 25) has an average oak site index of 65 (age 50), which is an average value for oaks across most of the Appalachians. This species-to-species relationship shows that average post-SMCRA reclamation site quality for oaks would be about 50, and the site quality potential for oaks of properly-reclaimed mine sites would be about 85. This estimate is confirmed by Ashby, *et al*. (1984) who evaluated mine soil productivities for oak species.

Table III.B-2 shows the relative influence of soil and site properties on oak site index, wood yield, and harvest value. Average oak sawtimber value at age 60 on average quality sites (SI = 65) is about $4,250 per acre. If forest sites are degraded through typical post-law reclamation from SI 65 to 50, potential harvest value becomes one-fourth of what it was originally. If sites are upgraded through reclamation to SI 85, harvest value doubles. These estimates show the dramatic effect site quality has on forest land value and, it shows why landowners and the mining community should strive for proper reclamation of forest land.

Table III.B-2
The Effects of Reclamation Technique on White Pine Productivity and Stand Value at 30 Years

Case	White Pine Site Type	Site Index* (Base Age 25)	Bd.Ft.Vol. at Age 30 (MBF/ac)**	Harvestable Wood Products	Harvest Price ($/MBF)	Total Value ($/acre)
I	Average quality of an undisturbed Appalachian forest site (Doolittle 1958)	55	35.1	small sawtimber	50	1,755
II	Projected average quality of a post-SMCRA reclaimed mine soil (Torbert et al., 1994)	45	6.1	pulp	20	122
III	Actual quality of a white pine stand on a good minesoil in Virginia (Kelting et al., 1997)	70	46.4	large sawtimber	75	3,480

*Site Index = Expected tree height after 25 years.
** Board Foot Volume at Age 30 (MBF/acre). MBF = thousand board feet (Vimmerstedt, 1962).

Table III.B-3
The Relative Effect of Site Quality
on Appalachian Oak Harvest Volumes and Stumpage Value at Age 60

Site Index	Appalachian Oak Site Index (ft) (Base Age 50)	Bd.Ft.Vol. at Age 60 (MBF/ac)*	Harvestable Wood Products	Stumpage Price ($/MBF**)	Total Value ($/acre)
Average	65	11.8	sawtimber	360	4250
Poor	50	5.6	small sawtimber	200	1120
Good	85	16.2	large sawtimber, veneer	520	8425

*MBF = thousand board feet (Schnur, 1937)

The information in Table III.B-2 is corroborated by the experience of reclamation personnel and is reflected in West Virginia's recently proposed commercial forestry regulations. In estimating the likely quality of reclamation to be obtained under these regulations, we must recognize the fact that the current regulations (which have been in place since May 16, 1983) require that selected overburden substitutes for soil be "equal to, or more suitable for sustaining vegetation than the existing topsoil, and the resulting soil medium is the best available in the permit area to support revegetation." Also, soil materials are to be redistributed in a manner that prevents excessive compaction of the materials. Be this as it may, the reality of reclamation in Appalachia is that selective overburden handling is rarely practiced beyond that required to keep highly toxic material out of the rooting zone; excessive compaction is commonplace. Andrews, et al, 1998, point out that "Height growth was greater on steeper slopes. In naturally-forested stands the opposite is usually true, because steeper slopes have greater runoff, shallower soils, and more erosion. On reclaimed sites, slope steepness is related to depth and compaction. Level sites are often subjected to greater vehicle traffic, resulting in more compaction and poorer drainage and aeration."

Production of soils that will support commercial forestry as part of mountaintop mining requires selective overburden handling and replacement procedures on a scale that has never been carried out in Appalachia. Full-mine scale replacement of native soils without excessive compaction does occur however. Replacement of native soils without excessive compaction in area mining operations, or with reduction of excessive compaction by ripping, is standard practice where prime farmland is reclaimed.

d. Soil/Overburden Chemistry

Andrews, *et al.*, 1998, found that the most important chemical factor influencing the growth of white pine was soluble salts. The second-most important soil chemical property affecting white pine growth was extractable phosphate, and in general, height growth declined when exchangeable manganese levels exceeded 20 mg/kg. Site requirements for different species of trees vary widely, and there is ample opportunity to further refine the site requirements for different tree species used in reforestation. However, from a practical standpoint, it is probably adequate to reconstruct the soil medium by salvaging material

from the top 10 feet of overburden. On average, this will result in a soil medium with an adequate chemical composition and with adequate microbial inoculum from the native soils.

Burger et al., 1998, address the practical aspects of re-establishing productive forests in Appalachia, stating:

> "Our work shows that, in nearly all cases, any mix of the surface 10 feet of soil and rock makes an excellent growth medium for virtually all native species of pines and hardwoods. Applying 4 feet of this mix of material without compaction creates a topsoil substitute that is usually as productive or more productive than the original soil. Woody debris and some rocks mixed in or laying on the surface actually create microsites for native species. Less grading and seeding is needed for forestry land uses, making the use of this topsoil substitute cheaper for the mine operator."

e. Soil Compaction

Compaction of mine soils is identified as one of the chief factors reducing the value of reclaimed forest lands. We are not aware of any research on the effect of natural forces such as freezing and thawing and root action on improving compacted mine soils. However, with the increase in the size of agricultural equipment and the advent of "no till" agriculture, there has been increasing attention given to the effect of compaction on agricultural soils. Research on soils that are subject to freeze-thaw cycles during the winter and root action from crops or native and introduced grasses suggests that compaction below the plow layer may persist a century or more (Sharratt, *et al.*, 1997; Kay, *et al.*,1985; Voorhees,1983; Sharratt, *et al.*, 1998; and, Blake, *et al.*, 1976). In spite of the lack of systematic data addressing the impact of natural forces and tree roots on the compaction of mine soils, it is prudent to assume that compacted mine soils, with their well documented detrimental impact on tree growth, will behave similar to agricultural soils with compaction enduring over similar periods of time.

f. Mycorrhizal Relationships

Mycorrhizae have been widely reported to aid survival and growth of forest trees under many different site conditions (Ruehle and Marx, 1979) (Parkinson, 1978) (Danielson, *et al.*,1978). *Pisolithus tinctorius* (Pt.) was found to improve the survival and growth of pine seedlings on acid coal mine spoil by Marx and Artman (1979). Schoenholtz and Burger (1984) found that inoculation with this same fungi enhanced seedling growth to some extent, but high amounts of natural ectomycorrhizal colonization probably masked some of the effects of Pt. Cordell and co-workers (1999), indicated that specific mycorrhizal fungi provided significant benefits to the plant symbionts on drastically disturbed mine sites through increased water and nutrient absorption, decreased toxic materials absorption, and overall plant stress reduction. Other researchers have contributed to the body of knowledge concerning the effects of surface mining on soil microbial communities and algal colonization and succession (Visser, *et al.*, 1978) (Starks and Shubert, 1978) (Shubert and Starks, 1978).

The role of mycorrhizal fungi in sustaining productive forests on more favorable mine sites has also been well documented. When a readily available source of nutrients are present, seedlings would not be expected to benefit nutritionally from mycorrhizae. Marx (1977) determined that loblolly pines with roots

that are growing rapidly due to high soil fertility have a decreased sucrose content and are not susceptible to ectomycorrhizal infection. Also, Torbet, *et al*. (1985) found that mycorrhizae did not have an effect on seeding growth in spoil material that had a high soil fertility. This study also determined that mycorrhizal trees not planted with a fertilizer pellet had significantly greater volumes due to enhanced diameter growth; however, fertilized non-mycorrhizal seedlings in rock mix spoils had greater heights, diameters, and twice the volume of non-fertilized infected trees in spoils with surface treatments.

The influence of pH on mycorrhizal fungi has had substantial investigation. It has been demonstrated that conifers are better adapted and are more productive on somewhat acidic soils (Pritchett, 1979). Part of this adaptation has to do with their symbiotic association with mycorrhizal fungi, which play a significant role in the rhizosphere of conifers (Marx, 1977). Theodorow and Bowen (1969) reported that most ectomycorrhizae associated with conifers do not thrive when the soil pH exceeds 6.5. This was confirmed in a study on minesoils by Schoenholtz et al. (1987) when the rates of colonization of mycorrhizal was compared for three pine species growing in two different spoils with pH values of 5.4 and 6.1, respectively. Numbers of trees and numbers of short roots per tree colonized were consistently higher at the lower pH. The colonized trees survived and grew better. Torbet and co-workers (1990) also found that there was a distinct inverse relationship between pine growth and mine soil pH which they attributed in part to the symbiotic association with mycorrhizal fungi.

Although more recent studies generally acknowledge the benefits of mycorrhizal inoculation, there has been caution to portray it as a panacea for revegetation problems on surface mine spoil. Torbert and Burger (1990) advised that their studies show that when a site is properly reclaimed and revegetated, virtually any tree species suitable to the climate can be established without the need for containerized seedlings, mycorrhizal inoculation, fertilizer tablets, or chemical weed-control. And in keeping with this same theme, Burger (1999) concluded in a research summary that on one study site, "After 2 years, all seedlings were colonized by native mycorrhizae. Special mycorrhizal treatment was not necessary; there was no difference in survival and growth between treated and untreated seedlings."

g. Planting Trees on Mined Land

Establishment of trees on surface mined lands has been documented for at least 50 years. Changes in the mining industry in recent years or, more to the point, changes in the methods of reclaiming mined lands have been responsible for the poor results on areas reclaimed to forest lands. As the poor results became apparent, a number of researchers began a quest for solutions to the problem. Among the leaders in this research were Dr. Don Graves of the University of Kentucky and Dr. James Burger of Virginia Tech. Their contributions to the research of reforesting mined lands have been prolific and have followed parallel lines. Both Graves and Burger were also intimately involved in the development of a document designed for the state of Kentucky to address the problems of reforestation on mined lands. The goal of the guidance document was not simply to get trees to survive on mined land, but to provide an environment in which they could thrive. Much of what is known today regarding reforestation of mined lands has been brought together in the Kentucky guidance document.

The document, called Reclamation Advisory Memorandum (RAM) #124, was developed with the assistance of coal industry officials, educators, environmental leaders, forestry and wildlife officials, and

federal and State mine regulators from Kentucky. Most current reforestation literature was reviewed and utilized in producing this guidance document. It was published March 10, 1997. The following summation of RAM #124 is essentially a summary of the state of the art of tree planting on mined lands in the eastern portion of the United States.

Successful tree planting is not measured by numbers of living stems per acre but by the potential of those living stems to produce "crops" of recreation, wildlife, lumber and other values associated with forested lands. RAM #124 was developed to enhance the potential for mined lands to produce viable, productive stands of commercial timber. Associated values are likewise increased by proper site preparation of mined lands. The RAM identified three practices that inhibit the establishment of productive stands of timber. They are:

1) excessive compaction of the surface 4-6 feet;
2) selection of inappropriate rooting medium; and
3) excessive competition from herbaceous ground cover.

Conversely, the RAM identified three practices that, if followed, could promote tree establishment and growth. They are:

1) minimal grading of level to gently sloping areas;
2) use 4 - 6 feet of slightly acidic to near neutral rooting medium;
3) and selection of less intrusive species for erosion control.

The RAM addresses each limitation with guidance to avoid certain practices and establish productive practices in their place.

Excessive compaction constructs a limited rooting zone, resulting in poor root penetration, along with poor survival and reduced growth. To achieve minimal compaction, it is recommended that end-dump equipment be used to place the rooting medium in tightly placed piles. The surface is then graded by low ground pressure equipment to grade the tops of the piles and gently level the area in one or two passes. Areas utilizing drag lines are advised to similarly place material in order that grading can be accomplished in 1 or 2 passes with a tracked dozer. Steep slope operations (over 27 degree slopes) are advised to end dump material that has had large boulders removed on the outslope and grade in one or two passes.

Limited topsoil and the erosiveness and compacting qualities of topsoil often make it desirable to utilize an alternate material as a growing medium. Growth medium with low to moderate levels of soluble salts, low pyritic sulfur content, pH levels between 5.0 to 7.0, and texture conducive to proper internal drainage should be selected. Revegetation species should be selected that are compatible with the soil pH, with consideration for the wide range of acceptable pH and limited range of optimum pH for tree species.

Excessive competition from ground cover has had a negative impact on establishment of tree stands on mined lands due to the use of aggressive species such as fescue and excessive fertilization designed for herbaceous vegetation . Selection of ground cover should be based on soil pH and the growth habit of the

species. Slow growing ground cover species insures soil stabilization while allowing tree seedlings to emerge above the ground cover, ensuring their survival.

Attention to these factors and practices, along with controlled fertilization is recommended by this State RAM in order to achieve establishment and good growth of timber stands on mined lands. One aspect of tree establishment that literature addressed but that was not addressed in this RAM is the effect of mycorrhiza on tree establishment and growth. Dr. Burger stresses the use of the top10 feet of soil and rock as the growing medium in his studies, providing natural inoculation with mycorrhiza. The RAM however did not strictly adhere to that recommended practice. It did however recommend the inoculation of seedling stock.

Reforestation is also subject to risks caused by the vagaries of the weather, browsing damage, girdling by mice and improper handling and planting of nursery stock. These risks have tended to discourage the choice of reforestation as a land use option by coal operators. However, these risks may be more than offset by the potential for reduced costs when the reduced grading required for successful reforestation is factored in.

5. Topography and Geomorphology

Topography describes the actual shape of a land form, while geomorphology is the study of the characteristics, origin, and development of a land form. Topography is a very important factor in determining the extent and practicality of coal mining on a given site, and the nature of its excess spoil disposal requirements. Steep-sloped, deeply incised topography as found in much of Tennessee and West Virginia, exposes many coal seams to access by surface mining methods, but limits the practical return of spoil to mine benches. Shallower geomorphology and less coal seams does not expose as many coal seams to surface access. Underground mining is not as strongly influenced by topography, but it is favored by incised lands that allow ready access to the outcrops of coal seams deeper in the geologic formation. This section provides background on the topographic and geomorphic setting of the study area to aid in understanding the influences that these features have on the mining activities discussed in other portions of this EIS.

a. Topographic Characteristics

The study area is characterized by steep slopes and narrow valleys. Several areas within the study area have steep river gorges. However, there are areas within the study area that have rounded hilltops, stream terraces, and floodplains near large rivers. Level stream terraces and wide floodplains along rivers and some tributaries provide areas of nearly flat land. Gently sloping plateau areas are interrupted and dissected by numerous rivers and streams with steep valley slopes in portions of the study area. The majority of the study area can be characterized by consecutive ridges with slopes greater than 20° and only a few small, rounded hilltops. Many portions of the study area have mountain peaks greater than 1,969 feet (600 meters). Elevation is depicted in Figure III.B-2.

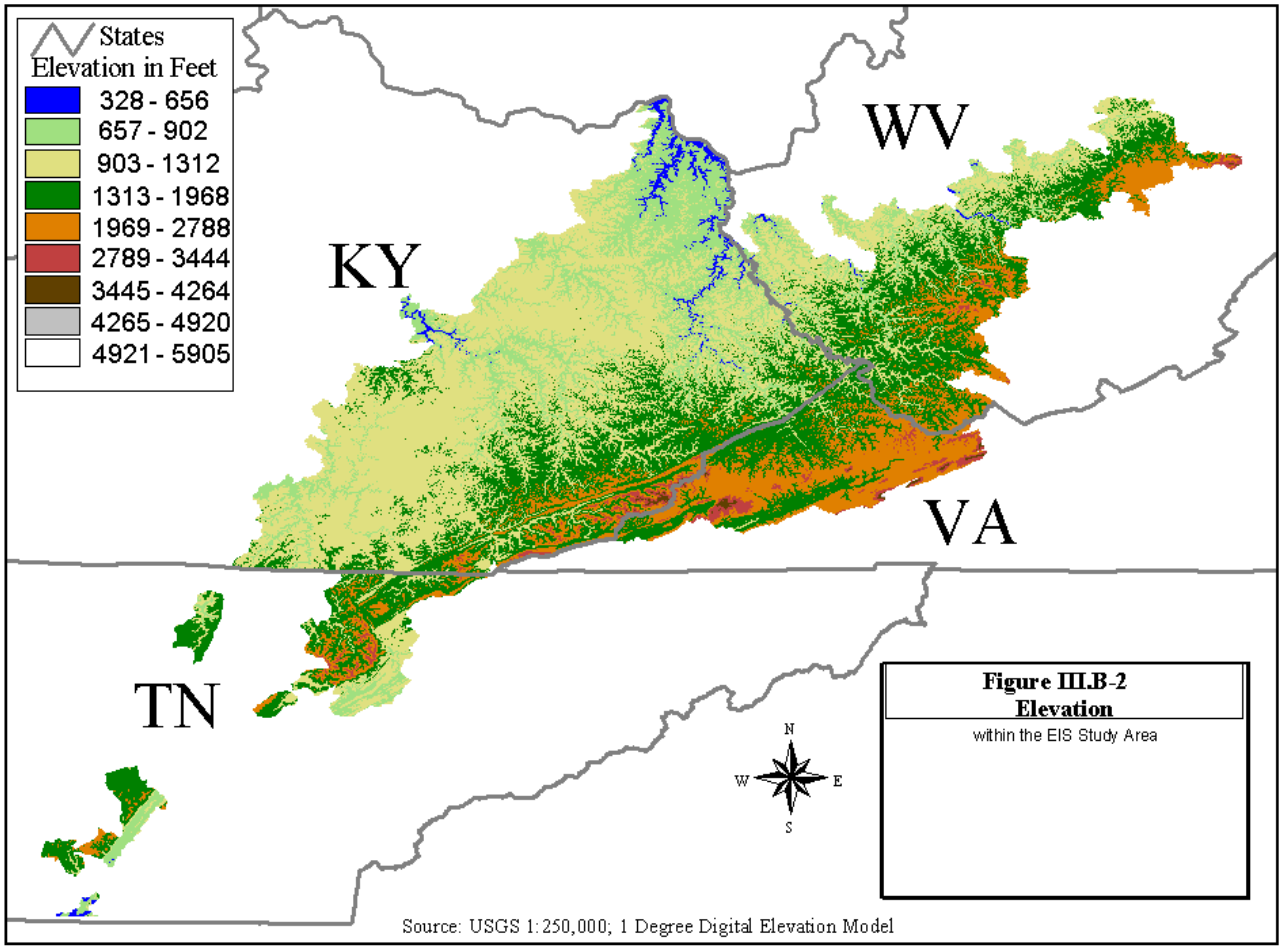


Figure III.B-2 Elevation

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b. Geomorphic Characteristics

After the mountain-building phase of the Appalachian orogeny, the study area experienced a long period of erosion stretching into the Miocene epoch. Most of the Appalachian Highland region is believed to have been beveled flat, as evidenced by the long ridge crests of equal elevation in the Valley and Ridge Province. After the Miocene, a regional uplift of undetermined origin elevated the modern Appalachian Mountain region to its approximate existing peak elevations. Rejuvenated erosion then carved into the elevated strata primarily along zones of structural or bedrock weakness. In the Ridge and Valley Province, the soluble limestone cores of breached anticlines eroded to form long, gently curving valleys, while in the Appalachian Plateau Province erosion along fracture trends was favored, forming dendritic and trellis stream patterns. The original drainage patterns of some large, pre-uplift rivers were preserved during the uplift and cross structural trends. The Susquehana River Valley is an example of such a superimposed drainage pattern. Other prehistoric drainage patterns have been abandoned over time, usually by significant drainage pattern changes occurring during glacial periods.

The ancient Teays Valley trends east-west across the lower Appalachian Basin. Prior to the Pleistocene Period (2.5 million years ago), the Teays River flowed westward across Virginia and West Virginia along a course presently occupied in part by the New River and Kanawha River systems. The Kanawha River follows the course of the pre-glacial Teays River upstream from St. Albans. The geologic history of the abandonment of the Teays River Valley west of St. Albans is poorly understood or documented. Today, the sediments of the former Teays River and its tributaries reach an elevation of nearly 800 feet (244 meters) within the former stream valley. The fine sand, silt, and clay within the sediments average 20 to 30 feet (6 to 9 meters) in thickness and may increase to a thickness of greater than 59 feet (18 meters) locally. These sediments serve as important aquifers for residential, industrial, and municipal use.

c. Steep Slopes and Slope Stability

The most significant topographic controls on surface mining activities within the study area are the steep slopes that are prevalent in the Appalachian Plateau Province. The slopes control both the volume and stability of excess material placement during filling. Steep slopes are the places where the mass movement of earth material is most likely to occur following mining or other disturbances. Landslides along highways are generally most common where slopes range between 20 percent and 35 percent (Hall 1980, Lessing et al., 1976). In many areas, more severe slopes already have been stabilized through slides and other earth movements, whereas these lesser slopes (20 percent to 35 percent) remain unstable and sensitive to mine-related disturbances. The regulations interpreting the Surface Mining and Reclamation Act (SMCRA) define steep slope as any slope of more than 20 degrees, or a lesser slope as may be designated by the regulatory authority of a state.

SMCRA regulations contain permitting, design, and construction monitoring requirements intended to implement state-of-the-art engineering standards for excess spoil disposal. The regulations and engineering standards are tailored to ensure meeting the SMCRA goals of long-term stability, public safety and environmental protection. To perform a retrospective study definitively evaluating the mass stability of large earth and rock structures requires intimate knowledge of representative shear strength parameters of the fill and foundation material, as well as definition of the phreatic surface within the fill. With reliable excess

spoil, geotechnical strength parameters and internal pore water pressure information (along with the dimensions of the fill, foundation, and bedrock) a stability analysis can provide accurate engineering estimates for the factor of safety of the fill. Various state regulatory programs routinely evaluate the company submission of this type of information in permits, evaluate the adherence to approved plans in monthly inspections, and assess the fills for signs of incipient or actual failure prior to making bond release decisions after construction. Company engineers and consultants perform extensive tests, stake their professional reputation and licenses on fill designs, document/certify critical construction phases, and attain certification quarterly. Valley Fill stability is discussed in Section III.K.

d. Unstable Slopes

Generally, most slope failures are confined to the thin layer of soil, colluvium, or weathered rock that develops on the steep valley slopes. Rockfalls are usually associated with the excavation activities of man, but they also may occur on natural cliff faces where meandering streams erode soft rocks that underlie more resistant sandstone bluffs. Any construction activity that involves: removal of vegetation, increased loading on the slope, undercutting the slope, or alteration of the hydrologic balance (surface water and groundwater), may induce slope failure. Coal mining and its related activities commonly involve all of these. Other factors that increase the potential for slope failure are as follows:

- Bedrock Factors - For example, the red shales of the Monongahela and Conemaugh Groups are naturally weak and incompetent. These red shales weather rapidly, especially when exposed, and are the rock type most commonly associated with landslides in West Virginia.

- Soil Factors - Easily erodible soils are thin, clayey soils weathered from shales. These soils are usually on steep inclines, impede groundwater infiltration, and are easily erodible.

- Slope Configuration - Naturally occurring or artificial concave slope configurations concentrate water, that lubricates joints to cause slope failure (Lessing et al., 1976).

Of the landslides studied in West Virginia, 69 percent occurred on concave slopes. In the Coal/Kanawha River Basin, the Muskingum-Upshur association presents a serious landslide hazard on slopes over 20 percent (11°). Muskingum-Upshur, Upshur, Vandalia, and Westmoreland soils also have a high landslide risk, and Brooke soils are moderately susceptible to landslides. The Meckesville, Shelocta, and Wharton series are to a lesser degree subject to slippage. These soils are the known soils to have the highest landslide risk in the Basin (Cardi et al., 1979). In the state of West Virginia the following soil series are susceptible to landslides: Brooke, Brookside, Clarksburg, Culleoka, Dormont, Ernest, Guernsey, Markland, Upshur, Vandalia, Westmoreland, Wharton, and Zoar. These soils are considered to be slide prone due to soil characteristics, percent slope and other variables.

Long, continuous precipitation events or sudden heavy rains may reduce the shear strength of soils and colluvium and load these materials sufficiently to produce landslides on steep dip and talus slopes. During coal mining on 25 percent to 36 percent slopes, spoil placed on the downslope, even temporarily, is highly susceptible to slope failure, especially during the spring rainy season (Lessing et al., 1976).

6. Climate

The climate within the study area is temperate and is favorable for many types of plants and animals. Generally, summers are warm and humid with winters moderately cold. Valleys can have lower temperatures than the surrounding hills when cooler heavier air drains to areas of lower elevations. Precipitation is fairly well distributed throughout the year. Seasonal temperatures, rainfall, snowfall, wind, and humidity differ from West Virginia, Kentucky, Tennessee and Virginia. An approximate average of 43 to 50 inches of rain falls on the Kentucky portion of the study area each year. Anywhere from 2 to 5 inches of rain can be expected in any given month. Approximately 52 to 55 inches of rain falls on the Tennessee portion of the study area in the average year. Anywhere from 3 to 6 inches of rain per month can be expected in this area with the wettest months being March and December and the driest month being October. Approximately 84 to 95 days throughout the year will experience greater than 0.10 inches of precipitation.

In the West Virginia portion of the study area, approximately 38 to 50 inches of rain occurs per year. Monthly rainfalls of 3 to 6 inches can also be expected in this area throughout the year. The wettest month tends to be July while the driest months are usually February, October, and November. In the Virginia portion of the study area, approximately 41 to 50 inches of rain occurs per year. Between 2 and 5 inches of rain can be expected in any given month of the year with the wettest months being March, May, and July and the driest month being October. Monthly temperature and precipitation data for each state within the study area are shown in tables presented in Appendix C.

C. APPALACHIAN AQUATIC SYSTEMS

1. Lotic (Flowing) Aquatic Systems

Lotic or flowing aquatic systems are important landscape features in the Mountain Top Mining/Valley Fills EIS Study area. Lotic systems may be considered to include rivers, streams, and creeks and springs. This section will discuss the types, features and functions of lotic systems in the study area.

a. Representative Streams

a.1. Physical Characteristics

Numerous physical parameters such as flow volume, substrate (i.e., the stream bottom made up of cobbles, gravel, sand, etc.), water chemistry, and bank cover influence the biota of the aquatic systems in the study area. These parameters are determined by the climate, lithology, relief and land use in the area of a particular stretch of stream. Many of these factors have been discussed in other chapters of this EIS.

EVEN WHERE INACCESSIBLE TO FISH, THESE SMALL STREAMS PROVIDE HIGH LEVELS OF WATER QUALITY AND QUANTITY, SEDIMENT CONTROL, NUTRIENTS AND WOOD DEBRIS FOR DOWNSTREAM REACHES OF THE WATERSHED. INTERMITTENT AND EPHEMERAL HEADWATER STREAMS ARE, THEREFORE, OFTEN LARGELY RESPONSIBLE FOR MAINTAINING THE QUALITY OF DOWNSTREAM RIVERINE PROCESSES AND HABITAT FOR CONSIDERABLE DISTANCES.

a.2. Stream Classification

Streams are generally classified through a system called stream ordering (Strahler, 1957). This system classifies streams based on size and position within the drainage network. A first-order stream is defined as not having tributaries. The confluence of two streams of the same order produces the next highest order. For example, the joining of two first-order streams results in a second-order stream. The joining of two second-order streams produces a third-order stream, etc. Headwaters are usually classified as first- through third-order streams, mid-sized streams as fourth- through sixth-order streams, and larger rivers as seventh- through twelfth-order streams (Ward, 1992). First order streams in the study area account for approximately 60% of total stream miles as represented by blue lines at the 1:100,000 scale USGS topographic map (EPA Region III June 2000 comments). This classification system can be misleading when just using blue lines on printed maps to indicate stream orders. It is known that there are many more miles of first order streams actually present in the field than appear on most commonly used maps . Therefore, this classification system includes some uncertainty. Stream ordering, though useful in placing a stream reach within an entire stream system, is not necessarily a meaningful description of the physical component of the stream reach itself.

In addition to first-through twelfth-order streams, ephemeral streams and intermittent streams occur in the Appalachian region. Ephemeral and intermittent streams have been defined in various ways depending on the regulatory program. Appendix B of this EIS presents the various definitions.

Generally, ephemeral streams have a discrete channel and flow only in direct response to precipitation events. In contrast, flow in intermittent streams is periodic or seasonal and based on

the presence groundwater. Perennial streams are those streams that maintain flow year round. The starting points of the intermittent and perennial streams may vary from year to year depending how wet or dry years have effected the groundwater table. Flow is permanent, but of a relatively low volume in first and second order perennial streams with flow volumes generally continuing to increase with stream order.

a.3. Habitats in Streams

Generally, headwater streams originate at high elevations in the study area. Substrate patterns in headwater streams channels are typically comprised of coarser material such as boulders, cobble rubble and bedrock. Large, woody debris often contribute to the substrate complexity in headwater streams. Small pools with finer sediments may also be found along headwater streams. Typical substrate patterns in larger rivers are comprised of finer material such as silt and sand. Mid-sized rivers typically contain a blend of cobble and gravel with some finer sediment interspersed in areas of slower flow.

Although intermittent streams tend to go dry for a portion of the year, macroinvertebrate life still exists within its channel. In a study of intermittent and perennial streams in Alabama, assemblages of normally intermittent streams did not differ greatly from those of nearby permanent or perennial streams (Feminella, 1996). Data recently collected in conjunction with this EIS (Interagency Invertebrate Study, 2000), suggests similar findings for ephemeral/intermittent streams in the study area. These data show that biological communities in the study area streams are present as soon as there is flowing water. During periods of no visible streamflow, interstitial water flows through the material below the steam. This special hydrology creates a unique habitat, called the hyporheic zone. Specially-adapted macroinvertebrates are able to continue their life cycles by burrowing into the hyporheic zone, especially in times of drought. Other macroinvertebrates live completely within the hyporheic zone (Hynes, 1970).

The combination of substrate characteristics and varying flow rates and other flow characteristics (hydrologic cycles, flow patterns, load transport and storage) produce channel features such as riffles, runs, and pools. Riffles are erosional habitats where surface water flows over coarser substrate, creating turbulence, which causes disturbances in the surface of the water. This turbulence increases levels of dissolved oxygen by encouraging the mixing of oxygen in the air with the water. Pools are depositional areas where flow is slow or stagnant, allowing finer particulate matter to settle onto the stream bottom. Runs are moderately fast sections of streams where the water surface is not as disturbed. Headwater streams, typically consist of alternating riffles and runs though small depositional pools, may be present and represent an important microhabitat. Mid-sized rivers typically contain all three features because increased width and depth allow more variation in flow.

Stream features that are important in determining habitat for aquatic organisms include, overhanging vegetation, the presence and characteristics of leaf packs, in-stream vegetation, large woody debris, undercut banks, and exposed tree roots. Overhanging vegetation consists of riparian shrub and herbaceous vegetation on banks that grows over and sometimes into the surface water. In-stream vegetation occurs where proper substrate and flow conditions allow growth. Snags are pieces of wood that have accumulated in a stream area. Undercut banks and exposed tree roots are caused by a combination of unstable banks and fast streamflow. All of these features provide unique habitat for cover, habitat, and food for macroinvertebrates and fish.

Other in-stream features that provide additional habitat include littoral areas such as shorelines, sandbars, and islands. Typically these features exist most prominently in depositional systems such as larger rivers. These littoral areas are important shallow habitats, which provide habitat for smaller fish and macroinvertebrates that are unable to live in the deeper sections of the river.

Wetlands and riparian zones may occur along streams. Wetlands and riparian zones may influence the physical characteristics of streams, thereby affecting stream habitats. In addition, wetlands and riparian zones may be used by stream biota directly during periods of elevated flow. Wetlands are crucial transition zones between terrestrial and aquatic habitats. They are defined as areas "that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (COE, 1987). Wetlands can be found on floodplains along rivers and streams (riparian wetlands). Typical steep geomorphology of headwater streams usually prohibits the formation of a floodplain, so wetlands are usually restricted to small depressional areas. As the gradient of the land becomes more gradual, more wetlands are found on the floodplain of the stream. Wetlands associated with rivers can take the form of forested wetlands, emergent marshes, wet meadows or small ponds. The unique characteristics and vegetative composition of wetlands provide important habitat for many species of aquatic macroinvertebrates, amphibians, and reptiles.

b. Energy Sources and Plant Communities

Aquatic ecosystem energy sources consist of allochthonous (organic material produced outside the stream such as leaves, wood, etc.) and autochthonous (instream primary production by plants, algae) sources. Allochthonous materials reach the stream either through directly falling into the stream or through indirectly being transported into the stream, commonly though wind movement or runoff. Allochthonous organic material has been found to be the predominant energy source in high-gradient streams of the southern Appalachians (e.g., Hornick et al., 1981, Webster et al., 1983, Wallace et al., 1992). Headwater energy sources are important, not only to invertebrates and vertebrates in upper reaches of the watershed, but, excess organic carbon is subsequently utilized by life forms in all stream orders down gradient. Since streams have a unidirectional flow, downstream areas are also dependent on upstream areas for portions of their energy (Vannote et al. 1980).

Plant communities of high-gradient streams live in what may be considered to be a physically challenging environment. Frequently these habitats are densely shaded and subject to high current velocities. As a result, the plant communities in high-gradient streams are reduced relative to lentic habitats and low-gradient streams (Wallace et al., 1992). However, the plant communities occurring in high-gradient streams contain flora uniquely adapted to survive in this type of environment. This habitat also supports an abundance of flora considered to be endemic (i.e., not found in other locations) to the region (Patrick, 1948). Possibly, the historic lack of direct anthropogenic (human-induced) disturbance to watersheds of high-gradient streams may have contributed to the survival of the unique and endemic flora of this region (Wilcove et al., 1998).

b.1. Vascular Plants and Bryophytes

Vascular plants, such as aquatic macrophytes or ferns, found in high-gradient streams typically have adventitious roots, rhizomes, flexible stems and streamlined narrow leaves (Westlake 1975, Wallace et al. 1992). In contrast, bryophytes (mosses and liverworts,) live closely oppressed to rocks and

boulders and are characterized by a small body size. In streams with high turbulent flow, mosses and liverworts have been found to be the dominant group of macrophytes (Westlake, 1975).

b.2. Algae

As summarized in Wallace et al. (1992), the algae of high-gradient streams are limited to species capable of anchoring to stable substrates, preferably large stable objects. Algae may temporarily colonize smaller objects during periods of low flow. The major groups of algae represented in high-gradient streams include red algae (Rhodophyta), filamentous green algae (Chlorophyta), and diatoms (Bacillariophyta) (Wallace et al.1992). Endemic and unique species of algae are common to the high-gradient streams of the southern Appalachians as described in Wallace et al. (1992).

b.3. Primary Production

Primary production is the input of energy into a system by the growth of flora living in the system. In streams, primary production is generally measured as mass of carbon or ash free dry mass, which is largely carbon, per unit area, per year. Primary production rates in Appalachian streams have been shown to vary with stream order, season, degree of shading, nutrients, and water hardness (Wallace et al., 1992). Although under some circumstances, gross primary production can be high (see Hill and Webster 1982b [in Wallace et al., 1992]), typical primary production inputs appear to range from approximately 9 to 446 pounds of carbon per acre of stream per year (Keithan and Lowe 1985, Rodgers et al., 1983, Wallace et al., 1992).

b.4. Allochthonous Energy Sources and Processing

Allochthonous energy sources consist primarily of leaves and woody material. However, dissolved organic carbon (DOC) from a variety of sources is an additional allochthonous energy source. Sources of DOC external to the stream include groundwater or runoff. Sources internal to the stream relate largely to leaching of organic matter from detritus or other organic matter. Fisher and Likens, in Science Applications International Corporation (1998), explain that over 90 percent of the annual energy inputs to small forested streams can be attributed to leaf detritus and dissolved organic carbon from the terrestrial environment. Webster et al. (1995) further discusses sources for organic inputs to streams.

The estimate of almost 3600 pounds of carbon per acre of stream per year developed by Bray and Gorham (1964) as a measure of leaf and wood litterfall into a stream per year, is considered to be a good estimate for input into high-gradient Appalachian streams. The mass of material input as leaf fall is generally greater than that input as woody material. However, in some circumstances the mass of input as woody material may equal that of leaf input (Webster et al., 1990).

Woody Material

In addition to functioning as an energy source, woody material may provide other important stream functions relating to hydrology and habitat structure. These functions may include contributing to stair-step stream bed profiles that result in rapid dissipation of the stream's energy; forming micro-pools or sieve-like structures that retain other particulate organic material, which may influence

trophic and nutrient dynamics; providing fish habitat; providing a substrate for some stream invertebrates; and functioning as a food source for wood-eating organisms (Wallace et al., 1992).

Organic Matter Processing

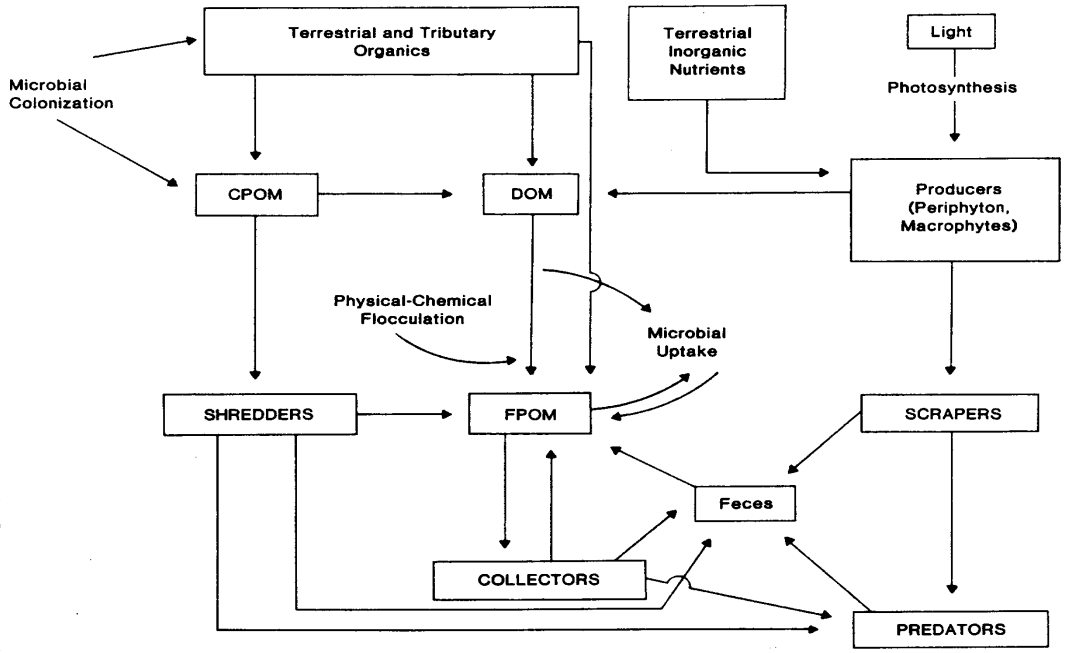
The headwater stream (first- through third-order) is the origin for energy processing within the river ecosystem. Headwater streams in the study area are located in forested areas and are characterized by a heavy leaf canopy and low photosynthetic production. Sources of energy for headwater streams are allochthonous in origin or derived from the terrestrial environment. The vast majority of this allochthonous material arrives in the streams in the form of Coarse Particulate Organic Matter or CPOM (> 1 mm or 0.039 inch in size). Smaller amounts of other allochthonous material that is transported to the stream includes Fine Particulate Organic Matter (FPOM, 50 um – 1 um in size or 0.0019 - 0.000039 inches in size) and Dissolved Organic Matter (DOM) traveling from surface and groundwater flow. Microbes and specialized macroinvertebrates living in headwater streams, called shredders, feed on the DOM and CPOM, converting it into FPOM and DOM. The FPOM and DOM are carried downstream to mid-sized streams.

Because mid-sized streams (fourth- through sixth-order) are wider than headwater streams, the canopy is usually more open and more light is able to penetrate to the stream bottom. As a result, a greater abundance of algae and aquatic plants are able to grow along the stream bottom. In general, the contribution of allochthonous material derived from terrestrial vegetation in midsized streams is less than in the headwater streams. Autochthonous material, meaning material that is derived from within the stream, becomes an important component of the energy budget in midsized streams. Autochthonous material includes both the primary productivity of the stream and the FPOM and DOM derived from upstream reaches which flow into midsized stream. Consequently, mid-sized streams may exhibit a shift from a heterotrophic to an autotrophic system, or one that generates its own energy through photosynthesis. The biological community of mid-sized streams differs somewhat from that in headwater streams in part because of the more diverse types of energy sources that are available. Specialized macroinvertebrates called collectors-filterers and collector-gatherers break down the FPOM carried from upstream reaches into Ultra-fine Particulate Organic Matter (UPOM, 0.5 – 50 mm in size or 0.019-1.97 inches in size). These macroinvertebrates, as well as microbes, also consume living plant matter (algae and aquatic plants) converting it into additional forms of energy. The UPOM derived from these energy sources is then carried downstream to larger rivers. Interestingly, collectors can actually also increase particle sizes in some cases by feeding on material in the several micron range and defecating compacted feces of a much larger particle size. These larger particles then become available to larger particle feeding detritivores (Wallace et. al., 1992).

Larger rivers (seventh- through twelfth-order) have different biological communities from lower order streams. The increased width of these rivers results in relatively insignificant allochthonous inputs. The depth, combined with suspended mineral and organic matter, prohibit much light penetration and consequent growth of algae and plants within the main channel. Collectors again become the primary macroinvertebrate community to process the particulate organic material. Larger rivers tend to be heterotrophic systems.

Figure III.C-1 illustrates the flowchart summarizing the energy processing that occurs within the river ecosystem.

Figure III.C-1
Energy Resource Categories and Invertebrate Classifications in River Ecosystems
(from Merritt and Cummins, 1996)



Several major models have been developed to describe the movement of energy and nutrients in rivers. These theories include the River Continuum Concept developed in Vannote et al. (1980) and the concept of nutrient spiraling. The development of the River Continuum Concept greatly improved the scientific communities' understanding of the ecosystem-level functions of rivers and provided direction for lotic ecosystem research over the last 20 years.

River Continuum Concept

The River Continuum Concept (Vannote et al., 1980) is a theory that details how differing energy sources are processed efficiently, progressing from headwater streams to large rivers. This theory explains that energy sources are dependent upon geomorphological, chemical, and biological factors that have evolved within the surface water ecosystem to create a balanced energy transport. The

general metabolism for the river ecosystem uses energy that is transported downstream from upstream reaches within the system.

From the headwaters to the mouth of the river, the river ecosystem is comprised of a balanced, efficient, longitudinal gradient of energy sources and processing in which the particle size of organic matter becomes more refined as the river becomes larger (Vannote et al, 1980). In each portion of a river ecosystem, some organic matter is processed, some stored, and some released (Vannote et al., 1980). Organic matter is conditioned by microbes (fungi and bacteria), and some is respired (to carbon dioxide) by microbes and animals, some converted to smaller particles and dissolved organic matter which is exported to downstream communities (Vannote et al. 1980). Macroinvertebrate communities at each section of the river ecosystem have become specifically adapted to maximize the processing of energy available in the form of organic matter. Since macroinvertebrate communities serve as a food base for higher trophic organisms (i.e., fish) in the food web, these higher trophic organisms have also evolved to fit available niches in the stream ecosystem. Figure III.C-2 summarizes the River Continuum Concept and the types of benthic macroinvertebrates mentioned that are typically distributed along the river ecosystem. General range of stream widths (in meters) are given for each order.

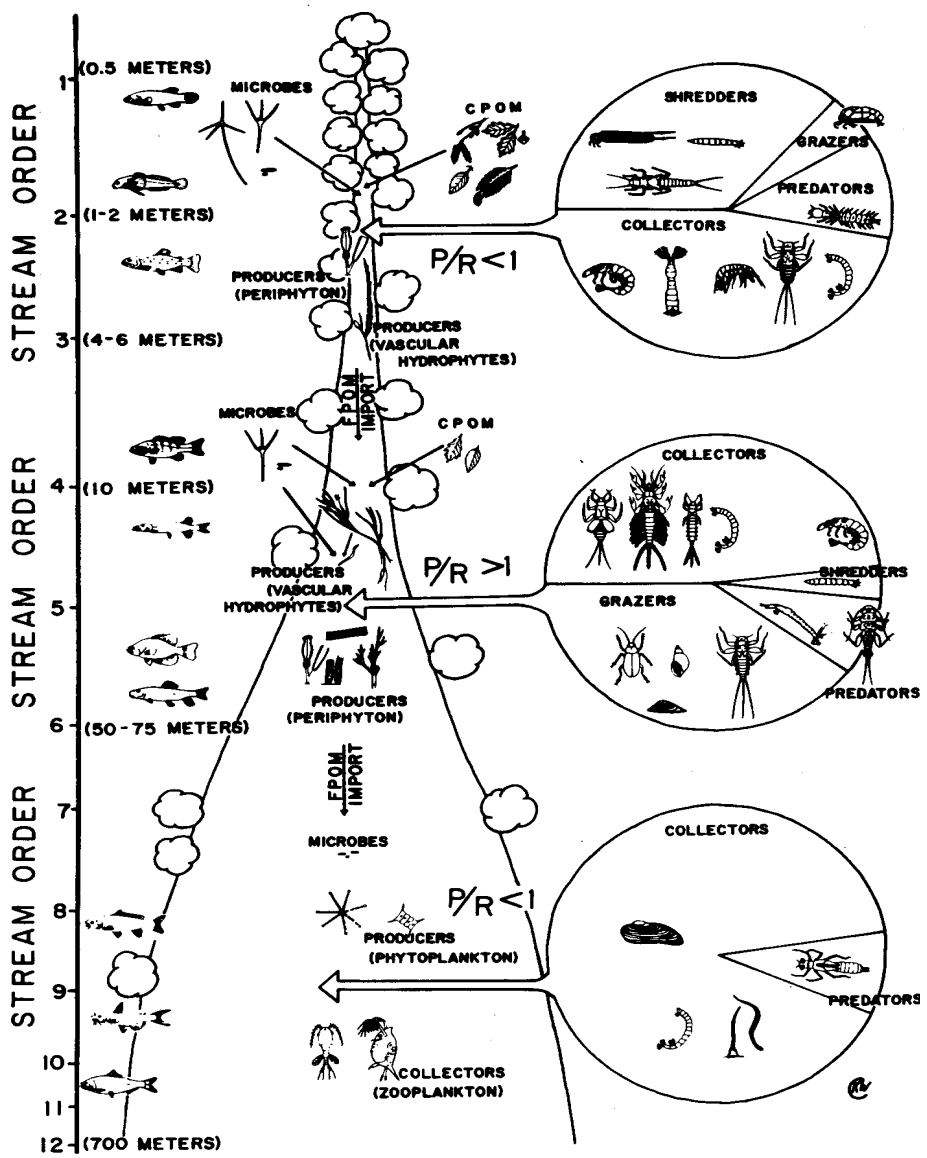
Heterotrophic systems are designated by the P/R ratio (gross photosynthesis to community respiration ratio) < 1, and autotrophic systems are designated by the P/R > 1.

c. Animal Communities

c.1. Invertebrates

Stream order typically dictates the community structure of the resident aquatic life. Headwater streams harbor primarily benthic macroinvertebrate communities who are specialized to feed on the CPOM deposited in the system. Examples of benthic macroinvertebrates include crayfish, worms, snails and flies. The majority of benthic macroinvertebrates in headwater streams are classified as shredders and collectors, who feed on the CPOM and FPOM, and predators who feed on the other macroinvertebrates. Typical benthic macroinvertebrates found in headwater streams in the study area include insects such as mayflies (Ephemeroptera), stoneflies (Plecoptera), caddisflies (Trichoptera), dragonflies and damselflies (Odonata), beetles (Coleoptera), dobsonflies and alderflies (Megaloptera), true bugs (Hemiptera), springtails (Collembola), and true flies (Diptera). Other macroinvertebrates that have been collected include crayfish (Decapoda), isopods (Isopoda), worms (Oligochaeta and Annelida) and snails (Gastropoda) (FWS, 1998; Science Applications International Corporation, 1998).

Figure III.C-2
Diagrammatic Representation of the River Continuum Shown as a Single Stream of Increasing Order
(Vannote et al., 1980)



In the southern Appalachian Mountains, macroinvertebrates of several orders including Ephemeroptera, Plecopter and Trichoptera have been found to be rich in species, including many endemic species and species considered to be rare. This diversity and unique assemblage of species has been attributed to the unique geological, climatological and hydrological features of this region (Morse et al., 1993, Morse et al., 1997). Many biologists agree that the presence of a biotic community with such unique and rare populations should be considered a critical resource.

Stream macroinvertebrates are typically classified on the basis of their functional feeding group (Cummins 1973, Cummins and Klug 1979, Merritt and Cummins 1984). Insects within a functional feeding group share similarities in their morphology, feeding behavior and feeding mechanisms (e.g., scraping, collecting, shredding, filtering, etc.). Typical functional feeding groups are described below.

Scrapers

Scrapers are adapted to scape materials such as, algae or periphyton and its associated microflora from rock or organic substrates, such as leaves (Wallace et al., 1992). Typically scrapers include certain taxa of snails, mayflies, caddisflies, beetles and fly larvae.

Shredders

Shredders chew primarily large pieces of decomposing vascular plants (≥ 1 mm or 0.039 inch diameter) along with its associated microflora and fauna. They may also feed directly on living vascular hydrophytes or gouge decomposing wood submerged in streams (Wallace et al., 1992). In addition to aquatic insects, many omnivorous crayfish in the study area are facultative shredders. Shredders are important because their mode of feeding causes the generation of large quantities of small particles. These particles are more easily transported downstream and may be acted on by microbes more easily due to the increase in the surface area to volume ratio. Common shredders in the study area are certain taxa of stoneflies, caddisflies and fly larvae.

Collector-gatherers

Collector-gatherers feed primarily on fine pieces of decomposing particulate organic matter (FPOM ≤1 mm or 0.039 inch diameter) deposited within streams (Wallace et al., 1992). Many chironomidae larvae are collector-gatherers.

Collector-filterers

Collector-filterers have specialized anatomical structures (setae, mouthbrushes, fans, etc.) or silk and silk-like secretions that act as sieves to remove particulate matter from suspension (Jorgensen 1966, Wallace and Merritt, 1980) (Wallace, 1992). Some mayflies, caddisflies and fly larvae are collector-filterers.

Predators

Predators feed on animal tissues by either engulfing their prey or by piercing prey and sucking body contents (Wallace et al., 1992). Predators include dragonflies, hellgrammites, some taxa of stoneflies, caddisflies, beetles, fly larvae and some crayfish.

c.2. Vertebrates

Two groups of vertebrates, fish and salamanders are the major stream-dwelling vertebrates in the study area. Typically, salamanders occupy small, high-gradient headwater streams while fish occur

farther downstream. Predation by fish is believed to restrict salamanders to the smaller streams or the banks of large streams (Wallace et al., 1992).

Fish species present in headwater streams tend to be representative of cold water species, and primarily sustained by a diet of invertebrates (Vannote et al, 1980). As found with invertebrates and amphibians, the fish assemblages of the Appalachians tend to contain a relatively large number of endemic and unique species. Some fish species collected in the pristine headwaters of West Virginia include blacknose dace (*Rhinichthys atratulus*), creek chub (*Semotilus atromaculatus*), and slimy sculpin (*Cottus cognatus*) (FWS, 1998).

Many different kinds of amphibians and reptiles live in or near streams and wetlands. Many types of amphibians in particular are unique to the Appalachian regions. The West Virginia Division of Natural Resources has published a pamphlet, "Amphibians and Reptiles of West Virginia: A Field Checklist." This list mentions 46 amphibious species and 41 reptilian species, the vast majority of which are most likely located throughout the study area within suitable habitat of Kentucky, Tennessee, and Virginia. These species include mole, dusky, woodland, four-toed, green, spring, red, mud, and brook salamanders as well as newts, hellbenders, and mudpuppies, which can frequently be found near aquatic habitat. Skinks, a lizard species, can also be found around aquatic habitats. Toads as well as cricket, chorus, true, leopard, pickerel, and treefrogs are associated with aquatic habitats. Snapping, spotted, map, musk, mud, and painted turtles as well as sliders, cooters, redbellies, and softshells can also be found in these areas. Water, crayfish, brown, garter, ribbon, and kingsnakes are associated with aquatic habitats. Many of these amphibious and reptilian species may be primarily terrestrial, but live in proximity to aquatic areas such as streams and wetlands. In addition, several species strictly rely on the presence of streams or wetlands for at least part of their life cycle (Conant and Collins, 1991).

The diversity and distribution of fishes in West Virginia is intimately related to drainage divides. The Potomac and James rivers drain the Atlantic Slope, while the remainder of the state drains to the Gulf of Mexico via the Ohio and Mississippi rivers. The fauna of all West Virginia systems draining into the greater Ohio River are similar in composition and have an interrelated history. The greater Ohio River drainage is chiefly comprised of the Monongehela, Little Kanawha, Kanawha, Guyandotte, and Big Sandy/Tug Fork rivers. The upper Kanawha (New) River system above the Kanawha Falls has a unique fauna with six endemic species; the bigmouth chub (*Nocomis platyrhynchus*), the New River shiner (*Notropis scabriceps*), the Kanawha minnow (*Phenacobius teretulus*), the candy darter (*Etheostoma osburni*), the Kanawha darter (*Etheostoma kanawhae*), and the Appalachia darter (*Percina gymnocephala*); all but *E. kanawhae* occur in West Virginia. For this reason, the New River is treated separately from the greater Ohio River drainage with respect to fish distribution. In the ichthyological literature, New River refers to all of the Kanawha River drainage above Kanawha Falls (Stauffer and Ferreri, 2002).

A shift in the fish community from cold-water to more warm-water fish species occurs in mid-sized streams. Generally, the fish community becomes more diverse and more piscivores (fish-eaters) coincide with the invertivores (Vannote et al, 1980). Studies have determined that approximately 277 native freshwater fish species, distributed among 22 families exist within the central Appalachian drainages (EPA, 1983). Minnows, suckers, catfishes, sunfishes, and perches are the five predominant families. (EPA, 1983). The lack of modifications, combined with numerous geological, climatic, and hydrological events in eastern Kentucky have allowed the rivers to harbor

a fairly diverse fish community (EPA, 1983). In addition, the geological events associated with the development of the river system within the MTM/VF EIS study area have resulted in a unique fishery system which has importance in the evolution and speciation of North American freshwater fishes (Stauffer and Ferreri, 2002).

d. Ecosystem Function

The value of headwater streams in the study area was the subject of a symposium held in April 1999. The proceedings of this symposium have been included in Appendix D and are summarized below.

The changes in invertebrate communities from stream headwaters to mouth have been well documented. However, local conditions may exert as great or greater an influence on the biotic communities as can be seen by examining stream order alone. In general, major shifts in the relative abundance of macroinvetebrates considered to be shredders, scrapers and collector-gatherers are seen from headwaters to mouth. Collector-filterers and predators are generally found in all stream orders. However, differing species may occur to occupy these niches in different stream reaches. Shredders are generally relatively abundant in headwater areas where allochthonous inputs are high, and present in lower abundance in mid-order streams, where less of the organic matter input is allochthonous. Shredders may be absent or occur in only localized conditions in higher order streams. Scrapers tend to be present at a relatively low abundance in headwater streams owing to the relatively low amount of periphyton (periphyton inhabiting the surfaces of underwater vegetation, rocks, and other substrates) present in these stretches. The relative abundance of scrapers increases in mid-order streams in conjunction with an increase in periphyton abundance, but decreases again in high order streams owing to decreases in suitable habitat and physical limitations. Collector-filters are present in all reaches of a stream. However, the species occupying these niches varies tremendously, from almost entirely arthropods in headwater streams to largely molluscs and arthropods, especially aquatic insects, in high-order rivers.

Small streams play a pivotal role in lotic ecosystems. Small streams:

- Have maximum interface with the terrestrial environment with large inputs of organic matter from the surrounding landscape
- Serve as storage and retention sites for nutrients, organic matter and sediments
- Are sites for transformation of nutrients and organic matter to fine particulate and dissolved organic matter
- Are the main conduit for export of water, nutrients, and organic matter to downstream areas (Wallace in Symposium on Aquatic Ecosystem Enhancement at Mountain Top Mining Sites, January 2000)

The major functions of headwater streams can be summarized into two categories, physical and biological (Wallace in Symposium on Aquatic Ecosystem Enhancement at Mountain Top Mining Sites, January 2000):

Physical

- Headwater streams tend to moderate the hydrograph, or flow rate, downstream
- They serve as a major area of nutrient transformation and retention

- They provide a moderate thermal regime compared to downstream waters- cooler in summer and warmer in winter
- They provide for physical retention of organic material as observed by the short "spiraling length"

Biological

- Biota in headwater streams influence the storage, transportation and export of organic matter
- Biota convert organic matter to fine particulate and dissolved organic matter
- They enhance downstream transport of organic matter
- They promote less accumulation of large and woody organic matter in headwater streams
- They enhance sediment transport downstream by breaking down the leaf material
- They also enhance nutrient uptake and transformation

In summary, light and the input of allochthonous material are the two limiting factors in the contribution of energy to a river ecosystem as a whole. When an energy source is altered or removed in the upstream reaches, downstream biological communities are also affected. The value of headwater streams to the river ecosystem is emphasized by Doppelt et al. (1993): "Even where inaccessible to fish, these small streams provide high levels of water quality and quantity, sediment control, nutrients and wood debris for downstream reaches of the watershed. Intermittent and ephemeral headwater streams are, therefore, often largely responsible for maintaining the quality of downstream riverine processes and habitat for considerable distances."

2. Lentic (Non-flowing) Aquatic Systems and Wetlands

a. Overview

Lentic aquatic systems are defined as non-flowing water bodies such as lakes and ponds. Strausbaugh and Core (1978) states that there are no natural lakes and ponds in West Virginia (other than beaver ponds). This statement highlights several features of the lentic systems found in the study area. Virtually all lentic systems in the study area have been formed by impounding flowing water systems. The majority of the lentic systems in the study area are small ponds. Small impoundments are constructed for agricultural use, community water supplies, recreational areas, or flood control, or may have resulted from road construction or surface mining activities (Menzel and Cooper, 1992).

There is no clear distinction between a pond and a lake. Attempts have been made to classify lentic water bodies as ponds or lakes depending on depth and on surface area. A reasonable distinction between ponds and lakes may be made on the type of lake mixing that occurs. Water bodies may be considered lakes when the wind plays the dominant role in mixing. In ponds, gentler convective mixing predominates (Goldman and Horne, 1983).

ON A REGIONAL SCALE, SMALL PONDS OR IMPOUNDMENTS IN THE APPALACHIANS PROVIDE HABITAT FOR COMMON ANIMAL AND PLANT POPULATIONS THAT REQUIRE AQUATIC CONDITIONS FOR FEEDING OR REPRODUCTION.

Wetlands are also a water-related system that occurs throughout the study area. As per section 404 of the Clean Water Act, wetlands are defined as:

> Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

As can be seen from this definition wetlands and lentic aquatic systems may be overlapping. Note that this regulatory definition does not define shallow lakes and ponds as wetlands. For resource mapping purposes, the FWS (Cowardin et al. 1979) has also defined wetlands as follows:

> Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification, wetlands must have one or more of the following three attributes: 1. At least periodically, the land supports predominantly hydrophytes; 2. The substrate is predominantly undrained hydric soils; and 3. The substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

In this definition, shallow lakes and ponds are included as wetlands. Wetlands are frequently mapped using the classification system developed by Cowardin et al. (1979). In this system, some types of lentic systems (i.e. lakes) are designated as deepwater habitats as distinct from wetlands, while ponds are typically considered to be a type of palustrine wetland.

b. Physical Environment

Four elements play a major role in defining the structure of a lake or pond. These include the physical characteristics, chemical characteristics, biological characteristics and the watershed for a particular pond or lake.

The hydrology of the lentic systems in the study area is dependent, in many cases, on both surface runoff, as most ponds are formed by damming a small stream, and by groundwater input. Springs and other gains from groundwater may provide the majority of the water to some ponds (Menzel and Cooper, 1992). Studies have found that water levels in Appalachian impoundments tend to remain fairly constant over the year. However, sediment inflows may greatly reduce the capacity of impoundments, especially in the years immediately following impoundment construction.

Watershed conditions can greatly affect conditions in Appalachian impoundments. For example, ponds located in a forested setting would tend to receive more allochthonous input than ponds located in agricultural settings. Depending on the variation in inputs to ponds, i.e., terrestrial detritus versus algae in more open reaches, the change in energy base can also influence the food base and the community structure of ponds.

Small impoundments in this region are usually classified as soft water with dissolved solids less than 120 mg/L and hardness less than 60 mg/L as Ca CO3 (Geraghty et al., 1973). Even in limestone regions dissolved solids rarely exceed 350 mg/L with a maximum hardness of 120 mg/L (Menzel and Cooper, 1992). Impoundment pH typically ranges from 4.1 to 10. Most Appalachian impoundments are found to be phosphorus limited, as is true for most freshwater bodies (Menzel and Cooper, 1992).

c. Energy Sources and Plant Communities

Plant communities in ponds and lakes consist of submerged, floating and emergent vascular plants, phytoplankton, and periphyton. Autotrophic bacteria may also occur in lentic systems and contribute to the primary production of these systems.

c.1. Phytoplankton and Benthic Dwelling Micro-organisms

Phytoplankton

All major groups of algae are found in small ponds. However, the species distribution of small ponds generally differs from that of large impoundments and lakes. In small ponds, benthic algae and periphyton may detach and become part of the planktonic community (Menzel and Cooper, 1992).

If nutrient enrichment is present, blue-green algae (i.e., cyanobacteria) in small ponds may become dominant. This results in negative impacts from several perspectives. Blue-green algae is often considered noxious to humans and are often rarely consumed by planktivores.

Bacteria and Fungi

Bacteria and fungi are the major decomposers in small ponds. Although these organisms may occur as part of the planktonic community, the vast majority of bacteria and fungi are found on or in the top several centimeters of sediments. Bacteria and fungi may also represent a food source for benthic dwelling organisms.

c.2. Vascular Plants

Vascular plants in small impoundments include species with submergent, float-leaved or emergent growth forms. Submergent macrophytes are found rooted in benthic sediments at depths from 3 to 12.5 feet depending on light penetration. Submergents may occur in patches or may cover the entire bottom of ponds.

Floating or floating-leaved vascular plants may be very abundant in small ponds if nutrients are present. Where these plants are found in abundance, they may reduce the photosynthesis in the hypolimnion, (cold lower layers of a body of water) resulting in an increase in water column respiration. This may result in anoxic (low amounts of oxygen in the water) conditions in the water column, with elimination of fish in the pond (Menzel and Cooper, 1992).

Emergent macrophytes typically occur where sedimentation or benthic morphology has resulted in sediments located at a suitably shallow depth from the surface of the water. Examples of emergent species common to ponds in the Appalachian Mountains include cattails (*Typha latifolia*) and willows (*Salix sp.*). Emergent macrophytes are an important energy source for small impoundments and provide habitat for numerous vertebrate wildlife (Menzel and Cooper, 1992).

Small ponds tend to fill with sediments as they age. This results in changes in the plant community beginning with sparse populations of non-persistent emergents and submergents in the first several years after impoundment. Pond vegetation 8 to 25 years after impoundment may be characterized as latter successional wetland plant communities consisting of woody vegetation on the pond margin, emergent persistent vegetation located inside the woody margin, and a pond surface and substrate largely covered by submergent or floating-leaved species or absent entirely (Gunn, 1974).

c.3. Primary Production

Most ponds found in the southern Appalachians tend to be highly productive, eutrophic systems, (having concentrations of nutrients optimal or nearly so for plant or animal growth), although some small impoundments in this area may be oligotrophic (low concentrations of plant nutrients and hence low productivity). Submergent or emergent vegetation is the primary source of primary production in these systems (Menzel and Cooper, 1992). The presence of nutrients, light penetration, and temperature appear to be the major factors influencing primary production in small impoundments in the study area.

d. Animal Communities

Animal communities may be arbitrarily divided into two groups: those dwelling in the benthos and those dwelling in the water column. Often organisms move between these two zones during their lifecycle (Menzel and Cooper, 1992). Invertebrate groups found in small impoundments include zooplankton and insect larvae. Major vertebrate groups include fish and reptile. Birds may heavily utilize vegetated portions of the benthos for feeding and breeding.

d.1. Invertebrates

Pond invertebrates may function as primary consumers or secondary consumers and also represent a major food source for fish.

Zooplankton

Major groups of zooplankton include the Cladocera, Copepoda and Rotifera. Zooplankton populations exhibit seasonal population cycles, which may be controlled by a variety of factors. Zooplankton may feed on phytoplankton, detritus or other zooplankton. They are considered to be important in the nutrient cycling dynamics of small ponds.

Zoobenthos

Major groups of benthic dwelling organisms in ponds include aquatic oligochaetes (worms), crustaceans and immature insects. Feeding modes for zoobenthos include herbivorous, carnivorous and detrital feeding. Organisms feeding on detritus may actually obtain a majority of their energy from the microbial fraction of the detritus (Walker, Olds and Merritt, 1988). Zoobenthos greatly increase the secondary productivity in ponds through exhibiting high growth rates (Cooper, 1987). For example, some Chironomidae (Midge flies) may experience up to 10 life cycles per year in southern Appalachian ponds (Cooper, 1987).

d.2. Vertebrates

Five major groups of vertebrates are found in small impoundments in the southern Appalachians including fish, amphibians, reptiles, birds and mammals. These animals inhabit or use freshwater ponds for feeding or breeding during at least some part of their lifecycle. Available literature indicates a limited species diversity in all groups except birds (Menzel and Cooper, 1992).

Fish are generally the dominant predators in ponds. Predominant types of fish in small impoundments include bluegill and other sunfish, brown bullhead, bass, yellow perch and golden shiner. Frogs, turtles, and water snakes are other commonly occurring vertebrate species found in small impoundments.

e. Ecosystem Function

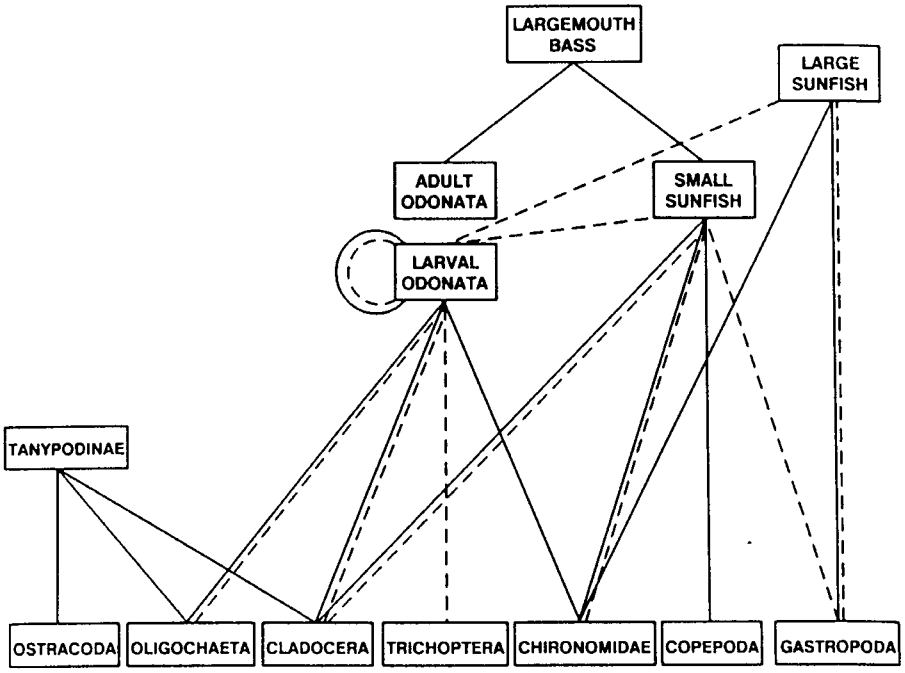
Small ponds or impoundments serve a variety of functions within the regional ecosystem, but also exhibit distinct internal ecosystem dynamics. On a regional scale, small ponds or impoundments in the Appalachians provide habitat for common animal and plant populations that require aquatic conditions for feeding or reproduction. These may include animal species such as beaver, waterfowl, fish or pond-dwelling obligate aquatic plant species. Small impoundments may contribute to flood control, and may improve the water quality of riparian systems downstream from the impoundment through the temporary removal of organic and inorganic nutrients and toxic materials from water that pass through them (Mitsch and Gosselink, 1993).

Ecosystem-level functions occurring within small ponds and impoundments include food web and the related energy flow relationships. Food webs in pond systems are well-developed and have been well studied (Johnson and Crowley, 1989). A typical food web of a small pond or impoundment system is summarized in Figure III.D-1, Major links in the food web of littoral zones. Compared to small streams, ponds are relatively self contained and have a limited ability to cycle nutrients on a watershed scale.

This figure summarizes a study of the feeding web occurring in the littoral zone of Bays Mountain Lake, which is located in Sullivan County, Tennessee. The watershed of this lake was classified as forested mountaintop (Crowley and Johnson, 1982). This lake is anticipated to be similar to natural ponds found in the study area. As shown in this figure, insect larvae, crustaceans, oligochaetes, gastropdods (snails), and ostracodas (minute fresh-water crustaceans with a bivalve, hinged shell) accounted for the majority of the secondary productivity in the shallow area of this pond. These organisms were consumed by predacious midge larvae (Tanypodinae), larval dragonflies and damselflies (Odonata), and small sunfish.

Large sunfish also consumed some benthic immature insects and gastropods, but were found to feed on larval odonates (dragonflies and damselflies) as well. The top predators within the pond were largemouth bass. These fish fed primarily on small sunfish and adult odonata. Food webs of other ponds and small impoundments in the study area have been found to exhibit similar types of food webs as illustrated in the figure. As summarized by Menzel and Cooper (1992), “Thus, while specific producers and consumers of importance may be dictated by habitat, abiotic parameters, or geographic location, the generalized pond food web is predictable.”

Figure III.C-3
Major Links in the Food Web of Littoral Zones — Prey Comprising at Least 10% of the Diet of Predators — Statistically Significant Depletion of Prey Populations in Enclosure Experiments
(from Johnson and Crowley, 1989)



f. Wetlands in Study Area

The wetlands and deepwater habitats in the MTM study area are almost entirely riverine (rivers and streams) or palustrine (e.g., marshes, swamps and small shallow ponds) (Tiner 1996). In West Virginia, palustrine wetlands, primarily ponds, have been found to be the most abundant type of wetland (Tiner 1996). Nearly all (99%) of the state's wetlands fall within the palustrine system. West Virginia's wetlands are mostly comprised of ponds, forested wetlands, and emergent wetlands (Tiner 1996). Reviewing wetland inventory summary maps available on the web (www.dep.state.wv.us/watershed), it can be seen that palustrine wetlands are common in areas of the state with extensive riverine wetlands. However, many isolated palustrine wetlands occur in areas lacking riverine systems as well.

A qualitative assessment of the occurrence of wetlands in areas subjected to surface mining compared to areas which had not experienced surface mining was performed as part of this EIS. National Wetland Inventory (NWI) maps produced by the FWS for the States of Virginia and West Virginia and the Commonwealth of Kentucky were used in this evaluation. One observation from this evaluation is that areas with surface mining frequently contain numerous, small ponds (indicated as wetlands classified as PUB or PUS, palustrine unconsolidated bottom or palustrine unconsolidated shore, respectively). Areas lacking surface mining did not appear to have as many small ponds as did mined areas. It is likely that these ponds were created as a result of surface mining activity. Additionally, in the review of the NWI maps for this area, it is clear that these

numerous, small pond-type wetlands on surface mining sites are not directly connected to the stream system in the region. Most of these wetlands appear to be formed in isolated small depressions on the formerly surface mined area. As such, these isolated pond-type wetlands would not be expected to contribute to energy flow or nutrient cycling in the stream system of the watershed. Ongoing research is being conducted on techniques for developing pond-type wetlands that would be more integrated with watershed-level aquatic functions (see Atkinson et al. 1997). However, most of this work is still in the conceptual stages. Programs such as the Powell River Project (http://als.cses.vt.edu/prp/index.html) are pursuing research to improve techniques for wetland construction/restoration on surface mining sites.

Existing information on surface mining techniques indicates that some surface mining practices do tend to result in pond formation both before and after mine restoration while other practices do not result in the formation of ponds (Atkinson and Cairns 1994, Atkinson et al. 1996). It is also important to note that the NWI maps generated for West Virginia were developed based on aerial photography from the early 1980's. In the past 15 to 20 years, it is likely that many of the wetland/ponds mapped as PUB may now contain emergent vegetation such as cattails.

Other types of palustrine wetlands such as forested swamps or shrub swamps were also observed in the study areas associated with creeks or rivers as marked in the NWI maps. It is believed that these areas are largely naturally formed wetlands and are not related to mining practices based on their position in the landscape and the maturity level of the vegetation in these wetlands (Tiner 1996).

The ecosystem functions of created lentic systems were discussed and summarized during a symposium on aquatic ecosystem enhancement held in January, 2000 by the MTM/VF EIS work group investigating this technical study area (EPA et al. March 20, 2000). Several presenters from academia, coal companies and environmental consultants discussed the values of man-made pond and wetland systems.

Characteristics and functions of man-made ponds and wetlands, as summarized by Dr. Wallace in EPA (March 20, 2000) include:

- Less of an interface with terrestrial environments than seen with headwaters streams
- Autochthonous primary productivity, primarily from algae and aquatic plants
- Energy systems tend to be closed with less linkage, if any, to other areas, or downstream ecosystems
- Disturbance in a pond will tend not to affect other ecosystems such as downstream areas
- These systems can be important sites of nutrient storage and uptake provided that a sufficiently vegetated littoral zone is present
- Under post-mining conditions, biological communities appear to resemble natural communities and are not as indicative of disturbance as is found in headwater streams

REI Consultants evaluated aquatic habitat functions provided by sediment control ponds and ditches (in EPA March 20, 2000). They found that functions present depended on the age of the structure with the number of functions increasing with structure age. The establishment of functions also

depended somewhat on water quality though older ponds tended to exhibit better water quality in most cases. Functions provided by the ponds and ditches included:

- Habitat for groups of aquatic insects typical to lentic habitats
- Water filtration/nutrient fixation
- Wildlife habitat including fish habitat for fish typical of small ponds
- Possibly, water treatment through filtration and precipitation. This function may be of increased importance for ponds developed in channels leading to headwater streams

In summary, functions of man made ponds and wetlands exist and may be considerable. While these functions differ from those of headwater streams, these functions do have their own inherent values. In fact, the establishment of ponds or wetlands on benches or at the toe of mined areas may tend to limit the effect of disturbances on the downstream watersheds (Wallace, B. in EPA et al. March 20, 2000).

3. Interrelationship Between Headwater Streams and Native Forests

Riparian (water-edge) habitats are transitions (ecotones) between terrestrial and aquatic environments and constitute a transition zone through which energy, nutrients, and species are exchanged. These areas typically are especially productive biological communities in which both species diversity and species densities are high (Warner, 1979). Characteristic woody vegetation exists in narrow bands along the streams that dissect this rugged landscape and include such species as black willow (*Salix nigra*), silver maple (*A. saccharinum*), box-elder (*A. negundo*), hackberry (*Celtis occidentalis*), sycamore (*Platanus occidentalis*), and cottonwood (*Populus deltoides*). In the rich alluvial soils along the streams, many species of shrubs and herbaceous plants can be found. Riparian habitat in the study area is limited to the narrow bands along the numerous streams because of the mountain and valley topography (WVDNR Water Resources 1976a).

THE SOUTHERN APPALACHIANS HAVE THE RICHEST SALAMANDER FAUNA IN THE WORLD

The headwater streams of the study area have a profound influence on the surrounding terrestrial habitat-- just as the terrestrial habitat influences the headwater streams. Leaves tend to blow across the forest floor and collect in the headwater streams which are wet depressions in the landscape. Very little of this coarse organic material in the form of leaves is transported downstream; most is processed by living organisms. The importance of the relationship between streams and the native forests is highlighted by the difference in coarse organic material inputs between streams flowing through forests and streams flowing through grassy areas. Streams flowing through grassy areas have much lower inputs of coarse organic material than streams flowing through forests (Sweeny, USFWS 2000). Also, different kinds of leaves from different species of trees affect the production and biomass of invertebrates. In addition, as precipitation percolates through leaves on the forest floor, it extracts organic compounds from the leaves. These dissolved organic compounds drive a major portion of the aquatic system's productivity (USFWS 2000). In aquatic ecosystems, the degree of land-water interaction between the terrestrial environment and the aquatic environment influences ecological processes and food web interactions (Adams and Hackney, 1992). The headwater streams of the study area have maximum terrestrial-aquatic interface ratios. Thus, the interconnection of the terrestrial and aquatic environments is greatest in these headwater streams. As mentioned previously, allochthonous organic matter typically dominates in headwater streams and other aquatic ecosystems with high ratios of land-water interaction. Therefore, the importance of surrounding forests to these streams can be easily understood in terms of generating energy for the aquatic ecosystem in the form of dead leaves and other organic matter. In addition to this relationship are the interrelationships between terrestrial wildlife and the aquatic environment of headwater streams in the study area.

The southern Appalachians have one of the richest salamander fauna in the world (Petranka 1998, Stein et al., 2000). Many species of salamanders are aquatic or semi-aquatic and utilize headwater streams at some point in their life histories. These aquatic and aquatic-phase (some larvae) salamanders are entirely predaceous and generally include a large proportion of aquatic insects in their diets (Wallace et al., 1992). The dusky salamander (*Desmognathus fuscus*), a semi-aquatic species, is a stream-side inhabitant of mountain brooks and seeps in the Appalachians. The dusky salamander spends the majority of its time in the terrestrial-aquatic environment interface zone,

along the margin of streams and seeps, opportunistically foraging on insects, slugs, and other invertebrates (Burton, 1976). Salamanders constitute a large portion of the animal biomass in eastern forests, in particular, in headwater streams. Biomass of the genus *Desmognathus* alone ranges from 1.673 to 2.683 g/m^2 (0.484 oz/yd^2 to 0.078 oz/yd^2) from four studies of headwater streams in the Southeastern United States (Wallace et al., 1992).

Many purely terrestrial species also depend on the headwater streams in the study area for their survival and the terrestrial-aquatic ecotone results in a diverse flora and fauna for these locations. For example, unique avifauna assemblages can be found along the riparian zone of headwater streams. The acadian flycatcher (*Empidonax virescens*) is commonly encountered throughout the study area (Buckelew and Hall, 1994), but is seldom found in upland forests, favoring the understory vegetation along small headwater streams where it feeds on emergent aquatic insects (Murray and Stauffer 1995). Neotropical migrant songbirds are also often attracted to headwater stream areas for breeding areas because of the diversity of the habitat and the availability of emergent aquatic insects. The Louisiana waterthrush (*Seirus motacilla*) neotropical migrant song bird is considered an obligate headwater riparian songbird because its diet is comprised predominantly of immature and adult aquatic macroinvertebrates found in and alongside these streams and it builds its nest in the stream banks (Mulvihill 1999). The Louisiana waterthrush is one of the earliest arriving migrants to the study area that places its nest among vegetation along flowing streams . The Louisiana waterthrush is also an area-sensitive species, requiring undisturbed forest tracts of 865 acres to sustain a population (Buckelew and Hall 1994). Therefore, preservation of large tracts of forest containing headwater streams is needed for the conservation of the Louisiana waterthrush in the central Appalachians (Murray and Stauffer 1995).

D. IMPACT PRODUCING FACTORS TO HEADWATER STREAMS FROM MOUNTAINTOP MINING

1. Studies Relating to Direct and Indirect Surface Water Impacts from Mountaintop Mining and Valley Fills

Surface mining operations in steep slope terrain generate excess spoil that is often placed in adjacent valleys. Mining operations and associated fills can directly impact headwaters by mining through or burying streams and eliminating existing terrestrial, riparian, and aquatic habitats. These operations also have the potential to indirectly impact stream conditions downstream from fills through physical or chemical changes. . In scoping discussions held to evaluate the impacts of MTM/VFs on headwater streams, eight potential impact factors were identified and are listed below.

Potential Impact Factors

1. Loss of linear stream length
2. Loss of biota under fill foot print or from mined stream areas
3. Loss of upstream energy from buried stream reaches
4. Changes in downstream thermal regime
5. Changes in downstream flow regime
6. Changes in downstream chemistry
7. Changes in downstream sedimentation (bed characteristics)
8. Effects to Downstream Biota

These factors fall into two categories: those occurring from the direct filling or mining of headwater streams (Factors 1, 2 and 3 in part), and those factors that manifest their effects through changes in characteristics of the stream located downstream from filled or mined areas (Factor 3 in part and Factors 4 through 8). These factors are related to the functions performed by headwater streams within the ecosystem. This section will focus on studies relating to each of these potential impact factors.

a. Loss of Linear Stream Length from Filling and Mining Activities Associated with Fills

Three studies examined the loss of stream length from valley filling. The findings of these studies are summarized below.

The EIS steering committee commissioned a study to determine the extent of valley fills in the EIS study area. This study, known as the fill inventory, includes a variety of information regarding valley fills constructed from 1985 to 2001, including the feet of stream under valley fill footprints. This study measured streams based on a synthetic stream network defined on a 30-acre watershed accumulation threshold over the National Elevation Dataset (NED). The NED for each state was processed to enforce hydrologic integrity. A flow accumulation grid was prepared and queried to define a drainage network over the entire region. The synthetic stream network represents all drainage for watersheds greater than 30 acres. The fill inventory study (USDOI OSM 2002) is presented in detail in Section III.K. This study estimated that between 1985 and 2001 approximately 724 miles (1.23%) of stream in the EIS study area were directly impacted by valley fills (i.e.,

covered by fill).

A study performed by the USFWS (USFWS 1998) evaluated stream miles permitted for filled with excess spoil and other coal mining wastes in Kentucky, Pennsylvania, Virginian and West Virginia between 1986 to 1998. This study found that at least 900 stream miles were permitted for filling in this time period. The study did not evaluate actual stream miles filled which are believed to be less than the number of miles permitted to be filled. The geographic area evaluated in this study was larger than that of the EIS study area. However, since 91% of the stream miles approved for fills were located in West Virginia or Kentucky, the results are applicable to this EIS. Other uncertainties relating to the accuracy of this estimate are presented in study. Only blueline streams from USGS topographic maps were included in this evaluation. This study did not evaluate miles of stream filled that were not marked as blueline streams, nor was an estimate made for the number of miles of streams mined through.

A cumulative impact study of the length of stream directly impacted within the study area was performed by the USEPA (2002). The stream lengths evaluated were based on the same synthetic stream network as the OSM fill inventory which includes streams located upslope from the USGS blueline streams. This cumulative impact study differed from the previously discussed studies in that the estimate of stream length impacted was based on length of stream filled and length of stream mined through. This study estimated 1,208 miles of direct impact to stream systems in the study area based on permits issued in the last ten years (1992-2002). This estimated of filled or mined through streams represents 2.05% of the stream miles in the study area.

It has been suggested that streams have been, or could be, created during the reclamation of mined or filled sites. It was not the intent nor design of these studies to assess any re-creation of streams. Due to the current lack of data to support creation of viable streams on mining operations, studies exploring the amount of, or possibility for, creation of streams should be considered.

b. Loss of Biota under Fill Foot Print or from Mined Stream Areas

When streams are filled or mined all biota living in the footprint of the fill or in the mined area are lost. There is little question that perennial streams support viable aquatic communities that could be lost from valley fills. However, prior to investigations performed in support of this EIS, the existence of aquatic communities in streams classified as “ephemeral” or “intermittent” was questioned. In fact, the points on the slope of a watershed at which ephemeral, intermittent and perennial streams originated were very poorly understood. Numerous studies in and around the MTM/VF study area had documented the existence of aquatic communities in “headwater stream” systems (See USFWS 1999) but not at the level of geographic detail needed to address questions on the existence of aquatic communities in the upper most stream reaches in the study area.

b.1. Primary Literature Review of Aquatic Communities in Streams with Ephemeral or Intermittent Flow Regimes

Literature results indicated that aquatic organisms could potentially exist in streams with ephemeral and intermittent flow regimes. In western Oregon taxa richness of invertebrates (>125 species) in temporary forest streams exceeded that in a permanent headwater stream (100 species) (Dietrich and Anderson 2000). Dietrich and Anderson (2000) also found that only 8% of the species in the total

collection were only found in the permanent headwater. A total of 25% were restricted to the summer-dry streams and 67% were in both permanent and summer-dry streams. In other words, most of the aquatic life found in the temporary streams was also found in permanent streams, clearly indicating that the temporary streams support aquatic life similar to that found in permanent streams. These researchers concluded that the potential of summer-dry streams with respect to habitat function is still widely underestimated.

In several northern Alabama streams of varying flow permanence, including a stream that was normally perennial, Feminella (1996) found little differences in the invertebrate assemblages. Presence-absence data revealed that 75% of the species (171 total taxa, predominantly aquatic insects), were ubiquitous across the 6 streams or displayed no pattern with respect to permanence. Only 7% of the species were found exclusively in the normally intermittent streams. Again, this study clearly indicates that intermittent streams support aquatic life.

Many researchers have found that intermittent streams, spring-brooks and seepage areas contain not only diverse invertebrate assemblages, but some unique aquatic species. Dieterich and Anderson (2000) found 202 aquatic and semi-aquatic invertebrate species, including at least 13 previously undescribed taxa. Morse et al (1997) have reported that many rare invertebrate species in the southeast are known from only one of a few locations with pea-sized gravel or in springbrooks and seepage areas. Kirchner (F. Kirchner pers. comm. 2000 and Kirchner and Kondratieff 2000) reports 60 species of stoneflies from eastern North America are found only in first and second order streams, including seeps and springs. Approximately 50% of these species have been described as new to science in the last 25-30 years.

Williams (1996) reported that virtually all of the aquatic insect orders contain at least some species capable of living in temporary waters and that a wide variety of adaptations across a broad phylogenetic background have resulted in over two-thirds of these orders being well represented in temporary waters. This researcher goes on to say that “perhaps the concept of temporary waters constraining their faunas is based more on human perception than on fact”.

b.2. Studies in the MTM/VF Study Area

The USGS (2002 Draft) is completing their “E-point, P-point” study to characterize the size of watersheds located upstream from the starting point of perennial, intermittent and ephemeral headwater streams within the MTM/VF study area. The following table summarizes their results.

Boundary	**Median Drainage Area Upstream of Boundary (acres)**	**Range of Drainage Areas Upstream of Boundary (acres)**
Ephemeral-Intermittent	15.2	6.3 to 45.3
Intermittent-Perennial	40.8	18.0 to 150.1

Field work on aquatic communities was performed by OSM and USGS biologists in some of the same watersheds used for the USGS (2002-Draft) “E-point, P-point” study to assess the potential limits of viable aquatic communities in small headwater streams in southern West Virginia

(Interagency Invertebrate Study 2000). Most of the small streams sampled in the study were not indicated by a blueline on existing 1:24,000 scale USGS topographic maps. The study found that all eight of the target orders of insects selected were found within the headwater reaches evaluated. Furthermore, the study found that a number of taxa that were found in the extreme headwaters have multi-year life cycles. This would suggest that sufficient water is present for long-lived taxa to complete their juvenile development prior to reaching the aerial adult stage in these areas. Although only contiguous flow areas were considered for this study, the field work took place in the winter, and it was considered probable that these extreme headwaters were subject to annual drying.

As part of the work to describe stream conditions in southern West Virginia for this EIS, the EPA found that intermittent streams supported diverse, healthy and balanced invertebrate populations preceding and following a severe drought in the summer of 1999 (USEPA, 2000). During the summer and fall 1999 index periods, many of the reference streams in this EPA study were flow limited, with only trickles of water in their channels, and some of these streams were found to go completely dry. In the spring 1999 index period, preceding the drought, and in the winter 2000 index period, following the drought, all of the intermittent streams could be sampled, and all of the intermittent reference streams were in good or very good condition with diverse and balanced benthic invertebrate assemblages (USEPA, 2000). Clearly these streams, though intermittent for several months in some cases, supported diverse and balanced aquatic life.

b.3. Conclusions Regarding the Existence of Aquatic Communities in Streams Potentially Impacted by Direct Filling or Mining Activities

As can be concluded based on results from the primary literature and from studies performed for this EIS, filling or mining stream areas even in very small watersheds has the potential to impact aquatic communities some of which may be of high quality or potentially support unique aquatic species. It has not been determined if drainage structures associated with mining can provide some benefits (i.e.; increased flows at toe of fills, retaining drainage structures) that could offset aquatic impacts.

c. Loss of Upstream Energy from Buried Stream Reaches

Considerable information regarding the energy cycling functions of headwater streams has been presented in this EIS in Section III.C. The extent to which valley fills eliminate energy resources that may be used by downstream aquatic communities is not well documented. There is a lack of information on the degree to which length of stream directly correlates with the amount of energy in the form of fine-particle organic material or coarse-particle organic material leaving a particular reach of headwater stream. The Value of Headwater Streams: Results of a Workshop, (Appendix D) emphasizes the importance of headwater streams in energy and nutrient spriraling down through a watershed ecosystem. The following is a summary from information provided in Appendix D. Reference citations from primary literature are presented in Appendix D. Forest leaf litter is particularly important to macro invertebrates that process organic matter for downstream reaches. Experiments demonstrate the reliance of stream biological communities on energy inputs from the surrounding forests. When leaf litter was excluded from a stream, the primary consumer biomass in the stream declined, as did invertebrate predators and salamanders. Leaf litter exclusion had a profound effect on aquatic productivity, illustrating the direct importance of terrestrial-aquatic ecotones.

Other experiments illustrated that, although invertebrates and microbiota in headwater streams are only a minute fraction of living plant and animal biomass, they are critical in the export of organic matter to downstream areas by converting leaf litter to fine particulate organic matter, which is much more amenable to downstream transport than the leaves themselves. The extent to which energy loss may be offset by input from reclamation of the mine site and adjacent undisturbed areas is unknown. Impacts that this type of net energy "change" would have on the downstream aquatic environment is uncertain and requires further investigation.

d. Changes in Downstream Thermal Regime

Valley fills have the potential to impact a variety of water quality parameters. One study of thermal impacts of valley fills was performed by the USGS (USGS 2001c) on one stream below a valley fill site and one stream below an unmined site. This study recorded stream temperature at a valley fill site and at an unmined site on a daily basis. Water temperatures from the valley fill site exhibited lower daily fluctuations and less of a seasonal variation than water temperatures from an unmined site. Water temperatures were warmer in the winter and cooler in the summer than water temperatures from the unmined site. Based on the data from this study, it appeared that the maximum daily difference between the two streams was approximately 13.5 degrees Fahrenheit. This study included only two streams so it cannot be determined if the observations made would be true for a number of streams below valley fills. It is also difficult to predict the possible impacts of this moderated thermal regime on the downstream aquatic communities. This issue remains as an uncertainty that requires further investigation.

e. Changes in Downstream Flow Regime

Valley fills have the potential to alter the flow regime of streams downstream from fill areas. One study of the impact of valley fills on stream flows was performed by the USGS (USGS 2001c) on one stream below a valley fill site and one stream below an unmined site, and comparing one flow parameter at many streams with and without filling in the watershed. Low stream flows were investigated by comparing 90-percent flow durations, daily stream flow records, base-stream flows and storm flows. Generally, the 90-percent flow durations at valley fill sites were 6 to 7 times greater than the 90-percent flow durations at unmined sites. Some valley fill sites, however, exhibited 90-percent flow durations similar to unmined sites and some unmined sites exhibited 90-percent flow durations similar to valley fill sites. Daily stream flows from the one valley fill site evaluated generally were greater than daily stream flows from the one unmined site evaluated during periods of low stream flow. The valley fill site evaluated had a greater percentage of base-stream flows and lower percentage of storm flows than did the one unmined site evaluated.

This study included only two streams except for the evaluation of 90-percent flow durations, so it cannot be determined if the observations made would be true for a number of streams below valley fills. It is also difficult to predict the possible impacts of this moderated and elevated flow regime on the downstream aquatic communities. This issue remains as an uncertainty that requires further investigation.

f. Changes in Downstream Chemistry

Mining and associated valley fills have the potential to alter the water chemistry of streams

downstream from fill areas. It is possible to relate water chemistry to biological functions of streams where Federal or State Ambient Water Quality Criteria exist.

f.1. Studies Addressing this Impact Factor

The USEPA (2002) conducted a study of the stream chemistry associated with sites classified as mined, unmined, filled and filled/residence. Detailed descriptions of each of the EIS classes were presented in the report. In summary, unmined sites were not located downstream from mines or fills. Mined sites were located downstream of older mine project with no fills, filled sites were located downstream from mined sites with valley fills and filled/residence sites were located downstream from mined, filled sites with residential dwellings in the watershed. The data from this report indicate that MTM/VFs increase concentrations of several chemical parameters in streams. Sites in the Filled category had increase concentrations of sulfate, total dissolved solids, total selenium, total calcium, total magnesium, hardness, total manganese, dissolved manganese, specific conductance, alkalinity total potassium, acidity and nitrate/nitrite. There were increase concentrations of sodium at sites in the filled/residence category which may be caused by road salt and /or sodium hydroxide treatment of mine discharges. Results for all other parameters were inconclusive in comparing among EIS classes.

Comparisons to AWQC were performed with a subset of the total data set as explained in USEPA (2002a). Selenium concentrations from the Filled category sites were found to exceed AWQC for selenium at most (13 of 15) sites in this category. No other site categories had violations of the selenium limit. No other constituents exhibited violations of the AWQC for any category.

In a study conducted in 1998 as part of the National Water Quality Assessment (NAWQA) program of the U.S. Geological Survey, surface water quality was sampled in 12 study areas in the Appalachian Coal Region to measure changes in water quality from baseline conditions that had previously been monitored in 1979-81. Each sample collected during the July-September 1998 sampling period was matched to a 1979-81 sample considered to be most similar in discharge and season. About 180 sites were sampled to assess changes. Sites were selected for sampling on the basis of a three-factor categorical design of geology, mining method, and mining date within the surface drainage basin above each site. Geology was represented by the contrast between the Allegheny-Monongahela River and the Kanawha River Drainage basins. (This corresponds roughly to the northern and southern coal fields in West Virginia terminology.) The mining method was identified as underground, surface, or both. The mining date was identified as before the historical sample, after the historical sample, or both. The reference conditions in both study areas were identified as basins that had never been mined, and particular effort was spent in identifying these basins. While the study did not focus on mountaintop mining specifically, its results are considered relevant to the topic area and are therefore worth reviewing.

The study found that the median pH of summer base flow in these streams increased about 0.5 unit from 1980 to 1998 in both the northern and southern parts of the study area since pH is a logorithmic scale, a change of 0.5 pH is a big change. During the 1998 sample period, the median pH among all sample sites was 7.9 in the north and 7.4 in the south. Alkalinity of the streams also increased and was reflected in decreased concentrations of iron and manganese. These effects would be expected on a regional basis as a result of increased compliance with permit limits and with increasing efforts to control the worst cases of acid drainage from abandoned mines. While

improvements in pH, iron, and manganese were seen, median concentrations of sulfate among all sites increased from 38 mg/L to 56mg/L in the north, and from 46 mg/L to 77 mg/L in the south. Sulfate is a good indicator of the total disturbance of a basin by mining and other large scale earth moving activities because most sulfate is produced by oxidation of pyrite minerals to acidic iron sulfate, and these types of activities increase the amount of pyrite minerals that are available for oxidation. Among 52 basins where mining occurred both before and after 1980, for example, the sulfate concentration more than doubled in 13 basins, including greater than five-fold increases in 5 basins. In both northern and southern basins, sulfate concentrations of less than 20 mg/L were common in unmined areas. Acid loads from the pyrite reaction are neutralized at a regional scale by both alkaline minerals naturally present in mined areas and by engineered additions of alkalinity. Acid production will continue, however, in proportion to the amount of available pyrite, and after mining ends, acid production will gradually decrease as the amount of pyrite is consumed.

A study was also conducted by OSM on the cumulative off-site impacts from a large area mine in southeastern Ohio over a twelve year period. The location of the study was on the Central Ohio Coal Company (COCCO)property where a dragline was used. OSM used the 1980 data submitted by COCCO and data collected between 1987 and 1999 by the Ohio Environmental Protection Agency (OEPA) to evaluate the impacts. Although this study was not in this EIS study area it was included to show how mining activities without valley fills can impact water quality. The chemical analysis of the impacted streams indicated similarly elevated levels of hardness, sulfates and conductivity as did the EPA 2002 study. (USDOI OSM 2000)

f.2. Summary and Conclusions

In summary, mining and valley filling activity appear to be associated with some downstream changes in surface water chemistry. These changes include increases in a number of cations that are known to be associated with surface mining such as sulfate, total dissolved solids, total calcium, total magnesium, hardness, total manganese, dissolved manganese, specific conductance, alkalinity, and total potassium. The majority of these constituents may also increase in many other types of large scale earth moving activities.

In the USEPA (2002a) stream chemistry study, selenium was found to exceed AWQC at Filled sites only, and was found to exceed AWQC at most Filled sites included in the study. The existence of selenium at concentrations in excess of AWQC at most of the filled sites indicates a potential for impacts to the aquatic environment and possibly to higher order organisms that feed on aquatic organisms.

While changes in water chemistry downstream from mined, filled sites have been identified, it is not known if these changes are resulting in alterations to the downstream aquatic communities or whether functions performed by the areas downstream areas from mined, filled sites are being impaired. Question exist as to how the downstream chemistry is affected by factors such as time, method of mining, reclamation practices and size of operation. Further evaluation of stream chemistry and further investigation into the linkage between stream chemistry and stream biotic community structure and function are needed to address the existing data gaps.

g. Changes in Downstream Sedimentation (Bed Characteristics)

Valley fills have the potential to alter geomorphological features of streams downstream from fills such as sediment particle size. One study of the impact of valley fills on sediment particle size was performed by the USGS (USGS 2001c). Particle sizes were measured at 54 small stream sites in four watersheds. Valley fill sites had a greater number of particles less than two millimeters in size, a smaller median particle size and about the same 84th percentile particle size as compared to the mined and unmined sites. Results were based on visual comparisons of box and whisker plots developed for each data class.

Similar results on sediment particle size at stream sampling stations below fills were obtained from USEPA (2000). Valley fill sites had a greater number of particles less than two millimeters in size and a smaller mean particle size. However, the mean substrate size class was found to be very similar between unmined, filled, filled residential and mined EIS class sites. The authors stated that these data indicate that the valley fills do not seem to be causing excessive sediment deposition in the first and second order streams that were sampled but cautioned against generalizing this finding to higher order streams or to reaches downstream in these watersheds. In contrast, sampling downstream of mountaintop mining/valley fill sites in Kentucky revealed greater sediment deposition and smaller substrate particle sizes than in reference streams (EPA 2001).

In the OSM study of Central Ohio Coal Company (COCCO) property, stream habitat was evaluated in 1987 and 1999 using OEPA's Qualitative Habitat Evaluation Index (QHEI). The author stated that the QHEI may be somewhat subjective, but it is still a good indicator of habitat quality. The QHEI indicated impairments from heavy to moderate silt cover and substrate embeddedness in two streams studied in 1987. However, the 1999 sampling showed that the streams had improved sufficiently to support warm-water biota (USDOI OSM 2000).

While these studies illustrate that mining and valley fills may alter the sediment composition of streams, it is not known if this change may impact functions of streams downstream or how long these changes may persist. Assessment of stream sediment characteristics should be included in any further evaluations or monitoring program for streams downstream from mining and valley fills.

h. Effects to Downstream Biota

MTM/VFs have the potential to impact aquatic biota since mining and filling activities may occur within streams. A review of the literature available for this EIS on this topic has revealed that there are at least four types of studies which have been performed to evaluate the impact of mining in general and MTM/VF in particular on aquatic macroinvertebrate biota. These four types of studies include: A. Comparisons of results from stream sites upstream of mine input to downstream results; B. Comparisons of Pre-mining results to post-mining aquatic community results; C. A multivariate analysis study on a regional basis of potential impact producing factors to stream systems; and D. Studies of stream sites located downstream from mined or valley filled areas in comparison to reference locations.

Several studies evaluating the potential impacts of mining or mined-valley filled areas on fish communities address the issue of potential impacts of mining and associated fills to aquatic biota. These studies have been summarized below.

Most studies evaluated basic water chemistry and field water chemistry parameters, and habitat

characteristics including substrate conditions. Stream order was included as a criteria for establishing the study but was not evaluated further in most cases. Neither the size nor age of mining or associated fills were included as evaluation criteria in any study summarized here.

h1. Summary of Results from Upstream-Downstream Comparison Type Studies

Four studies of this type were made available for use in this EIS from coal companies, particularly from Pen Coal Corporation. These studies included studies evaluating macroinvertebrate communities downstream from mine influences to upstream sites for Twelvepole Creek (Pen Coal 1998; Pen Coal, 2000c), Honey Branch (Pen Coal, 1999a) and Trough Fork Creek (Pen Coal, 2000a). These studies assessment evaluation metrices relating to the abundance, number of taxa, proportion of sensitive species present, and diversity and evenness of the aquatic macroinvertebrate community at stream sampling locations above and below the influence of mining. Usually water chemistry and habitat characteristic evaluations were performed in concert with the biotic evaluation.

Overall, the abundance of macroinvertebrates was found to be similar in upstream and downstream stations or to be slightly higher in downstream stations. As discussed in these studies and other studies (see Arch Coal in prep 2002), this increase in abundance may be related to the presence of releases from sedimentation ponds or other releases of solids into the stream. The number of taxa were found to be similar in upstream or downstream stations or to decrease at downstream locations near to the influent area from the mines. The largest difference seen between upstream and downstream locations was the change in proportion of sensitive groups. All four studies reported a decrease in the proportion of sensitive organisms in the stream sampling locations downstream from the mining influent. In addition, other metrices that evaluate the diversity, evenness and degree of pollution tolerance of the aquatic community were found to become more indicative of an impacted stream condition (i.e. diversity and evenness decreased, pollution tolerance increased).

Two types of physio-chemical factors were singled out by these studies as potentially contributing to these community changes. Several studies indicated that sedimentation was greater downstream from the point of mine influent. All studies noted increases in the water chemistry parameters sulfate, conductivity and hardness. Selenium was not an analyte in any of these studies.

These studies did not specifically address the presence of or potential impacts from valley fills. Given the current status of these studies, fills were probably part of the mine complexes evaluated by these studies but it is not known whether all downstream locations in these studies were downstream from fills or just from mining areas.

h2. Results of Comparisons of Pre-mining Biotic Conditions to Post-mining Aquatic Communities

Two studies comparing pre-mining biotic conditions to post-mining aquatic communities from the same stream sampling locations were made available for use in this EIS from coal companies, particularly from Pen Coal Corporation. These studies included studies on Trough Fork (Maggard and Kirk, 1999 and Pen Coal, 2000a), and Honey Branch (Pen Coal,1999a). These studies assessed evaluation metrices relating to the abundance, number of taxa, proportion of sensitive species present, and diversity and evenness of the aquatic macroinvertebrate community at stream sampling locations before mining was initiated and after or during the development of a mine. Usually water

chemistry and habitat characteristic evaluations were performed in concert with the biotic evaluation.
The evaluation for Honey Branch was complicated by the fact that the historic data from 1987 appeared to have been derived from sampling performed using different sampling techniques than are currently employed. The authors of this report stated that a qualitative comparison of current to past results suggests that the aquatic macroinvertebrate community has undergone a shift to a more tolerant, less sensitive community.

The evaluation of Trough Fork is an ongoing project. Sampling was initiated in 1995 prior to mine initiation. This study included sampling sites upstream and downstream from the influent from the mine complex. Between 1995 and 1999 the upstream sampling locations showed increases in abundance, taxa richness, the number of EPT genera and slight decreases in the proportion of sensitive organisms and community diversity. These changes may reflect the natural variation present in aquatic communities over time since there should be no direct effects from mining input to the upstream stations. Changes in the downstream station were similar to those seen at the upstream station for abundance and taxa richness. However, the diversity and evenness of the downstream macroinvertebrate communities decreased notably and the proportion of tolerant organisms increased notably in comparison to the 1995 results and the upstream station.

Water chemistry did not change much between the 1995 and 1999 sampling periods for the upstream sampling station. However, for the downstream sampling station, increases in conductivity, TDS, TSS, hardness, alkalinity, sulfates, sodium, calcium and magnesium were found the 1999 sampling period compared to the initial 1995 results. Selenium was not included as an analyte in these samples.

Anecdotally, the investigator noted that base flow had increases at the downstream location. The report stated that this should have a positive impact on the aquatic community, but results from the 1999 sampling period do not appear to indicate that a positive change is occurring at the stations downstream from the mine (Maggard and Kirk, 1999).

These studies did not specifically address the presence of or potential impacts from valley fills. Given the current status of these studies, fills may not be complete at this point. This on-going project represents an opportunity to investigate the relationship between fill age and downstream impacts.

h3. Results of A Multivariate Analysis Study on Benthic Invertebrate Communities and Their Responses to Selected Environmental Factors

An extensive study of invertebrate communities and their responses to environmental factors in the Kanawha River basin was performed by the USGS (USGS, 2001a). This study included in entire Kanawha River basin and, on a regional basis, focused on relationships between macroinvertebrate community characteristics with land use types and other stream-related factors such as stream chemistry and habitat characteristics. A variety of multivariate statistical analyses were used to explore the potential relationships among variables.

Results from this study indicated that in the Kanawha River Basin the effects of coal mining, such as changes in stream water chemistry and benthic habitat quality, strongly shaped aquatic

macroinvertebrate communities especially in basins of less than 128 square miles. Coal mining appeared to influence invertebrate communities through two factors: 1. Increasing habitat degradation through decreasing the median particle size of streambed material, and 2. Increasing the specific conductance and sulfate concentration of surface water. On a positive note, this study found little evidence of classic acidic mine drainage in the Kanawha River Basin.

The increase in specific conductance and sulfate concentration was associated with a proportional decrease in the sensitive taxa in the stream macroinvertebrate communities. The study also indicated that the decrease in median particle size of streambed sediment was the habitat characteristic that most strongly correlated to loss of sensitive taxa groups and increases in tolerant taxa. It was noted that other landscape level alterations such as large construction projects and stream dredging also decreased median particle size.

While this report did not focus on valley fills, potential impacts from valley fills to stream chemistry and possible alterations to stream geomorphology were discussed as areas in need of further investigation.

h4. Studies of Macroinvertebrate Communities in Stream Sites Located Downstream From Mined or Mined/Valley Filled Areas in Comparison to Reference Locations

A fourth type of study is available relating to the potential impacts of mining and valley filling on downstream aquatic invertebrate communities. Typically, these studies evaluated stream communities located downstream from mining plus valley fills, or mining alone in comparison to various reference locations.

This type of study originated with the USEPA (2000) study of numerous watersheds throughout the MTM/VF study area. A followup to this study using a variety of comparative statistical approaches is being prepared by the USEPA (2002 in prep). Also in preparation is a supplemental study of the sampling stations used in USEPA (2000) relating to mining performed by Arch Coal, Inc. A draft version of this report was released in August of 2000 but Arch Coal has indicated that a revised version of this report will be released shortly (Arch Coal, conference call of May 29, 2002). A supplemental evaluation of sampling stations used in USEPA (2000) relating to valley fills in the vicinity of the Hughes Branch was developed by Cannelton Industries (Cannelton, June 2000). Finally, EPA Region 4 has completed an evaluation of the impacts of MTM/VF to streams in Kentucky (USEPA Region 4, 2001).

Summary of the USEPA Stream Survey Study

The EPA streams study (USEPA 2000) was performed as part of this EIS to more fully evaluate what changes, if any, are occurring in benthic communities, stream chemistry, and aquatic habitat downstream of mining operations. These studies were designed for the express purpose of providing a synoptic description of stream conditions in five representative watersheds across the primary mountaintop mining area within the study area. These watersheds were defined by the West Virginia Geological and Economic Survey (WVGES) and include Twentymile Creek, Clear Fork, Island Creek, Mud River, and Spruce Fork.

The selected study sites were monitored for benthic macroinvertebrate populations, water chemistry, and physical habitat when adequate flows allowed. Benthic macroinvertebrate populations were

sampled in the five study watersheds using the RBP single habitat sampling protocol (USEPA 1999). Samples were collected over a period of five seasons: spring 1999, summer 1999, fall 1999, winter 2000, and spring 2000. Most of the unmined streams could not be sampled during the summer and fall 1999 sampling seasons due to stream flows being either too low to allow benthic sampling or the streams lacked flows altogether.

Methodology and results of the invertebrate component of the stream study are reported in the draft report "*A Survey of the Condition of Streams in the Primary Region of Mountaintop Mining/Valley Fill Coal Mining*", dated November 2000.

The primary objectives of this study relating to the impact of MTM/VF on stream communities were:

1. Characterize and compare conditions in three classes of streams: 1) streams that are not mined (termed "unmined"); 2) streams in mined areas with valley fills (termed "filled"); 3)streams in mined area with valley fills and residences (termed "filled-residential") and 4) streams in mined areas without valley fills (termed "mined").

2. Characterize conditions and describe any cumulative impacts that can be detected in streams downstream of multiple fills. Owing to conditions encounter no definitive conclusions were reached regarding this second objective.

This study evaluated benthic macroinvertebrate assemblage data, physical stream habitat assessments, quantitative estimates of substrate size, and limited field chemical/physical parameters.

Biological conditions in the unmined sites generally represented a gradient of conditions from good to very good, based on the WVDEP SCI scores. These sites are primarily forested, with no residences in the watersheds. One site scored in the high-end of the fair range in the summer of 1999, one site scored in the poor range in the fall of 1999, and one site scored in the high-end of the fair range in the winter of 2000. The authors believes these sites scored lower primarily because the drought and lower flows impeded their ability to collect a representative sample. They observed no other changes at these monitoring sites that could account for the changes in the condition of the streams, other than the low flows. When these sites were sampled in later index periods, they scored in the good or very good range.

Biological conditions in the mined sites generally represented very good conditions, although a few sites did score in the good and poor range. One site that scored in the poor range was believed to be naturally flow-limited even during periods of normal flow. The authors believed this site was ephemeral and only flowed in response to precipitation events and snow melt. The other mined sites generally had only a small amount of mining activity in their watersheds.

Biological conditions in the filled sites generally represented a gradient of conditions from poor to very good. One site scored in the very poor range in the spring of 2000. Over the five seasons, filled sites scored in the fair range more than half of the time. However, over a third of the time, filled sites scored in the good or very good range over the five seasons. The authors believe water quality explains the wide gradient in biological condition at the filled sites. The filled sites that scored in the good and very good range were found to have better water quality, as indicated by lower median

conductivity at these sites. The filled sites that scored in the fair, poor and very poor ranges had degraded water quality, as indicated by elevated median conductivity at these sites.

Biological conditions in the filled/residential sites (filled sites that also have residences in their watersheds) represented a gradient of conditions from poor to fair. Over the five seasons, filled/residential sites scored in the poor range more than half of the time. The remainder of the filled/residential sites scored in the fair range. No sites in the filled/residential class scored in the good or very good range. All sites in the filled/residential class had elevated median conductivities.

In general, the filled and filled/residential classes had substantially higher median conductivity than the unmined and mined classes. It is important to note that the filled sites generally had comparable or higher conductivity than the filled/residential sites within a watershed, indicating that the probable cause of the increase in the total dissolved solids at the filled/residential sites was the mining activity upstream rather than the residences. Presently, there are no aquatic life criteria for conductivity or total dissolved solids.

Biological conditions in the filled and filled/residential classes were substantially different from conditions in the unmined class and were impaired relative to conditions in the unmined class, based on the WV SCI scores.

The filled/residential class was the most impaired class. The causes of impairment in this class could include several stressors (e.g. the valley fills, the residences, roads). It is impossible to apportion the impairment in this class to specific causes with the available data.

The general patterns of stream biological condition presented in the previous paragraphs were clear in all three seasons that have complete data sets (spring 1999, winter 2000 and spring 2000)including sampling results from unmined sites.

The Rapid Bioassessment Protocols habitat assessment data did not indicate substantial differences between the stream classes. The habitat in the filled class and the filled/residential class was slightlydegraded relative to the unmined class. Individual sites in the filled and filled/residential classes had degraded habitat and excessive sediment deposition.

In general, the substrate characteristics of the filled, filled/residential, and mined classes were not substantially different from the unmined class. The data from this study did not indicate excessive fines in the filled or the filled/residential classes as a whole, however, there were specific sites within these classes with substantially higher percentages of sand and fines compared to the unmined class. It should be noted that many of the filled sites were established in first and second order watersheds in order to limit the potential stressors in the watershed to the valley fills. These data indicate that the valley fills and associated mining activity did not cause excessive sediment deposition in the upper reaches of these watersheds. The authors noted that it would not be appropriate to extrapolate this conclusion to reaches farther downstream in these watersheds or to larger order streams.

Correlations in this study between the benthic metrics and selected physical and chemical variables indicated that the strongest and most significant associations were between biological condition and conductivity. Physical habitat variables were more weakly correlated with biological condition and

some of these associations were not significant. Water quality appeared to be the major factor limiting the benthos in the impaired streams. This study also discussed findings related to flow and noted that perennial flow conditions were not needed to support high quality aquatic communities.

Summary of the Other Studies Relating to Impacts of MTM/VF on Stream Biota

A followup to the USEPA (2000) study using a variety of comparative statistical approaches is being prepared by the USEPA (2002 in prep). This study is analyzing data from the USEPA report along with data provided by various coal companies. Thus far, preliminary results, using only those sample periods from all sites where flow was sufficient to allow sampling, support the findings of the USEPA (2000) study. The Filled and Filled-Residential sites have been found to differ significantly from the unmined and mined sites in six to nine of the nine evaluation metrices. All differences observed are in the direction of impairment (e.g., decreased diversity, increase proportion of tolerant organisms in the community etc).

In preparation is a supplemental study of the sampling stations used in USEPA (2000) relating to mining performed by Arch Coal, Inc. A draft version of this report was released in August of 2000. Arch Coal presented some preliminary results from the revised version of this report in a teleconference (Arch Coal, conference call of May 29, 2002 and 2000). Based on this presentation, results appear to be similar to those in USEPA (2000). Arch Coal found filled and Filled-Residential sites showed decreases in EPT taxa and increases in the proportion of tolerant organisms in the community compared to reference sites. This study also measures abundance but results on this evaluation metric are not yet available for inclusion in the EIS. In their evaluation of physio-chemical parameters that might explain community changes observed, Arch Coal noted that the moderated thermal regime may have increase the degree-date accumulation of the stonefly populations resulting in emergence earlier in the season than had previously been observed. Although it is not known if such a change would result in changes to the community, it is interesting to note that changes to the thermal regime downstream from valley fills may be exhibiting a population level impact.

A supplemental evaluation of sampling stations used in USEPA (2000) relating to valley fills in the vicinity of the Hughes Branch was developed by Cannelton Industries (Cannelton, June 2000). This study looked at three stations below valley fills and other mining influences. These stations were evaluated using the WV SCI. SCI results ranged from good to very good. This study also found very low percentages of mayflies (ephemeroptera) at this sites and elevated surface water conductivity, hardness and sulfates. All findings presented were similar to the findings of the USEPA (2000) study.

EPA Region 4 conducted a one time sampling of streams in Kentucky and evaluated those samples for impacts from MTM/VF. This study compared sampling stations located downstream from mined-filled areas to reference streams. Severe impacts to the mayfly fauna was exhibited at all mined-filled sites. Decreases in pollution-sensitive macroinvertebrates were also observed at mined-filled sites. Also, decreases in taxa diversity were observed at mined-filled sites. Mined-Filled sites generally had higher conductivity, greater sediment deposition, and smaller substrate particle sizes. Strong negative correlations were observed between conductivity and indications of macroinvertebrate community health. (USEPA 2001)

OSM Report on the Cumulatative Off-Site Impacts from a Large area Mine in Southeastern Ohio.

OSM conducted a study of a Central Ohio Coal Company (COCCO) mine in Southeastern Ohio to determine the off-site impacts from a large area mined. This study, although not in this EIS study area, provides information to consider if the cause of the impacts being seen below MTM/VF studies were due to the SMCRA defined "valley fills" or could be expected from area mining "backfill". The study used both COCCO's samples from 1980 and Ohio Environmental Protection Agency (OEPA) samples from 1987 and 1999. The preponderance of the mining was done post-1972 (SMCRA) and completed in 1987 (Rannells Creek) and 1992 (Collins Fork).

OSM obtained fish study results, macroinvertebrate study results, water quality analysis, and Quality Habitat Evaluation Indicators (QHEI) from the OEPA samplings. Comparative surveys of macroinvertebrates on Collins Fork and Rannells Creek indicate similar results to those in the filled and filled/residence class sites of MTM/VF studies (i.e.; elevated conductivity, sulfates, hardness and a decline in pollution sensitive species). Evaluations of the invertebrate community quality appeared unchanged between the two OEPA sampling periods. It is particularly noteworthy that none of the macroinvertebrate samples in 1987 or 1999 showed any significant numbers or kinds of mayflies. This absence of mayflies has also been observed in recent surveys by the USEPA 2002 study in West Virginia in mining areas with acceptable pH's, but with high conductivities. (USDOI 2000)

i. Impacts of MTM/VF on Fish Assemblages

Two studies relating fish communities to potential impacts from mining and or mining and valley filling are available for use in this EIS. The USFWS MTM Fish Assemblage Characterization Report (Stauffer and Ferreri, 2002) directly addressed this issue.

An extensive study of fish communities and their responses to environmental factors in the Kanawha River basin was performed by the USGS (USGS 2001b). This study included in entire Kanawha River basin and, on a regional basis, focused on relationships between fish community characteristics with land use types and other stream-related factors such as stream chemistry and habitat characteristics. A variety of multivariate statistical analyses were used to explore the potential relationships among variables.

The USGS (2001b) found that stream size and zoogeography masked any potential water quality effects of land use on species composition and relative abundance of fish communities in the study. This and other factors relating to natural characteristics of fish communities in this region limit the usefulness of this study to evaluate mining impacts on fish communities.

Stream Fish Assemblage Characterization

There is little historical information regarding stream fish populations in the primary region of mountain top removal/valley fill coal mining. To address this data gap, fish communities at several pre-selected sites in the MTM/VF study area were sampled (Stauffer and Ferreri, 2002). The objectives of this study were to 1) characterize the fish communities that exist in the primary region of mountain top removal/valley fill coal mining in West Virginia and Kentucky, 2) determine if any

unique fish populations exist in this area, and 3) evaluate the effects of these mining operations on fish populations residing in downstream areas.

During 1999-2000, fish assemblages were sampled in 58 sites in West Virginia located on 1st through 5th order streams, and in 15 sites in Kentucky located on 2nd, 3rd, and 4th order streams. The majority of the sample sites were selected in consultation with personnel from U.S. Environmental Protection Agency (USEPA) Region III and Region IV. A few sites were added in the field to enhance the characterization of the fish communities in the primary region of mountain top removal/valley fill coal mining. Sites in West Virginia were assigned an EIS Classification based on U.S. EPA Region III classification. Sites in Kentucky were assigned an EIS Classification based on Region IV classifications. Two sites, Stations 6 and 22 (a 2nd order and a 4th order stream) in the Mud River watershed, were sampled during each year, and it was determined that collections at these sites were comparable between seasons. However, results from the 1999-2000 sampling effort indicated that there were not enough reference sites to adequately assess the potential effects of mountain top mining/valley fill operations on fish communities in the area. A strong relationship was found between stream size (as described by stream order) and the total number of fish species present. All of the unmined sites that were to serve as reference sites were located on 1st and 2nd order streams, while sites classified as mined, filled, filled/residential, and mined/residential occurred primarily on 3rd and 4th order streams making direct comparisons between mined and filled sites inappropriate. As a result, in Fall 2001, eight sites in the Mud River that were classified as filled or filled/residential were re-sampled along with five sites in the Big Ugly and three sites in the Buffalo Creek drainages that were chosen to serve as reference (of the unmined condition) sites in the Guyandotte River system.

Due to the confounding effects of drought, small stream size (low stream order), and human impact on reference sites in West Virginia, reference (unmined) sites could not be directly compared to filled sites directly during the 1999/2000 sampling season. Thus, results were developed based on Kentucky sites and 2nd order streams in the New River Drainage where comparable reference (unmined) and filled sites were available. Comparison of unmined sites and filled sites in Kentucky and in 2nd order streams in the New River Drainage indicate that mountain top removal/valley fill coal mining has had an impact on the condition of streams. In general, the number of total species and number of benthic fish species were substantially lower in filled sites than in mined sites in both Kentucky and 2nd order streams in the New River Drainage.

In 2001, the fish samples taken in the mined sites in the Mud River were compared with reference sites sampled in the Big Ugly drainage. Both the Mud River and Big Ugly rivers are part of the Guyandotte River system. Both the total number of species and the total number of benthic fish species were greater in the reference sites (median 17 and 6 respectively) than in the filled sites collected in 2001 (median=8 and 1.5). The total number of species collected during 1999/2000 was considerable higher (median = 12.5) than the total number of species collected at the same sites in 2001 (median 8). Water chemistry analysis revealed that five of the Mud River sites sampled in 2001 had detectable levels of selenium (9.5 - 31.5 μg/l). Filled sites that were associated with detectable levels of selenium seemed to be more impaired than filled sites that had no detectable levels of selenium. Total number of benthic fish species in reference sites (median=6) was higher than those recorded in filled sites with selenium (median = 0) and without selenium (median = 3). The fisheries study noted that a multiple year collecting regimen would be needed to see if there continues to be a decrease in the number of species over time in the filled sites.

This study did not address whether there are environmental benefits of sustained flows from filled watersheds when compared to no-flow conditions in some unmined reference streams. It is possible that the altered flow regimes found downstream from valley fills (USGS 2001) may affect fish habitat for parts of the year in those cases where fish habitat had been previously limited due to seasonally dry conditions. It is also possible that potential benefits from increased flows downstream of mountaintop mining/valley fill operations are offset by changes in water quality. For example, fish collected from one lake downstream of an extensive mining complex in West Virginia were found to contain selenium concentrations much higher than would be expected to occur naturally, indicating that the selenium associated with mining operations occurs in a form that is biologically available for uptake into the food chain (U.S. FWS, unpublished data).

2. Studies Relating to Mitigation Efforts for MTM/VF Impacts to Aquatic Systems

Surface mining operations in steep slope terrain generate excess spoil that is often placed in adjacent valleys. These valley fills encroach and bury headwater stream habitats, and potentially impact stream conditions downstream from fills. Past efforts at compensatory mitigation have not achieved a condition of no-net loss of stream area or functions.

a. Definition of Mitigation

Stream habitat and functions lost through mining and filling are subject to amelioration through mitigation. The Council on Environmental Quality (CEQ) has defined mitigation in its regulations at 40 CFR 1508.20 to include: avoiding impacts, minimizing impacts, rectifying impacts, reducing impacts over time and compensating for impacts. These can be summarized into three general types: avoidance, minimization and compensatory mitigation [MOA between US Army Corps of Engineers and EPA (EPA 1990)]. The objective of compensatory mitigation for unavoidable impacts is to offset environmental losses.

Where mining and filling activities have impacted streams compensatory mitigation may be used to replace lost habitat and functions. Compensatory actions (e.g., restoration of existing degraded wetlands or creation of man-made wetlands) should be undertaken when practicable, in areas adjacent or contiguous to the discharge site (on-site compensatory mitigation). If on-site compensatory mitigation is not practicable, off-site compensatory mitigation should be undertaken in the same geographic area is practicable (i.e., in close physical proximity and to the extent possible the same watershed).

b. Mitigation Goals

In determining compensatory mitigation, the functional values lost by the resource to be impacted must be considered. Functional values should be assessed by applying aquatic site assessment techniques generally recognized by experts in the field and/or the best professional judgment of federal and state agency representatives, provided such assessments fully consider ecological functions in the Guidelines. The ecological functions of Appalachian streams are described in Chapter III.C. Headwater streams receive, process and transport a major portion of the downstream biological energy budget from leaf litter and other terrestrial sources of carbon. Downstream

biological communities are adapted to existing physical, chemical, and biological conditions within these stream arrays

Headwater streams provide habitat for lotic aquatic communities. Generally, in-kind compensatory mitigation is preferable to out-of-kind. Replacement of a mined for filled stream by restoration or creation of a similar type of stream would be more in keeping with this policy than would replacing stream systems with palustrine wetland systems.

In addition, the areal extent of impacts must be considered in the development of successful mitigation efforts.

c. Requirements for Development of a Successful In-kind Replacement Mitigation Project

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: hydrology, hydraulics, water quality, fluvial geomorphology, sediment transport mechanics, plant ecology, macroinvertebrate and fisheries biology and land use (Inter-Fluv 1998). In addition, to mitigate for values lost, size of the mitigation project must be considered.

d. Limiting Factors for In-kind Mitigation Projects

Past efforts at stream construction in association with mine restoration have found limitations in each of the parameters needed for a successful in-kind mitigation effort for headwater streams.

Stream creation on filled areas is very difficult in general due to the inability to capture sufficient groundwater flows necessary to provide a source. There is some suggestion 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. However, no demonstration projects have yet been performed to validate this hypothetical design. Speakers at the Aquatic Ecosystem Enhancement at Mountaintop Mining Sites Symposium (Appendix D) concluded that, at best, streams recreated on mined lands would be expected to have only intermittent flow. As discussed in the USEPA Stream Chemistry Report, several chemical parameters have been found to be elevated in stream surface water downstream from filled/mined areas (USEPA 2002a). Chemical parameters elevated in excess of ambient water quality criteria may impair the aquatic productive of constructed streams.

Post-mining land use surrounding any restored stream would influence the potential functions of that stream. The cumulative impact study (USEPA 2002) found that over 80% of first to third order streams in the EIS study area are surrounded by forest. The cumulative impact study also found that land use for post-mining areas was primarily grasslands. Restored mined areas do not rapidly develop forest cover. This change in surrounding land use represents a factor that may impact the successful restoration of stream functions from a constructed stream.

Establishing aquatic communities of stream-dwelling organisms in restored or created streams depend on the extent to which the physical and chemical environment needed by these organisms has been re-created. It is possible that the elevated flow regimes found downstream from valley fills (USGS 2001) may have created additional fish habitat for parts of the year where previously fish habitat had been limited owing to seasonally dry conditions. It is not known if this increase in

stream length used by fish would be equated to greater fish product or simply represents an increase in area where fish are found.

During the development of this EIS, technical representatives from OSM and from West Virginia have suggested that groin ditches constructed along the edges of fills may represent an opportunity for in-kind replacement of streams with an intermittent or ephemeral flow regime. To date, no drainage structures observed appear to have successfully developed into a functional headwater stream (Appendix D). As discussed in the Aquatic Ecosystem Enhancement at Mountaintop Mining Sites Symposium (Appendix D), creating a more natural channel, increase the structural complexity in the mitigation design by adding boulders, logs and snags and encouraging the restoration of native plant species along a created channel such as a groin ditch would increase the potential for a successful stream creation project. However, the overall limitation to the re-construction of streams in mined and filled areas appears to be the associated with establishing suitable hydrology.

Creation of other ponds and wetland resources on mined land has shown more promise. Wallace (EPA 2000) suggested that these types of systems can be important sites of nutrient storage and uptake provided that a sufficiently vegetated littoral zone is present.

e. Types of Out-of-kind Mitigation

e.1. Onsite

The majority of past efforts at on-site mitigation have been aimed toward the development of palustrine wetland systems to replace streams destroyed through mining and valley filling activities. A review of National Wetland Inventory mapping in conjunction with status and trends information for the study area indicates that natural wetland areas typically found in the steep slope region are generally narrow linear vegetated wetlands along the stream valleys. Wetland areas are being created on reclaimed mine sites. Because steep slope areas are being flattened, it is anticipated that wetland acreage has actually increased as a result of these mining activities.

A number of studies have been performed to evaluate the functions provided by wetlands that have developed on, or been constructed on, mined and filled sites (Pen Coal, 1999 and USEPA, 2000). The results of two of these studies are summarized below.

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). Field surveys were 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.

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 a role in the processing, turnover, storage and cycling of nutrients in all systems. However, published studies demonstrating the occurrence of this function in wetlands established on mining sites are lacking.

In summary, to date functioning headwater streams have not been re-created on mined or filled areas as part of mine restoration or planned stream mitigation efforts. Most on-site mitigation construction projects have resulted in the creation of palustrine wetlands that resembled ponds. Some of these

created wetlands are isolated from other surface water systems while others occur in drainage channels which connect to the original stream system at some point. On some fills, linear-shaped wetlands may develop in groin ditches. Functions potentially restored or replaced by these wetlands include sediment stabilization, wildlife support and water quality maintenance. Functions not restored include habitat for aquatic organisms that require lotic or flowing-water conditions. Palustrine wetlands are known to process organic material which may be transported to downstream if the wetland connects to the original stream. However, it is not known whether the organic matter processing that occurs in created wetlands would mimic the processing found in a natural stream system. Functions of man made ponds and wetlands exist and may be considerable. While these functions differ from those of headwater streams, these functions do have their own inherent values. In fact, the establishment of ponds or wetlands on benches or at the toe of mined areas may tend to limit the effect of disturbances on the downstream watersheds (Appendix D: Wallace).

e.2. Offsite

Past efforts by the states in the MTM/VF Study area to initiate offsite compensatory mitigation practices are discussed below. However, past efforts at off-site compensatory mitigation have not achieved a condition of no-net loss of stream area or functions.

West Virginia Mitigation Prior to 1998

The WVDEP indicates that on-site mitigation of stream 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. 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. A stream mitigation threshold was established where the watershed, when measured from the toe of the fill, was greater than or equal to 250 acres and/or when the fill exceeds ½ acre of stream. In West Virginia, most coal companies opted to pay into a stream impact mitigation fund. Impacts were assessed at a rate of $200,000 per acre for permanent stream impacts from the toe of a fill, measured as length times width at the high water mark of Waters of the State. Temporary sedimentation ponds and culverts in stream channels were assessed at a rate of $20,000 per acre for each five-year period of channel occupancy. Coal companies could also perform other local mitigation or improvement projects in lieu of direct cash payment. Mitigation projects were usually developed in coordination with WV Division of Natural Resources.

Virginia Mitigation Prior to 1998

Prior to 1998 Virginia coal mining permits required limited terrestrial and aquatic mitigation for impacts to intermittent and perennial streams as a result of aquatic disturbances such as in-stream ponds or stream diversions/relocations. Much of this mitigation was driven by the In-stream Treatment Agreement between Virginia DMLR and the Environmental Protection Agency. This agreement states that in-stream structures with drainage areas greater than 200 acres will be mitigated. In many cases the operator would opt to leave sediment structures as wetlands to mitigate for stream disturbances. Prior to 1998 the Division of Mined Land Reclamation had no size requirements regarding fills in-stream or fill minimization procedures, however the Division did obtain terrestrial mitigation on the face of many small head of hollow fills.

Virginia did not have a system for payment into a fund in lieu of on the ground work for mitigation in the coal mining region of the state.

Tennessee Mitigation Prior to 1998

The Tennessee Water Quality Control Act including the 1994 amendments required a permit for activities resulting in alterations to the physical, chemical, radiological, biological, or bacteriological properties of any waters of the state.

Prior to 1998 an Aquatic Resource Alteration Permit (ARAP) or 401 certification was required for alterations resulting in alterations to the physical properties of waters of the state. The compensatory mitigation ratio for alterations to wetlands including fill activities was at least 3:1. Fill in waters deemed to be perennial streams was prohibited. Mitigation requirements for ephemeral and intermittent streams were established in the permit conditions of an Individual Aquatic Resource Alteration Permit for activities such as stream relocation. Isolated wetlands equal in size to 0.25 acres, not connected to other waters of the state and deemed non-jurisdictional by the USCOE, and wet weather conveyances were covered under a General ARAP without any compensatory mitigation.

The State of Tennessee has never established any system for which payments to a fund could be made in lieu of groundwork for mitigation. However, the state is currently developing guidelines for establishment of such a fund provided the proposed activity meets certain criteria.

E. COAL MINE DRAINAGE FROM SURFACE MINING

1. Study Area Water Quality Summary

The United States Geological Survey (USGS) has published a series of Open-File reports investigating the hydrology of designated watershed areas (classified by number, called Hydrologic Unit Codes, or HUCs) within the Eastern Coal Province. Many of these watershed areas fall partially or wholly within the study area, but are generally larger watersheds, e.g., 2-10 square miles, and thus may not necessarily represent typical headwater stream water quality. Generally, headwater streams have good water quality (USFWS 2000). The majority of these USGS watershed reports, date from 1981 to 1987 and are currently being updated. Recent reports are available for the Kanawha-New River Basin. These USGS reports characterize the surface water quality and quantity of mined and unmined regions in watershed areas. Watersheds that were assessed include the Little Sandy River and Tygarts Creek in Kentucky; the Clinch, Emory, Obed, Sequatchie, and Tennessee Rivers in Tennessee; the Powell and Clinch Rivers in Virginia; and the Gauley, Elk, Coal, New, Pocatalico, Guyandotte, and Kanawha Rivers as well as Twelvepole Creek in West Virginia.

THE PREDOMINANT SOURCE OF ACID MINE DRAINAGE IS PRE-SMCRA MINING.

The reports indicate that many of the watersheds were affected by coal mining activity, including surface and underground mining, construction and use of ancillary facilities such as roads, coal processing and coal transport. Many mines are located adjacent to or near streams and rivers to permit transport of coal by river barge and railroad. Most coal moves from the mines by rail or truck to a terminal near the larger rivers, and by barge or rail to the final destination. Mines, waste piles, and coal preparation plants, which are located close to streams and rivers, increase the potential for serious water-quality impairment–if improperly treated wastes are discharged. All watersheds appeared to have localized intensified areas of mining that result in moderate to severe degradation of surface water quality. Typically, there were substantial differences in measured values between mined and unmined areas. In areas of mining, decreased pH values and increased values of specific conductance, metals, acidity, sulfate, and dissolved and suspended solids were seen. These USGS reports indicate that localized surface water quality is also compromised by municipal and industrial wastewater discharges and land use changes and development (USGS, OFR 81-803). The 1980 vintage USGS studies may not represent post-SMCRA water quality. The predominant source of acid mine drainage is pre-SMCRA mining. The recent Kanawha-New River Basin studies indicate good surface water quality (Eychaner 1994 and 1998).

Streamflow in unregulated streams typically varies greatly during the year, following the precipitation and evapotranspiration regime. The greatest mean monthly flows usually occur during March, as a result of snowmelt runoff, increased precipitation, and relatively low evapotranspiration. Streamflow during spring and early summer is usually high as a result of increased thunderstorm activity. Streamflow recession during late summer and early fall results from evapotranspiration losses and decline of precipitation activity. During November and December, streamflow usually increases as evapotranspiration decreases and the winter rains begin (USGS, OFR 81-803). Flow duration is affected by many natural basin characteristics such as topography, geology, size of drainage area, climate, and by activities of man, including streamflow regulation and mining.

Surface and underground mines can affect streamflow duration when streamflow is augmented by mine drainage or pumpage (USGS, OFR 81-902).

2. Coal Mine Drainage

Coal mine drainage (CMD) is drainage from surface mining that causes water quality problems. CMD is the characteristic water that is produced from the increased weathering of minerals associated with backfilled material. In undisturbed geologic areas, groundwater flow in rock is typically along zones of secondary permeability, that is, faults, fractures and bedding planes. Minerals associated with the bedrock in the groundwater flow areas have been extensively weathered over millennia. However, during surface mining, the overlying contiguous bedrock that exists over the coal seams, also known as overburden, is broken up into smaller more homogenous rock particles. This break up increases contact of minerals by exposing new minerals to air and water. The exposure results in additional and increased weathering of minerals in the backfilled material.

Sulfide minerals, such as pyrite (FeS_2), are often associated with coal and overburden and are the primary minerals involved in the development of CMD. The oxidation of pyrite leads to the production of acidity and release of sulfate (SO_4^{2-}) and ferrous iron (Fe^{2+}) as indicated in the following reaction (Stumm and Morgan 1996):

$$FeS_{2(s)} + 3.5O_2 + H_2O \Rightarrow Fe^{2+} + 2SO_4^{2-} + 2H^+$$

Additional acidity is released from ferrous iron, as indicated in the following oxidation, hydrolysis (the splitting of a compound into fragments by the addition of water, the hydroxyl group being incorporated in one fragment, and the hydrogen atom in the other) and precipitation (the flocculation and settling of materials, in this case, such as iron hydroxides, following their chemical reaction in mine drainage) reaction (Stumm and Morgan 1996):

$$Fe^{2+} + 0.25O_2 + 2.5H_2O \Rightarrow Fe(OH)_3 + 2H^+$$

The above reaction is a simplification, in that the pH, cations (e.g., positive ions such as sodium and potassium) and anions (e.g., sulfate and chloride) affect the precipitation of ferric iron (Fe^{3+}) and precipitate formed, such as, goethite, lepidocrocite and jarosite (Nordstrom 1982). Acidity, soluble ferrous and ferric iron released from pyrite oxidation are capable of reacting with a variety of carbonate minerals (e.g., limestone, dolomite and siderite) and silicate minerals (e.g., clays, mica and feldspar) during neutralization and cation exchange processes (Rose and Crovotta, 1998*)*. It is these reactions that can increase concentrations of a variety of common metals (e.g., calcium, magnesium, manganese and aluminum) and trace metals (e.g., copper, cadmium, nickel and zinc). The resulting CMD will vary widely in composition, depending on the characteristics of the backfilled material and reclamation practices. There are generally two categories of CMD: acidic mine drainage (AMD) and neutral/alkaline mine drainage (NAMD) (Rose and Crovotta, 1998). Both types reflect, to some degree, oxidation of sulfide minerals and the release of acidity, iron and sulfate.

AMD is the category of mine drainage in which mineral acidity exceeds alkalinity. In many cases there is <u>no</u> alkalinity present. The pH of AMD varies widely from 2 to 6, and acidity ranges from

0 to 1000s of mg/L (measured by standard practice in terms of $CaCO_3$ equivalency, or the amount of calcium carbonate per unit volume that it would take to neutralize the acid sample). The high acidity is a result of elevated concentrations of dissolved metals--primarily iron, aluminum and manganese. These metals can be hydrolyzed and release additional acidity. In addition to hydrolyzable metals, AMD contains a variety of anions (negative ions, in this case primarily sulfate) and cations (such as, calcium and magnesium) that are the result of the pyrite oxidation, neutralization reactions and cation exchange in the overburden. Sulfate levels will range from 50 to 1000s mg/L depending on the amount of sulfide minerals and oxidation rates in the backfilled material.

NAMD is the category containing alkalinity equal-to-or-greater than mineral acidity. Since pH is circumneutral, that is approximately 7, mineral acidity is associated with dissolved ferrous iron and manganese only. Aluminum solubility is very low, less than 0.5 mg/L, at circumneutral pH. Dissolved metals and sulfate vary considerably in NAMD, depending on whether sulfide mineral oxidation occurs prior to or after groundwater has contact with an alkaline material, such as limestone. Sulfate and dissolved metals are typically lower in mine drainage where alkalinity is present before contacting sulfide minerals, due to lower oxidation rates that occur at an elevated pH. Greater dissolved metals and sulfate result in NAMD where neutralization and alkalinity is added after sulfide minerals are oxidized, a result of accentuated mineral sulfide rates at lower pH (Moses 1987). This difference is important. There is a greater potential for trace metals and metalloids to be contained in the NAMD, formed as a result of the later process, due to increased weathering and greater solubility.

a. Indicator Parameters

As previously discussed, mining activities tend to increase weathering of rocks and, as a result, increase the amount of dissolved minerals in the contact water and in watersheds containing mining activity. A number of other anthropogenic land uses, such as, agriculture, silviculture and urbanization, are also known to increase dissolved minerals in surface waters. Two parameters, specific conductance and total dissolved solids (TDS), are used to estimate the amount of dissolved minerals in mine drainage, other contaminated and natural waters. Specific conductance is a measure of the ability of water to carry an electrical current (as measured using a current cell and meter detecting the current returned) and is proportional with the quantity of ionized minerals in solution. Specific conductance rises with increasing dissolved minerals. TDS is measured by drying the matter (suspended solids) remaining after water is passed through a filter (APHA 1989). The two parameters can generally be correlated with specific conductance typically representing about 1.1 and 1.9 times TDS in most waters. Unfortunately, sample handling and methodology can often alter TDS and specific conductivity results, which may affect direct comparison of the two parameters. There is no accepted natural range for either parameter in “uncontaminated” water, due to their dependence on surrounding geology and land use. However, natural or unpolluted freshwater generally have specific conductance between 20 and 500 micromhos (µmhos) and TDS between 10 and 250 milligrams per liter (mg/L). As reported in Rose and Crovotta (1998), CMD has been reported to have specific conductance in excess of 5,000 µmhos (TDS of 3,000 mg/L).

A common parameter used to assess water quality and evaluate impacts of mine drainage is pH (the measure of the hydrogen ion activity $\{H^+\}$ in water) and is typically estimated using an electrode and meter calibrated with known pH buffer solutions (APHA 1989). The pH scale is 0 to 14, but

pH of natural or unpolluted waters generally fall between 5 and 10. Typical convention is to consider a water with a pH of 7 as neutral, values less than 7 as acidic, and greater than 7 as alkaline. This convention may lead to confusion in evaluating impacts of mining, since waters with pH in the 5 to 7 range may occur naturally and have alkalinity present in excess of mineral acidity (parameters discussed below). It may be more appropriate to consider pH as an indicator of aquatic health-- with optimal pH for aquatic life falling between 6 and 9. This pH range is also the range of minimal solubility for most toxic metals (e.g., aluminum, copper and zinc) that may be present in water (Stumm and Morgan 1996); the exception would be reduced metal species such as ferrous iron, which are unstable under oxidizing conditions. Values of pH outside this range (less than this range in the case of mining), would be suggestive of coal mine discharge-related impacts if and only if, other indicator parameters are also present. For example, acid rain-impacted surface waters may also have lowered pH (Herlihy *et al.* 1991).

Alkalinity, usually reported as milligrams per liter (mg/l) of $CaCO_3$, is an aggregate property of water that reflects its ability to neutralize acid inputs and in natural waters is typically a measure of the bicarbonate ion (HCO_3^-). In combination with acidity (carbonate system only), the two parameters assess the ability of a water to resist pH change, which is commonly referred to as "buffering capacity." Alkalinity is measured by titrating a sample (adding a solution, with an eye dropper-like device called a pipette, drop-by-drop) with a known acid concentration to a pH endpoint between 4 and 4.5. This endpoint is known by a color change of the titrated water with a pH sensitive dye called bromocresol green, or is measured with a pH meter (APHA 1989). Natural or unpolluted waters will range from near zero buffering capacity, for smaller headwater streams and poorly buffered waters, to more than several hundred milligrams per liter buffering capacity, for larger waters and waters in predominately limestone regions. Coal mining can cause alkalinity to increase or decrease, in the receiving stream, depending on overburden characteristics and mining and reclamation practices.

Acidity in natural or unpolluted waters (usually reported as milligrams per liter (mg/l) of $CaCO_3$), is another aggregate property of water that reflects its ability to neutralize base inputs and in natural waters, is typically a measure of the presence of carbonic acid (H_2CO_3) and bicarbonate ion (HCO_3^-). In conjunction with alkalinity, these two parameters represent the buffering capacity. Carbonate acidity is titrated with a known concentration of base solution to a pH endpoint of 8.3, as determined colorimetrically with metacresol purple or with a pH electrode and meter (APHA 1989). Acidity in CMD can be difficult to evaluate, because of the potential presence of reduced forms of primarily two metals, iron and manganese, which may or may not be included in the standard acidity titration method. In evaluating mine related acidity, it is frequently necessary to measure a different type of acidity, known as hot mineral acidity, which will include the contribution of reduced forms of metals on acidity. This method uses acid to lower the pH. and remove carbonate-related acidity, hydrogen peroxide as an oxidant, and heating to increase the rate of oxidation prior to titrating to the pH 8.3 endpoint (APHA 1989). This hot mineral acidity is also an aggregate parameter of the potential of a water to depress pH from the release of hydrogen ions during the hydrolysis and precipitation of soluble metals. Difficulty arises in evaluating hot mineral acidity results due to reporting differences in coal mining-related studies (frequently reported as acidity, total acidity, mineral acidity and total mineral acidity) and as negative or zero values where alkalinity exceeds hot mineral acidity. Hot mineral acidity reported from a number of coal mined sites (abandoned and permitted) ranged from zero to several thousand milligrams per liter (Rose and Crovotta, 1998).

Sulfate is a good indicator of influence by CMD, because its presence in coal mined areas is generally indicative of sulfide mineral oxidation. Natural or unpolluted freshwater can have elevated sulfate levels in the five to twenty milligram per liter range, depending on the influence of acidic deposition and connate water. In addition, sulfate can be increased from a variety of anthropogenic sources, including treated and untreated wastewater, urban and residential runoff, and agricultural practices. Common methods for analytical sulfate concentration determination include ion chromatography and turbidimetric methods (APHA 1989). Elevated levels of sulfate in CMD can exceed several thousand milligrams per liter and, as a result, can be increased in receiving surface waters to appreciable levels, depending on the CMD source and extent of mining throughout the watershed.

The most common metal used to evaluate impacts of coal mining on surface waters is soluble or total iron, which is contained in CMD, as a result of, sulfide mineral oxidation; iron may also be present from the solubilization of siderite. In most natural or unpolluted surface waters, soluble iron is either near or less than quantifiable concentrations due to its relative insoluble properties in oxidizing and circumneutral water environments. Soluble iron can be found in unpolluted surface waters, such as lake hypolimnion (bottom waters) and groundwater where low dissolved oxygen levels persist. The impact of soluble iron on water quality is generally related to drinking water aesthetics, taste and odor. However, at high concentrations, exceeding 1 mg/L, iron oxidization and precipitation in surface waters can impact stream and lake bottoms due to the formation of “yellow boy” precipitates or staining, named for its yellowish-red appearance, which destroys habitat for aquatic insects and spawning fishes (Hoehn and Sizemore 1977). Iron concentrations are determined colorimetrically or by atomic absorption spectrometry (APHA 1989) and for CMD can range from less than one to values greater than several hundred milligrams per liter.

In addition to iron, manganese is frequently evaluated as an indicator parameter of CMD impacts on surface and groundwater. Its presence is usually considered a result of secondary weathering of carbonate minerals (Crovotta *et al.* 1994). In most natural or unpolluted surface waters, soluble manganese is absent due to its limited solubility in oxidizing and circumneutral water environments similar to iron. If present, manganese may persist in surface waters longer than iron, due to much slower oxidation rates. The effects of manganese are generally related to drinking water aesthetics, taste and odor. EPA established CMD discharge limits for manganese based on links of its presence to toxic metals (e.g., copper, cadmium and nickel) in AMD. Recent studies indicate that other parameters, such as zinc or hot mineral acidity, may be better indicators of the presence of trace metals (Unz and Royer 1997). Manganese precipitation in surface waters may cause similar impacts as “yellow boy” and higher concentrations of manganese (concentrations in excess of 20 mg/l) may be toxic to early life stages of fishes (Lewis 1976, England 1977, Lewis 1978).

Aluminum is another metal frequently found in AMD, but is typically not found in NAMD. Its present is a direct result of secondary weathering of silicate minerals (e.g., clays). The presence or absence of aluminum is a direct result of pH-dependent solubility, with aluminum solubility increasing from, much less than 1 mg/L at circumneutral pH, to greater than 100 mg/l at pH less than 3 (Stumm and Morgan 1996). In soluble form, aluminum is hydrolyzable. In this form, it can be one of the major total “hot” acidity components in AMD, but is of little importance in NAMD or AMD, where the pH is greater than 5. Aluminum, when present in soluble form, is toxic to aquatic life at concentrations as low as 0.1 mg/l (Gagen *et al* 1994), but its pH-dependent solubility limits the toxic conditions to water of pH typically less than 5.5; water of pH greater than 9 may also

contain appreciable soluble aluminum. As an indicator, aluminum would only be of value in low pH waters where other parameters would be present at levels to provide sufficient evidence of mine drainage influence. In addition, since aluminum is one of the most common elements in the earth's crust, its presence, when measured as total aluminum, may be related to suspended solids contained in the sample from various sources, including eroded sediment carried in high flow runoff events and sediments entrained during sample collection.

Total suspended solids (TSS), the measure of particulate material suspended in a sample, is frequently included in parameters used to assess CMD-related impacts. TSS is measured gravimetrically, by weighing the amount of solids captured on a filter (APHA 1989). TSS can be a useful parameter to evaluate entrainment of sediment into a sample and erroneous iron and manganese measurements, which are frequently measured as total (requiring acid digestion) concentrations. In addition, TSS in waters is an indicator of upstream erosion, which may be the result of earth disturbances such as surface mining. TSS may also be increased in surface waters from other anthropogenic activities related to agriculture, silviculture and urbanization. Changes and differences in TSS concentrations associated with surface mining are also difficult to identify and assess, because TSS typically only occurs during storm-related runoff events, and is dependent on rainfall intensity, duration and antecedent conditions.

b. Effects of Coal Mine Drainage

Coal mine drainage can have a significant environmental impact, particularly on pre-SMCRA mine sites where prevention controls were not required. Once AMD occurs, it is a long-term problem. This section provides a summary of environmental impacts of CMD in surface coal mining operations.

CMD can cause chemical toxicity to aquatic life. Most aquatic organisms have specific pH tolerance ranges within which they can survive, and changes in pH resulting from CMD may result in poor health or mortality. An example would be fish kills that occur when large precipitation events flush acidic water from abandoned deep mines into streams. Fish usually cannot survive in streams with a pH of 4.5 or less (Doyle, 1976). Similarly, at reduced pH, aluminum and manganese can reach lethal levels, as well as combinations of mineral acids and iron and sulfur ions (Gore 1985). In severely impacted streams, CMD chemical toxicity may eliminate all aquatic life.

CMD may produce physical and chemical impacts to streams as a result of chemical precipitation. As CMD discharges co-mingle with cleaner surface waters, acidity is reduced, and entrained metals and sulfate become increasingly unstable in solution. Iron and aluminum will tend to precipitate as hydroxides forming orange and white (yellow boy) sludge that coats stream bottoms. If calcium is present in solution and the pH is sufficiently elevated, gypsum ($CaSO_4$) will also precipitate. These sludge materials have the effect of smothering the stream bottom, inhibiting the feeding and reproduction of benthic macroinvertebrates (worms, nymphs, crustaceans, etc.) and destroying fish spawing habitat.

CMD can adversely affect human populations by impuring surface and ground water used for drinking water and recreational purposes. Public and private water supplies drawing from CMD-affected sources may require additional treatment processes to produce potable water, which can add significantly to the cost of the water supply. Loss of aquatic life in a water body reduces the

recreation values, with attendant economic losses to the surrounding community. In terms of aesthetics, CMD can have a significant visual impact in affected streams resulting from the unnatural appearance of the iron sludge coating. Acidic waters can also affect physical structures, increasing corrosion of steel and concrete bridges, culverts, and other in-stream structures, reducing their functional lives. OSM compiled preliminary records on post-SMCRA mine sites that have CMD problems (OSM, 2000). These include sites still active and sites where bond forfeiture occurred, as shown in Table III.E-1. Several of these sites may be in Western Kentucky and Northern West Virginia outside of the EIS study area, and as many as a third of the sites may be underground mine sites. However the information does provide a general indication of the scope and significance of CMD.

Table III.E-1 Estimates of Post-SMCRA CMD Sites for States in the Study Area

State	Active Mine Sites		Bond Forfeiture Sites	
	# Permits	# Discharges	# Permits	#Discharges
Kentucky	10	10	27	30
Tennessee	13	34	2	3
Virginia	24	26	6	6
West Virginia	363	635	119	286
Total	410	705	154	325

Table III.E-2 shows the estimated amount of CMD from the four states in the EIS study area, as well as the types of estimated “loadings” (e.g., chemical constituents per unit volume of flow) for several indicator parameters. The data presented under the average column headings are averages per site. The data presented under the total column headings are totals per state.

Table III. E-2 CMD Flow and Loading Estimates for Post-SMCRA Mine Sites in Study Area States

State	**Total Flow (gpm)**	**Average Acidity (mg/L)**	**Total Acid Load (lbs./day)**	**Average Alkalinity (mg/L)**	**Average Fe (mg/L)**	**Average Mn (mg/L)**	**Average Al (mg/L)**
Kentucky	1,094	341	5,534	45	78	6	16
Tennessee	1,908	110	1,892	76	51	16	1
Virginia	3,508	81	232	81	6	4	10
West Virginia	59,993	299	111,158	43	41	16	20
Total	66,503	208	118,816	61	44	11	12

3. Methods of Controlling CMD

Once established, CMD is typically a long-term problem that is technologically or economically difficult to correct. Avoidance of CMD is a provision of the hydrologic balance protection standard in SMCRA, and regulatory agencies are authorized to restrict mining if there is a risk of CMD formation. Mining in potentially toxic areas is not precluded, but the mining applicant must demonstrate that CMD formation can be avoided by mining and reclamation practices (OSM 1994). In the event of CMD formation, the permit holder becomes liable for treatment of the CMD discharge to meet CWA receiving stream standards until such time as the situation is corrected, which can represent a considerable expense for long-term treatment obligations.

The simplest form of CMD prevention is avoidance of coal or overburden containing excessive amounts of pyritic material. The permitting process for a mine site normally requires collection of overburden and coal samples to be analyzed for pyritic content (usually expressed as total sulfur content) and neutralizing potential or alkalinity (usually expressed as tons of calcium carbonate equivalent per thousand tons of material). If the acidity generation potential of the pyritic material exceeds the neutralization potential of the overburden and coal, the area represented by the samples is considered to have potential to cause CMD if mined. If the acidity generation potential greatly exceeds the neutralization potential, the site may be considered of too great a risk to mine by either the coal operator or the reviewing regulatory agency. For low- to moderately-acidic sites, various practices may be employed to reduce the risk of CMD generation, as discussed in the following section.

The annual costs for Kentucky, Tennessee, West Virginia, and Virginia sites treating CMD are estimated to exceed $37,000,000 for active mine sites and $5,600,000 for forfeiture sites. The cost to construct treatment systems at sites where discharges are untreated in the four states is estimated at $3.8 million for active sites and $3.1 million at forfeiture sites. Thus, the impact is not only environmental, but economic as well. The high, long-term cost of CMD treatment serves as a strong incentive for mining companies to avoid coal seams and overburden in known CMD-producing areas. Where avoidance does not occur, companies take special care in development of mining plans with special handling controls to prevent or minimize CMD development (see next sections). Both

SMCRA and CWA are designed to minimize CMD problems through proper planning and handling, but if all else fails, long-term treatment will be required to assure minimal impacts to the hydrologic resources.

a. Overburden Blending

If potentially toxic pyritic materials are scattered or contained in stratigraphic units that cannot be readily identified and segregated during mining, and the overburden is found to be net alkaline on a whole for a given mining area, most mining operations will use overburden blending to avoid CMD formation. This concept assumes that excavation and backfilling processes will sufficiently mix the toxic materials with other non-toxic or alkaline overburden materials to form a relatively homogeneous, "net alkaline" spoil. Alkaline materials may also be redistributed within a mine site from areas of excess alkalinity to areas of alkaline deficiency. This method is generally the most common in use for MTM/VF mining sites.

b. Isolation Methods

The concept behind isolation of potentially toxic overburden is to prevent contact between pyritic material and oxygen and water, thereby excluding both reactants necessary to form CMD. Isolation requires selective collection and placement of toxic materials during mining (a process known as *special handling)*. Toxic materials are typically segregated during mining and placed in backfill "pods," which are elevated above the anticipated postmining groundwater level and may be encapsulated by non-toxic materials to further inhibit contact with oxygen (Perry et. al. 1998). This adds to the cost of the mining process, because of the additional material handling steps and the necessity, in some cases, to create additional mine benches on toxic overburden horizons that would not be needed to recover coal seams alone. Isolation is another commonly-proposed method of CMD avoidance in MTM/VF mining.

c. Submergence Methods

Submergence of toxic overburden materials is a form of isolation, in that oxygen is expected to be excluded from contact with pyritic materials by permanent submergence under water. This requires a relatively flat isolation area with a deep, permanent, and essentially stagnant postmining water table to prevent migration of oxygen into the containment area. This method is not widely used in the Appalachian mining region (Perry et. al. 1998).

d. Alkaline Addition

A direct approach to correcting a net deficiency in overburden alkalinity is to add alkaline material during the backfilling process to serve as a neutralizing agent. This method has been applied on a number of mine sites with varying degrees of success. Crushed limestone, kiln dust, or alkaline fly ash materials are typically used as neutralizing agents, and may be placed on the pit floor prior to backfilling, mixed with spoil during backfilling, or applied to the reclamation surface during regrading. A combination of pit floor spreading and backfill blending appears to be the most effective. The most successful alkaline addition sites are those that have used substantial addition rates (500 tons per acre or more) or those with low cover overburden and very low concentrations of pyritic materials (Smith & Brady 1998). This practice requires a ready source of alkaline addition

materials--either on the mine site, or within an economical haulage distance. Because of the scale of MTM/VF mining operations, alkaline addition could represent a considerable expense for mining; and blending or isolation methods are preferred.

4. Abandoned Mine Lands

Abandoned mine lands (AMLs) are pre-SMCRA (i.e., mining occurred before 8/3/77) sites where mine operators were not necessarily required to conduct various backfilling, regrading, or revegetation techniques and where SMCRA reclamation bonds were not applied. These lands are widespread within the study area coalfields, visible as unreclaimed spoil piles, open highwalls, coal refuse piles, and abandoned mine facilities. AMLs can represent a considerable reclamation liability to the public, as pre-SMCRA mine operators are not normally under a legal obligation to reclaim them. AMLs are a primary source of AMD discharges, often representing physical hazards due to unreclaimed highwalls and unstable slopes, and are visually unattractive and are generally low productivity lands.

Under SMCRA, the OSM was authorized to oversee the implementation of and provide funding for state AML reclamation programs. Funding was established by a tax on mined coal, and AML funds are redistributed to the states based on their primacy status and the priority listing of their abandoned sites for reclamation. Kentucky, Virginia, and West Virginia administer their own AML programs, while Tennessee's AML Program is administered directly by OSM, although in cooperation with a State agency. Although these AML programs have been successful to date in remedying most "high" priority AMLs, many "low" priority sites still await funding for reclamation. The "high" priority sites are to correct safety hazards. Environmental remediation is not in the highest priority category; therefore, the ability for AML funds to correct environmental problems is extremely limited. Recent collaboration led by OSM with EPA, COE, and other agencies created the Appalachian Clean Streams Initiative (ACSI) that is addressing pre-SMCRA CMD problems through construction of passive treatment and other remedial approaches. While AML funding through ACSI has steadily increased, many mining program experts believe it will not be possible to effectively remediate aquatic resources damaged by past mining through the AML program.

5. Remining

A coal remining operation is defined by CWA Section 301(p) as "...a coal mining operation which begins after February 4, 1987 at a site on which coal mining was conducted before August 3, 1977," and a remined area is "...only that area of any coal remining operation on which coal mining was conducted before August 3, 1977." In essence, remining is new coal mining undertaken in areas of pre-SMCRA mining activities, including AMLs. The term is considered separate from new mining conducted on sites mined after August 3, 1977 because of certain water quality liability relief measures afforded by CWA Section 301(p) for potentially beneficial reclamation activities on pre-SMCRA sites.

Remining represents an avenue for achieving low- or no-cost reclamation of AMLs, with private mine operators affecting the reclamation as part of their normal mining operations on a site. Remining normally occurs where unmined coal reserves on pre-SMCRA sites have become economical to mine because of advances in equipment capabilities and mining methods. MTM/VF operations, for example, can completely recover high-cover (a large ratio of overburden to coal

volume) coal seams that could have only been economically and partially-mined from the outcrop by operations occurring decades ago. Remining operations generally must meet the same reclamation standards as other surface coal operations, and leave remined areas reclaimed to modern standards on completion. Exceptions from meeting the standards for water quality are relaxed where remining occurs in areas with pre-existing CMDs. Highwall elimination, topsoil salvage, and revegetative success standards also are adapted to remining situations.

a. Water Quality Benefits of Remining

Adverse water quality conditions on AMLs are often related to the mining technique that was employed on the sites. Pre-SMCRA surface mines often did not employ backfill regrading or special handling techniques for acid- and toxic-forming overburden, leaving spoil cast in loose, irregular piles and open mine pits where water could pool in contact with acidic pit floor materials. Pre-SMCRA underground mines also were not designed for AMD prevention and underground mine pools formed in flooding mines after abandonment, exposing to acidic materials in remaining coal to water and oxygen from open mine entries.

On surface mine sites, remining may ameliorate existing AMD conditions by regrading and revegetating the unreclaimed spoil surfaces to restore a more natural surface runoff pattern and limit the infiltration of atmospheric oxygen into the spoil. Backfilling and regrading of highwalls eliminates open pit floor pools and reduces the exposure of groundwater on the pit floor to oxygen following backfilling. Remining may extend to greater cover depths than historic operations and potentially liberate greater amounts of alkaline material, which tends to naturally weather out under low cover. Revegetation also reduces sediment runoff from sparsely vegetated or unvegetated spoil piles and pit floors. Hydrologic routing during mining and reclamation also controls the points at which infiltration and contact with CMD-forming spoil can occur.

On some sites, it is economical to mine former underground mine workings, depending on the depth of the seam and the quantity of the coal remaining. This process is known as *daylighting*, whereby some or all of an underground mine is excavated, and the void is backfilled with spoil once the coal has been recovered. This can be very beneficial to water quality, since groundwater pooling in mine voids is in contact with potentially acidic material remaining in the coal, roof, and floor materials. Ongoing collapse of mine voids tends to rejuvenate the exposure of pyritic materials over time, continuing the process of AMD formation for long periods. After surface mining and reclamation, no voids remain in the remined areas, and the pyritic material in the coal and mine roof is replaced with more homogeneous spoil, potentially with neutralizing alkaline material (if present in the overburden). Remining can also redirect groundwater movement patterns by eliminating preferential drainage paths along structural gradients in mine voids, potentially reducing the quantity of water draining to any remaining underground mine workings.

A study conducted in the Pennsylvania bituminous coalfields indicates that the majority of remining operations resulted in either no change or an improvement in water quality in terms of contaminant loading (Hawkins 1994). Loading is the mass of a contaminant carried by water, as opposed to its concentration, and is a better measure of the potential impact of a discharge on downstream water quality. Of 24 sites studied, 8 showed significant reductions in AMD contaminant loadings, as opposed to 4 that showed significant increases, with the remaining 12 sites showing no significant change in water quality. The study notes that significant increases in water quality were usually

associated with operations that daylighted substantial areas of abandoned underground mines. It is also suggested that water quality improvements may not be immediately apparent following remining due to the time necessary to equilibrate the site, and that several years of observation may be necessary to assess any long-term benefits.

b. Regulatory Aspects of Remining

One deterrent to remining by private mine operators is the presence of pre-existing AMD on previously mined sites. Under normal circumstances, the mine operator would assume responsibility for non-compliant discharges emanating from a permitted mine site. To promote remining reclamation, CWA Section 301(p) provides for federal or state mine permitting programs to allow special provisions concerning pre-existing discharges on remining sites. Briefly, applicable permitting programs may modify effluent limitations on a case-by-case basis for pH, iron, and manganese where pre-existing discharges will be affected by remining operations. Adjustments to effluent standards are made using best available technology and best professional judgement to set site-specific numeric effluent limitations. The permit applicant must demonstrate that the remining operation will result in potential water quality improvements. The applicant must also not allow pH levels to drop or iron and manganese levels to rise (above levels before remining) or exceed state water quality standards. The Interstate Mining Compact Commission (IMCC), a network of coal mining regulatory programs formed by the governors of numerous coal mining states) has a remining task force. Kentucky, Virginia, Tennessee, and West Virginia have active remining programs to promote remining. The Energy Policy Act of 1992 (modifying SMCRA) has remining provisions.

Kentucky

The Kentucky Department for Surface Mining Reclamation and Enforcement (DSMRE) strongly supports and has been encouraging remining activities for several years. Remining benefits both the people and the environment of Kentucky through reclamation of abandoned mine lands at little or no cost to the government. Kentucky Reclamation Advisory Memorandum 129 (RAM #129) discusses certain issues and procedural matters related to remining operations and implementation of the incentives. RAM #129 includes relevant definitions and explains eligibility, permitting, and bonding related to remining.

Permittees may enter into an agreement with DSMRE for reclamation of AML-eligible sites adjacent to coal mining permit areas. However, DSMRE is not obligated to enter into any Reclamation Agreement. Criteria, as listed in RAM #129, must be demonstrated for DSMRE to consider an AML Reclamation Agreement with a permittee.

RAM #129 criteria include:

- The proposed reclamation area must have been determined to be AML-eligible by the DSMRE's Division of Abandoned Mine Lands (DAML). The eligible reclamation site will be inventoried by the DAML and registered on the national Abandoned Mine Land Inventory System (AMLIS).
- The proposed area must be identified by the DAML as priority III, or greater, in accordance with KRS 350.555 and Section 403(a) of the Federal Surface Mining

Control and Reclamation Act of 1977.

- The proposed area must be causing off-site environmental impacts, but with little likelihood that the site could be addressed under the AML program in the foreseeable future.

Virginia

Virginia has an active Clean Water Act section 301 program. Virginia is actively working with the EPA in pursuing a regulation change to the Clean Water Act for the coal remining category for discharges from remining sites. Seventy percent to eighty percent of Virginia surface mining permits include at least some AML areas, according to a ongoing Virginia DMME study. Anecdotal information indicates that this percentage is on the increase, as very few first-cut surface mining operations are currently active in Virginia.

Virginia's experience documents the significant environmental benefits of remining on AML properties. Individual operations have eliminated eroding outslope areas, daylighted acid-producing AML deep mines to produce improvements in water quality, and backfilled dangerous highwall areas with excess spoil from active mines. One severe AMD/AML site, eligible for ACSI funds, has been substantially reclaimed via a remining operation and water quality has been improved dramatically–without expenditure of AML Trust Fund dollars.

Coal mine operators will not seek to permit most AML areas for fear of incurring liabilities that they will not be released from. These areas include barren and eroding outslopes, unstable highwalls, AMD seeps, open pits, and underground mine portal openings. To encourage remining of the AML areas, Virginia DMME has been providing incentives for AML reclamation by active mining operations. Several of the incentives are being formalized through rule changes proposals filed with OSM for program amendment approval. These program changes would result in increased AML reclamation via remining. For example, the “no-cost AML contract” allows active operators to backfill AML highwalls, cover acid-forming material, and to stabilize outslopes; improving environmental conditions and reducing or eliminating spoil placement in hollow fills.

The Virginia coal industry is on the decline. Coal production has fallen from 38 million tons in 1997 to 32 million tons in 1999. Without these mining operations, the opportunity to reclaim these AML sites would be lost. Once an operator mines through an area, the remaining coal reserves are depleted.

West Virginia

Remining operations are addressed by Module 13 of the WVDEP surface mine permit application. Applicants must provide an abatement plan discussing the alternatives considered, and detailing why the selected remining plan will result in water quality improvements. Applicants are required to collect consecutive bi-monthly samples for one year (24 samples minimum) from pre-existing discharges in areas to be affected by remining, and from upstream and downstream sample points on receiving streams for these discharges. Acidity, iron, and manganese effluent limitations are based on loading rather than concentration.

Daily maximum effluent limits are established for each discharge by using the third greatest concentration observed in the entire baseline monitoring data set for each parameter. Monthly average limitations are established separately for the summer/fall (May to October) and winter/spring (November to April) seasons. These are set as the average of the two median values from the data sets for each season. A trend line monitoring limit is established, setting a threshold limit, beyond which, revisions to the abatement plan may be necessary. This applies only to acidity. The trend line limit is set as the average daily loading of all baseline data for the pre-existing discharges contributing to a given watershed outlet.

A bond release limit is also established to determine the maximum annual loading that the remining area can contribute to receiving streams and still retain bond release. This is calculated as the cumulative annual average loadings for acidity, iron, and manganese. The averages are based upon baseline monitoring data on pre-existing discharges affected by the proposed remining operation.

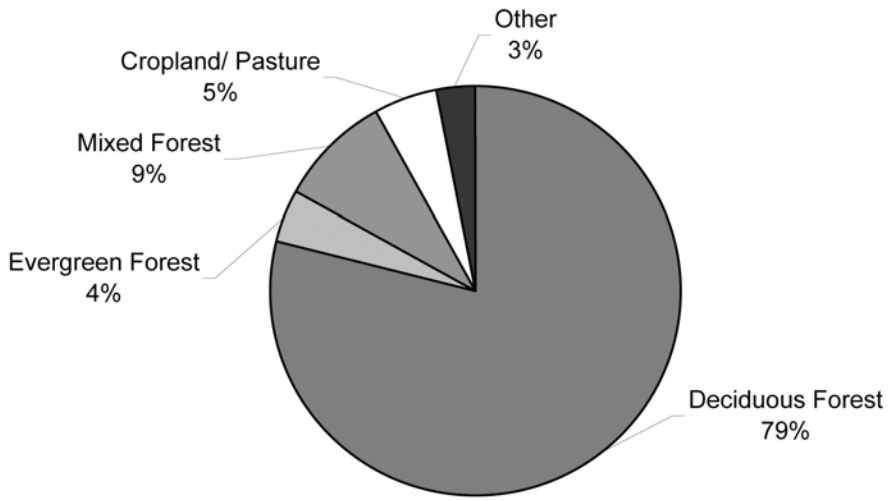
The final component of the West Virginia remining permitting process is establishment of in-stream water quality permitting conditions and in-stream water quality standards. The applicant provides minimum, average, and maximum values for pH, iron, and manganese for downstream baseline data on receiving streams. The applicant then provides in-stream water quality standards felt to be necessary to achieve bond release for the remining area, along with explanation of the methodology used to arrive at these standards. The desired standards are then used to apply for a water quality variance from the Environmental Quality Board.

Anecdotal information from the WVDEP indicates that few mine operators have opted for the remining designation to date. This is due to an earlier program that offered remining protection, but was later revoked, leaving some operators with unexpected liabilities.

F. APPALACHIAN FOREST COMMUNITIES

The study area contains many different terrestrial habitats resulting in a wide diversity of wildlife species including both game and nongame species. This diversity is due, in part, to the fact that the study area is geographically positioned between northern and southern vegetative communities, and that it has a complex and variable topography. The majority (92%) of the study area is forest land [Figure III.F-1 - Anderson Level Land Use/Cover in the Project Study Area].

Figure III.F-1 - Anderson Level Land Use/Cover in the Project Study Area



Characteristic vegetation types are found within each previously described ecological subregion section [Refer to Table III.A-1 - Ecological Subregion Section Characteristics]. The mixed mesophytic forest type is common throughout the project area. Mixed mesophytic forests are those found in habitats of intermediate moisture regime (between wet and dry). Likewise, oak dominated forest types are characteristic of each ecoregion and often co-occur with various pines. Pine dominated forest types are less common and are virtually absent from the study area. Other forest types common to these ecoregions, but not necessarily associated with the project study area, include the spruce-fir, northern evergreen, and floodplain communities (Straughsbaugh and Core, 1997; Martin et al., 1993).

Slope and aspect describe the angle and facing direction, respectively, of a mountainside. Slope and aspect have strong influences on soil moisture and thus, strong effects on vegetative communities. In the Appalachians, forest communities are distributed along both elevation and moisture gradients (Whittaker, 1956). Cove forests tend to dominate the steep-sided, mesic, (relatively moist) canyons while pine-heath communities dominate the more xeric (dry) ridges and peaks. Various oak forests dominate the flats and more open slopes that are intermediate between mesic and xeric conditions.

General forest types can be subdivided into more specific types. Ten different forest cover types are depicted in the West Virginia Gap Landcover for the West Virginia portion of the study area. Both the National Landcover forest cover types and the West Virginia Gap Landcover equivalents are presented in Table III.F.-1.

Table III.F-1.
Areas of Different Forest Cover Types
in the West Virginia Portion of the Study Area

National Landcover Dataset Forest Cover Type	Area (acres)	WV GAP Dataset Forest Cover Type	Area (acres)
Deciduous and Woody Wetlands	2,398,222	Diverse Mesophytic Hardwoods	1,852,790
		Cove Hardwoods	350,862
		Mountain Hardwoods	258,679
		Oak Dominant	193,833
		Floodplain	17,383
		Woodlands	5,716
		Total	**2,673,547**
Evergreen	52,910	Mountain Conifer	865
		Conifer Plantations	168
		Total	**1,033**
Mixed	252,520	Hardwood/Conifer	31,634
		Mountain Hardwood/Conifer	793
		Total	**32,427**
All Forest Cover Types	**2,703,652**	**All Forest Cover Types**	**2,712,723**
Total WV Study Area	**2,896,833**	**Total WV Study Area**	**3,007,623**

Note: The difference in total forest cover acres between the two data sets are a matter of scale.

The following text describes the forested communities of the study area. To avoid confusion with nomenclature related to author preference, we have listed the community types as presented by Martin et al. (1993) and placed in parentheses the forest community name used by the National Landcover Dataset and the West Virginia Gap Dataset.

1. Broadleaf Deciduous Forest Communities

a. Mixed Mesophytic Forests (Diverse Mesophytic Hardwood Forests)

Mixed mesophytic forests are found in moister habitats of north-facing slopes and in coves. The mixed mesophytic forest of the Appalachian coal fields supports one of the richest floral, breeding bird, mammal, and amphibian communities of any upland eastern U.S. forest type (Hinkle et al., 1989; cited in McComb et al., 1991); it has also been described as "the most biologically diverse ecosystem in the southeastern United States" (Hinkle et al., 1993). The diverse mesophytic forest is the dominant forest type in the study area, comprising slightly more than 68% of the forested portion of the study area in West Virginia.

Canopy species common to the mixed mesophytic forest type include American beech (*Fagus grandifolia*), yellow poplar (*Liriodendron tulipifera*), white basswood (*Tilia heterophylla*), various maples (*Acer* spp.), various oaks (*Quercus* spp.), as well as other species. The understory is usually diverse with more than 25 understory species known throughout the study area. Ferns and spring herbs are also abundant in the mixed mesophytic forest type. Among these are fragile fern (*Cystopteris fragilis*), jack-in-the-pulpit (*Arisaema triphyllum*), wild ginger (*Asarum canadens*e), and many others (Strausbaugh and Core, 1997).

Due to the abundance and variety of fruits, seeds, and nuts, mixed mesophytic forests provide excellent habitat for wildlife and game species alike. Also, an important forage source for migrant birds, especially in the spring, are invertebrates of the mesophytic forest (e.g., caterpillars, spiders, soil invertebrates). Species of birds typically present include the wood thrush (*Hylocichla mustelina*) and acadian flycatcher (*Empidonax virescens*). Additionally, many invertebrates are unique to the cove hardwoods habitat. For instance, the Diana fritillary butterfly, (*Speyeria diana*) is a denizen of the mixed mesophytic forests of southern West Virginia south to northern Georgia (Allen, 1997).

Under certain climatic and soil conditions, such as those found at the middle of north-facing slopes, eastern hemlock (*Tsuga canadensis*) or white pine (*Pinus strobus*) can become very prominent within the mixed mesophytic forest type. Although these trees provide cover for wildlife, their shade prevents the development of the understory vegetation that serves as food for game species. However, these tress do provide important habitat for various birds and small mammals. Blackburnian warblers (*Dendroica fusca*) and black-throated green warblers (*D. virens*) may inhabit areas that contain eastern hemlock and white pine.

Cove hardwoods, a subset of the mixed mesophytic forest type, are found in cool, moist valley bottoms and on lower slopes (Wilson et al., 1951, Hinkle et al., 1993). Because of their position on lower slopes, cove hardwoods form the upland forest border of the agricultural bottomlands that are scattered throughout the central section of the Appalachian Basin. The many layers of vegetation and the lush ground cover make the cove hardwoods an important habitat type for wildlife (USFWS, 1978). Cove hardwoods comprise approximately 13% of the forested lands in the West Virginia portion of the study area.

The dominant species in the cove hardwoods forest type are various maples, yellow poplar, and American beech; however, dominance is shared by a large number of species including, various oaks, hickories (*Carya* spp.), cherry (*Prunus* spp.), and black walnut (*Juglans nigra*), to name a few. This forest type is characterized by a diverse understory of trees that never attain canopy position such as, dogwoods (*Cornus* spp.), magnolias (*Magnolia* spp.), sourwood (*Oxydendrum arboreum*), striped maple (*Acer pennsylvanicus*), Paw-Paw (*Asimina triloba*) and redbud (*Cercis canadensis)*. Wildflowers are commonly found in this forest type because of the open canopy in the spring.

b. Appalachian Oak Woods (Oak Dominant Forests)

As the name implies, Appalachian oak woods are dominated by various species of oaks. The American chestnut (*Castanea dentata*) was co-dominant in this region until the chestnut blight of the early 1900's nearly extirpated this species. Most often Appalachian oak forests exist as mixed stands of assorted oaks and other species. Rarely is one species found in a pure stand; however, dominance of one species is often observed. For example, north-facing slopes at higher elevations are often dominated by red oaks (*Q. rubra*), likewise chestnut oak (*Q. prinus*) typically dominates at moderate elevations on dry slopes and ridgetops (Stephenson et al.,1993). Oak forests account for about 7% of the forested lands in the West Virginia portion of the study area.

At least 96 species of North American wildlife include the acorn in their diet (Stiling, 1996). Oak forests can support large populations of gray squirrels (*Sciurus carolinensis*) because of the availability of den trees and mast (nuts and fruits; Gill et al., 1975; WVDNR-Wildlife Resources, 1977). As many as 45 to 50 species of songbirds may breed in these forests because of the structural diversity of the vegetation (Samuel and Whitmore, 1979). Songbirds commonly present in this habitat include the red-eyed vireo (*Vireo olivaceus*), scarlet tanager (*Piranga olivacea*), red-bellied woodpecker (*Melanerpes carolinus*), downy woodpecker (*Picoides pubescens*), Carolina chickadee (*Parus carolinensis*), and many species of warblers (Allaire 1978; USFWS, 1978), all of whom forage on the invertebrates associated with this forest complex. Oak forests are considered to be prime habitat for wild turkey (*Meleagris gallopavo*) (WVDNR-Wildlife Resources, 1980a).

c. Northern Hardwoods (Mountain Hardwood Forests)

Northern hardwoods are restricted in the study area to cool, moist, north-facing upper slopes or ravines where cold air collects. They often intergrade with cove hardwoods on midslopes. The dominant species are American beech, sugar maple (*A. saccharum*), red maple (*A. rubrum*), and yellow birch (*Betula lutea*), with occasional stands of eastern hemlock or white pine (White et al., 1993). The canopy of this forest type is less open than that of the cove hardwoods type, and the lower layers are less developed. Witch hazel (*Hamamelis virginiana*), mountain laurel (*Kalmia latifolia*), rhododendron (*Rhododendron maximum*), spicebush (*Lindera benzoin*), hobblebush (*Vibernum alnifolium*), maple-leaf viburnum (*V. acerifolium*), deciduous holly (*Ilex* spp.), and elder (*Sambucus* spp.) are the typical shrubs in this community (Wilson et al., 1951). Approximately 9.5% of the forests in the West Virginia portion of the study area are the northern hardwood type.

Northern hardwoods are an important factor in the diversity of the fauna in the study area, because they support populations of plants and animals that are typical of the more northern forests. These include the golden-crowned kinglet (*Regulus setrapa*), Canada warbler (*Wilsonia canadensis*), red-breasted nuthatch (*Sitta canadensis*), northern water thrush [*Seiurus noveboracensis* (along shaded streams)], rock vole (*Microtus chrotorrhinus*), and long-tailed shrew (*Sorex dispar*) (Smith, 1974). American beech, sugar maple, and red maple may be used by wildlife as den trees (Wilson et al., 1951). Northern hardwood forests also contain the typical forest fauna assemblages of the region.

d. Floodplain Forests

Floodplain forests in the mountainous study area are generally restricted to narrow bands of vegetation along streams that have distinct woody and herbaceous components (Strausbaugh and Core, 1997). Characteristic woody species include, but are not limited to, black willow (*Salix nigra*), sycamore (*Platanus occidentalis*), ninebark (*Physocarpus opulifolius*), and box-elder (*A. negundo*). The herbaceous community often contains a mixture of climbing plants and erect herbs like greenbrier (*Smilax* spp.) and peppermint (*Mentha* spp.) to name a few. In the valleys, floodplains may be much broader but often times these areas have previously been converted to agricultural land use because of the fertility of the soils.

Floodplain forests have a great diversity of plant and animal species because of their association with water and because they serve as migration corridors. Some of the many species of wildlife that inhabit floodplain forests include waterfowl, songbirds, and a variety of reptiles and mammals. The moist soils associated with floodplain forests provide habitat for amphibians, particularly salamanders. Pools within the forest may provide habitat for amphibians, reptiles and invertebrates.

2. Other Forest Communities

a. Oak-Pine Forests (Hardwood/Conifer Forests and Mountain Hardwood/Conifer Forests)

Oak-Pine forests are located on south-facing slopes where the moisture level is between that of dry white oak woods and very dry pine woods. Characteristic of this forest type is a mix of oaks, pine, and often reduced numbers of hickories (Monk et al., 1990). Virginia pine (*P. virginiana*) and assorted oaks are the dominant canopy species (Bones, 1978); however, short-leaf pine (*P. echinata*) and loblolly pine (*P. taeda*) can reach abundant proportions in some areas (Skeen et al., 1993). Blueberry (*Vaccinium* spp.), huckleberry (*Galussacia* spp.), wild rose (*Rosa* spp.), hawthorn (*Crataegus* spp.), wild grape (*Vitis* spp.), and greenbrier (*Smilax* spp.) are the common woody shrubs. The herbaceous ground cover is sparse. The mixture of evergreen and deciduous trees makes this forest type particularly suitable for white-tailed deer (Gill et al., 1975), especially when this type of habitat is interspersed with pasture or silvicultural clear-cuts (Wilson et al., 1951, Skeen et al., 1993). This forest type is rare in the study area accounting for slightly more than 1% of the forested land in the West Virginia portion of the study area.

Because of their dependence on conifers for food and cover, the long-eared owl (*Asio otus*), pine warbler (*D. pinus*), black-burnian warbler, and red squirrel (*Tamiascurius hudsonicus*) inhabit the mixed oak-pine woods. Other birds commonly present include the great-crested flycatcher (*Myiarchus crinitus*) and the black-throated green warbler. Wild boar (*Sus scrofa*) forage for mast in this habitat during autumn and winter (WVDNR-Wildlife Resources 1977). Furthermore, this forest type harbors a diverse fauna of small mammals due to the abundance and variety of seeds, fruits, and nuts.

b. Pine Forests (Mountain Conifer Forests)

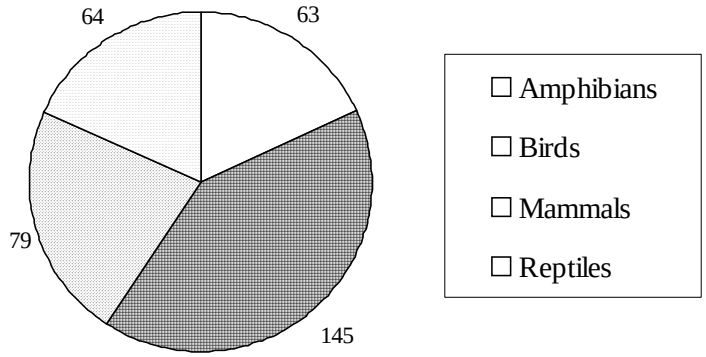
Virginia pine is the dominant species in old field habitats. Pitch pine (*P. rigida*) can become locally abundant on upper slopes with poor soils and is most often found mixed with hardwoods. Several other species of yellow pine, the short-leaf pine and loblolly pine, are of secondary importance, are essentially non-existent in the coalfields, and seldom reach dominance status outside of the Southwestern Appalachians Ecoregion. The pine forest type is often interspersed in the same part of the study area as the oak-pine forest type. The undergrowth vegetation is relatively sparse. Blueberry, mountain laurel, and dewberry (*Rubus permixtus*) are the most common species of shrubs (Wilson et al., 1951). Less than 1% of the West Virginia portion of the study area forest land is of pine forest.

The value of this habitat to most wildlife is low because of the limited availability and variety of food plants. Unless the dry pine community is interspersed with other types of habitat, it provides little more than cover (USFWS, 1978). These dry conifer stands essentially are inhabited sparsely by the same species of wildlife as those mentioned previously for the oak-pine forest type.

3. Animal Communities

Echternacht and Harris (1993) have compiled a detailed treatise on the fauna and wildlife of the southeastern United States, including the region of interest of this EIS [Figure III.F-2 - Number of Species of Terrestrial Vertebrates from the Appalachian Plateau Province]. Endemism, the localized geographic distribution of a species, is high in the region. Fourteen of the 351 vertebrate species, nine of which are amphibians, are endemic to the Appalachian Plateau Province. That is, as many as 14 vertebrate species may be found in the study area that are not found anywhere else in the world.

Figure III.F-2.
Number of Species of Terrestrial Vertebrates from the Appalachian Plateau Province



Adapted from Echternacht and Harris (1993)

The physiography of the study area allows for both northern and southern faunal components and the complex variation in local environment allows for habitat specialists. Mammal species representative of boreal (northern), temperate (warm in summer, cold in winter, moderate in spring or fall), and tropical climates are found in the Appalachian Plateau Province (Barbour and Davis, 1974).

a. Birds

Birds are amazingly diverse in the study area, due largely to the mosaic of microenvironments associated with the Appalachian Plateau Province. At least 38 families of birds can be found throughout the region. Species of birds with the greatest breeding distribution across the study area are those of forest or edge habitats and many are year round residents. Portions of the study area contain critical breeding habitat for some species of Neotropical migratory birds (Buckelew and Hall, 1994). Some of the highest concentrations of Neotropical migrant bird species like the scarlet tanager (*Piranga olivacea*), worm-eating warbler (*Helmitheros vermivorus*), Louisiana waterthrush (*Seiurus motacilla*), and wood thrush (*Hylocichla mustelina*) occur in West Virginia (Rosenberg and Wells, 2002). The mixed mesophytic forests are reported to support the richest avifauna in Kentucky (Mengel, 1965, cited in Hinkle et al., 1993) and one of the richest avifauna's in the eastern United States (Hinkle et al., 1993).

Mountaintop mining in the past has converted forest land to grasslands and in some instances shrub habitats in southern West Virginia. This change in available habitat has resulted in a shift in the distribution of birds throughout southern West Virginia with an increase in the abundance of edge and grassland bird species at reclaimed mountaintop mining sites (Wood and Edwards, 2001; Canterbury, 2001). This shift is likely apparent at mountaintop mining sites throughout the study area of this project but data supporting this claim are lacking. Many of the grassland and edge bird species now utilizing reclaimed mountaintop mining sites were once absent or rare in southern West Virginia because historically this habitat type did not occur in southern West Virginia (DeSalm and Murdock, 1993).

Eighty-four of 92 "probable" or "confirmed" breeding birds, based on data presented by Buckelew and Hall (1994) in the *West Virginia Breeding Bird Atlas*, were confirmed at mountaintop mining sites in southern West Virginia in 1999 and 2000 (Wood and Edwards, 2001)[see Appendix E for details]. The eight species not identified by Wood and Edwards (2001) are not associated with habitats associated with mountaintop mining sites (residential, urban habitats).

Species richness and abundance of songbirds is higher in shrub/pole habitats of mountaintop mining sites than in grassland, fragmented forest, and intact forest habitats (Wood and Edwards, 2001; Canterbury, 2001). The abundance of forest interior birds is significantly lower in fragmented forests near mountaintop mining sites than from intact forests near mountaintop mining sites suggesting that this bird guild is negatively influenced by mountaintop mining (Wood and Edwards, 2001). Species richness and abundance is lower on reclaimed grasslands than shrub/pole, fragmented forest, and intact forest habitats (Wood and Edwards, 2001). In general, species richness and abundance are expected to be greatest from diverse habitats, like the shrub/pole communities and lowest in the least diverse habitats, like grasslands. Studies conducted on reclaimed mountaintop mining sites in southern West Virginia support this assumption (Wood and Edwards, 2001).

Mountaintop mining sites are known to support at least ten grassland and shrub bird species not previously listed in the WV BBA (Wood and Edwards, 2001). Grassland birds are declining throughout much of the United States (Knopf, 1994). Three grassland bird species listed as "rare" in West Virginia (West Virginia Wildlife and Natural Heritage Program, 2000) are known to occupy mountaintop mining sites in southern West Virginia (Wood and Edwards, 2001). It is possible that some of the grassland bird populations on mountaintop mining sites reclaimed with herbaceous cover are existing as "sinks". "Sink" populations are maintained by immigration because death rates exceed birth rates (Pulliam, 1988). The core breeding ranges of the ten grassland birds identified on reclaimed mountaintop mining sites are in the grasslands of the Midwest. However, data suggest that the large reclaimed grassland habitats available on the mountaintop removal/valley fill mine complexes surveyed in southern West Virginia are sufficient to support breeding populations of grasshopper sparrows with nest success rates similar to populations found in other grassland habitats. Important nesting habitat characteristics included patches of dense grassland vegetation interspersed with patches of bare ground. These habitat conditions support high densities of breeding grasshopper sparrows, even on newly reclaimed sites. As ground cover develops, however, sites will become unsuitable for grasshopper sparrows unless habitats are managed to maintain the required conditions.

Some argue that mountaintop mining has the potential to negatively impact many forest songbirds, in particular neotropical migrants, through direct loss and fragmentation of mature forest habitats. Forest-interior species like the Acadian flycatcher, American redstart, hooded warbler, ovenbird, and scarlet tanager have significantly higher populations (at least one year of the two-year study) in intact forests than fragmented forests (Wood and Edwards, 2001). Furthermore, cerulean warblers, Acadian flycatchers, and wood thrush are more likely to be found in a forested area as distance from the mine increases (Wood and Edwards, 2001). These data suggest that forest-interior bird species are negatively impacted by mountaintop mining through direct loss of forest habitat and fragmentation of the terrestrial environment.

Of the 84 bird species identified on reclaimed mountaintop mining sites in southern West Virginia in 1999 and 2000, 13 species were raptors (Wood and Edwards, 2001). Of the six species typically associated with forested habitats, the red-shouldered hawk was the most common. Red-shouldered hawks were more abundant in intact forest than in fragmented forests. Of the seven species typically associated with more open habitats, the American kestrel, northern harrier, red-tailed hawk, and turkey vulture were commonly observed as expected. Rough-legged hawks and short-eared owls were observed in low numbers in the grassland habitats. They are more northern species that use large areas of open habitat and are rarely seen in West Virginia. A pair of adult peregrine falcons was observed throughout the summer on one mine in grasslands surrounding a highwall. The falcons often used the highwall for perching, but there was no evidence of breeding.

b. Mammals

There are 18 families of mammals in the project study area and mammalian diversity is greatly influenced by the presence of species from both northern and southern forest components. The variable landscape of the study area and drastic changes in elevation allow for a complex variation in the local environment over short distances. Many mammals take advantage of this complex environment and are found specializing within the project area (Wilson and Ruff, 1999). For example, the masked shrew (*Sorex cinereus*) is a common inhabitant of the coniferous and northern

deciduous forest biome, but the peak of its southern range extends into the project area where it thrives in moist, cool forests (Merritt, 1987) like the cove hardwoods.

Small mammal species richness does not differ between grassland, shrub/pole, fragmented forest, and intact forest habitats from mountaintop mine sites in southern West Virginia (Wood and Edwards, 2001) [see Appendix E for details]. Small mammal species abundance tends to be greater in grassland and shrub/pole habitats than in fragmented and intact forest habitats (Wood and Edwards, 2001). Rip-rap filled drainage ditches on reclaimed mine sites provide habitat for the Allegheny woodrat (*Neotoma floridana*) (Wood and Edwards, 2001), which is listed as threatened, endangered, or a species of special concern by the states of Indiana, Maryland, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Virginia, and West Virginia. No studies are available that address the possible impact that mountaintop mining has on bats and larger mammals. There is, however, anecdotal evidence that mining has had a positive impact on white-tailed deer (*Odocoileus virginianus*) populations in the study area.

c. Herpetofauna

Five families of lizards and skinks, four families of turtles, and two families of snakes make-up the reptile assemblage of the study area. Four species of reptiles are endemic to the Appalachian Plateau Province of the study area (Echternacht and Harris, 1993). Endemism may be greater along the plateau because climatic conditions are more stable than the other ecoregions of the study area (Green and Pauley, 1987). Among the amphibians of the study area are five families of frogs and toads, and five families of salamanders. The southern Appalachians have one of the richest salamander faunas in the world (Petranka 1998, Stein et al 2000). Petranka (1993) presented a conservative estimate that there are about 10,000 salamanders per hectare of mature forest floor in Eastern forests.

Over a two-year study (2000 and 2001) of mountaintop mining sites in southern West Virginia, 1750 individuals were captured or observed using drift fence arrays, stream searches, and incidental sightings (Wood and Edwards, 2002). Of a possible 58 species expected to occur in the study area, 41 were encountered. The 41 species included 12 salamander species, 10 toad and frog species, 3 lizard species, 13 snake species, and 3 turtle species.

Amphibian and reptile species richness and abundance does not differ between grassland, shrub/pole, fragmented forest, and intact forest habitats from mountaintop mine sites in southern West Virginia (Wood and Edwards, 2001)[see Appendix E for details]. Salamanders appear to be less common in the grasslands of reclaimed mountaintop mining sites than in the nearby forests (Wood and Edwards, 2001). Herpetofaunal species, like salamanders, that require loose soil with ample ground cover, are generally absent from reclaimed mountaintop mining sites (Wood and Edwards, 2001). Salamanders are an important ecological component in Eastern forests (Burton and Lykens, 1975; Hairston, 1987) and salamander populations appear to recover slowly following forest clearing and disturbance (Bennett et al., 1980; Pough et al, 1987; Ash, 1988; Petranka et al., 1999). Mountaintop mining results in greater soil disturbance than forest clearing so a longer time may be required for recovery of salamander populations from mountaintop mined sites.

4. Interior Forest Habitat and Area Sensitive Species

A variety of wildlife species require large tracts (hundreds to thousands of acres) of continuous forest cover. Interior forest habitats are relatively rare and easily lost. Disturbance regimes, like agriculture, mining, and suburban sprawl, decrease interior forest habitat while increasing forest edge habitat, thus affecting the composition and distribution of wildlife within the region. For example, much of the avifauna (birds) of the study area depends on large areas of interior forest habitat for their survival (Robbins, 1980; Askins, 1993; Buckelew and Hall, 1994; Patton, 1994; Robbins et al., 1989). For example, the black-and-white warbler (*Mniotilta varia*) is an area-sensitive species usually not found in forest tracts less than 200 hectares (about 500 acres). Similarly, the worm-eating warbler (*Helmitheros vermivorus*) seems to require forest tracts of at least 150 hectares (370 acres). While other bird species, like the ovenbird (*Seirus aurocapillus*) and the Kentucky warbler (*Oporornis formosus*), are indirectly dependent on large tracts of interior forest because of their extreme susceptibility to brown-headed cowbird (*Molothrus ater*) parasitism in forest edge habitats.

Brown-headed cowbirds are found in very low abundance at reclaimed mountaintop mining sites in southern West Virginia; subsequently, nest parasitism is not likely a significant cause of nest loss in the study area (Wood and Edwards, 2001). Whether or not mountaintop mining has a negative effect on the breeding success of forest interior bird species through direct loss of interior forest habitat remains in question. Studies conducted at reclaimed mountaintop mining sites in southern West Virginia have yielded forest interior bird species in shrub/pole and fragmented forest habitats as well as intact forest habitats (Wood and Edwards, 2001; Canterbury, 2001). However, the abundance of forest interior bird species was significantly lower in fragmented forests than intact forest, suggesting a detrimental impact (Wood and Edwards, 2001). Canterbury (2001) suggests that studies of nesting success are needed to determine if mountaintop mining is having a negative impact on forest interior bird populations. Intuitively, it makes sense that the loss of interior forest habitat would be detrimental to wildlife populations dependent upon such habitat.

Not all large forest tracts contain interior forest habitats [Figure III.F-3 - Relationship Between Patch Shape/Size and Interior Forest Habitat]. A long, narrow forest patch may be comprised entirely of edge species. Thus, when considering the needs of area sensitive species the shape of the forest tract must be considered.

Figure III.F-3.
Relationship Between Patch Shape/Size and Interior Forest Habitat

Assume both patches are of equal area. The patch on the left contains interior forest habitat (solid shade) while the patch on the right is entirely edge habitat (dot shade).

5. Deforestation

DEFORESTATION AFFECTS WILDLIFE BY DIRECTLY REMOVING AVAILABLE HABITAT FOR SOME SPECIES WHILE OPENING THE FOREST AND PRODUCING HABITAT FOR OTHER SPECIES. FURTHERMORE, INDIRECT AFFECTS OF DEFORESTATION MAY INCLUDE INCREASED SOIL EROSION, LEADING TO SILTATION OF AQUATIC HABITATS, EUTROPHICATION OF AQUATIC HABITATS BY ACCELERATED NUTRIENT RELEASE, THE CONVERSION OF FOREST HABITATS TO RANGELANDS OR SUCCESSIONAL FIELDS, AND A CHANGE IN THE REGION'S CONTRIBUTION TO GLOBAL PRIMARY PRODUCTION (STILING, 1996).

Energy accumulated by plants is referred to as primary production. The energy remaining after plant respiration and stored as organic matter is net primary production. Globally, temperate forests produce approximately 13% of the worlds net primary production per year (Whittaker, 1975). Temperate forests also provide habitat for a large proportion of the study area's wildlife. The Land Use Assessment study concludes that approximately 5% of the West Virginia mountaintop mining study area contained evidence of having been disturbed by past or current mining [Appendix G]. Deforestation results in both habitat loss and fragmentation of the terrestrial environment.

Habitat loss is generally understood to be the single most important cause of wildlife population declines and a threat to present-day wildlife populations (Illinois Wildlife Habitat Commission, 1985). It follows that the deforestation of large portions of the Appalachians through mountaintop mining is a significant concern from the standpoint of forest-dwelling wildlife, in particular, forest interior species. On the other hand, the loss of forested habitats is equaled by a gain in other habitat types, like grasslands.

There is disagreement about what these changes in the terrestrial environment mean. Many point out that reclamation efforts have created habitat, like grasslands, edge habitat, and scattered ponds, that are important for game species such as wild turkey, bobwhite quail (*Colinus virginianus*), ruffed grouse (*Bonasa umbellus*), and white-tailed deer. Many grassland and shrub bird species, previously unrecorded as having breeding populations in southern West Virginia, are known to breed on reclaimed MTM/VF sites (Wood and Edwards, 2001). Among these grassland songbirds is the grasshopper sparrow (*Ammodramus savannarum*), which is listed as "rare" by the West Virginia Wildlife and Natural Heritage Program (2000) but is found to be abundant and breeding successfully on Mountaintop mining sites (Wood and Edwards, 2001). Two other "rare" species in West Virginia (West Virginia Wildlife and Natural Heritage Program 2000), the bobolink (*Dolichonyx oryzivorus*) and Henslow's sparrow (*A. henslowii*), were present at some mountaintop mining sites but not confirmed as breeding (Wood and Edwards, 2001). Furthermore, with the exception of a few rare species, the densities of songbirds on grassland and shrub/pole mountaintop mining sites was similar to that reported in other studies indicating that the quality of habitat and availability of resources is similar to other sites (Wood and Edwards, 2001). It should be noted that the presence of rare, threatened, and endangered species in these reclaimed habitats is more likely a result of the habitat being rare in the study region than the species being rare. That is, many of the rare species encountered at mountaintop mining sites are common or abundant in other parts of the United States where their required habitat is more abundant.

The above findings provide evidence that mountaintop mining practices provide favorable conditions for some species. However, these advantages may not surpass the disadvantages these practices have on the sustainability of plants and wildlife in the region.

Historically, vegetative communities of the Appalachians have undergone much change beginning with the replacement of pine and spruce forests by oaks, due to climatic warming about 10,000 years ago (Abrams, 1992). Humans began to alter the Appalachian vegetative communities about 1,000 to 3,000 years ago, increasing the extent of oak-chestnut forests, due to use of fire (Delcourt and Delcourt, 1998). More recently in the 1800's, logging, increased fire, clearing of forests for settlement, and the loss of the American chestnut (*Castanea dentata*) to chestnut blight fungus have led to massive changes in the vegetative communities of the Appalachians (Nowacki and Abrams, 1991). Possibly, the greatest impact to Appalachian vegetative communities was exerted by the logging industry. Clearing of forests leads to soil erosion, drying of understory, increased fires, and the depletion of soil nutrients. Logging has decreased dramatically in the study region since the 1940's, and coupling this with the abandonment of old farms has led to an increase in forest area for the region over the past 50 years (Barrett, 1995). Approximately 244,000 acres in the West Virginia portion of the study area have been disturbed by past or current mining (Yuill, 2001).

Mountaintop mining operations in the Appalachian coal fields involve fundamental changes to the region's landscape and terrestrial wildlife habitats. Prior to 1998 (the start of this EIS) with the increasing size of these operations, a single permit involved changing thousands of acres of hardwood forests into herbaceous cover. This is true even for the short-term when forest is post-mining land use. While the original forested habitat was crossed by flowing streams and was comprised of steep slopes with microhabitats determined by slope, aspect, and moisture regimes, the reclaimed mines are often limited in topographic relief, devoid of flowing water, and most commonly dominated by erosion-controlling, herbaceous communities. Islands of remnant hardwood vegetation may be present on some of the reclaimed mines, and some planting of trees and shrubs may have been undertaken.

Handel (2001) studied 55 mountaintop mining sites in southern West Virginia that were reclaimed with herbaceous vegetation and ranged in age from 6 to 24 years. Handel (2001) determined that trees and shrubs are extremely low in abundance and number on mine sites compared to surrounding forests. Reclaimed sites where trees and shrubs were invading tended to be dominated by two or three species whereas the surrounding forests were very species rich. The invasion rate of native trees and shrubs onto mined sites is most likely restricted by excessive soil compaction, large mining area, poor soil quality, and the application of grassy mixes for erosion control. Furthermore, Handel (2001) found that there were 17 fewer forest herb species on plots adjacent to mountaintop mining sites than in interior forests. This effect extended from the edge of the reclamation area 50 m into the forest.

a. Forest Fragmentation

The phrase “forest fragmentation” describes a formerly continuous forest that has been broken into smaller pieces (Jones, 1997). The disruption of continuous forest habitats into isolated and small patches may have two negative affects on biota dependent upon forest habitat: decreased area and increased isolation of the remaining patches (Meffe and Carroll, 1994). However, disruption also provides habitat for those species that thrive within the ecotone of forest and open habitat.

Fragmentation leads to a decrease in the abundance of many species of songbirds in the study area (Wood and Edwards, 2001). Wood and Edwards (2001) list ten species of forest-dwelling songbirds that are negatively impacted by forest fragmentation. Since native trees and shrubs have a slow invasion rate on mined sites (Handel, 2001) we can assume that the invasion rate of area sensitive forest-dwelling songbirds will be even slower. Similarly, we can assume that the invasion of rate of forest-floor dwelling salamanders will be slow on post-mined sites. Wood and Edwards (2001) found that taxa dominance shifted from salamanders to snakes when intact forests were converted to grasslands through reclamation of mountaintop mining sites. Populations of many eastern forest amphibian species are largely dependent upon coarse woody debris, litter moisture and depth, density of understory stems, and canopy cover (deMaynadier and Hunter, 1995). These are traits absent on most post-mining sites and traits that appear to be slow to return to reclaimed mountaintop mining sites.

b. Forest Edge Habitat, Edge Effect

Edge habitat occurs at boundaries between different types of land cover. Certain species require resources in two or more vegetation types and thus require edge habitat. The outer boundary of a habitat patch is a zone that varies in width depending on the variable being measured. For example, edge zones are usually drier and receive more sunlight than interior forests, and thus have a different floral composition, which favors shade-intolerant species. Climatic edge effects, such as this, may have a negative effect on interior species of the patch through altering of the physical environment and increasing competition for resources. On the other hand, due to the different microclimate associated with the edge ecotone; these habitats are often more diverse than the interior habitat and contain unique wildlife assemblages (Yahner, 1988).

Edge effect is used to describe the negative influence, like the microclimatic differences described above, that edges have on the interior of a habitat and on the species that use the interior habitat. However, edge effect can be used to describe the increase in edge species richness often observed at the ecotone of forest edges.

Many species of wildlife are attracted to “edges,” or areas where two or more different habitat types come together. This fact has been the basis for traditional wildlife management schemes (including those recommended by State resource agencies for mine reclamation), which seek to promote edges to maximize “biodiversity.” However, as explained by Heckert et al. (1993), promoting edges at the expense of large habitat blocks can lead to *lower* wildlife diversity:

> Wildlife diversity can be viewed on two different levels. On one level, diversity can be viewed as the number of species that occur on a single tract of land, such as private landholdings, single fields, or woodlots. On the other level, diversity can be viewed as the number of species that occur within a larger geographic area such as large conservation areas, counties, and watersheds.
>
> Land management focused entirely on providing abundant edge has come under recent criticism because it can exclude species that require large uniform habitat blocks or do not survive near edges. If most parcels are managed to increase edge, only those species tolerant of edges will prosper. Species needing uniform habitat blocks away from edges can be eliminated. The result of such management will be

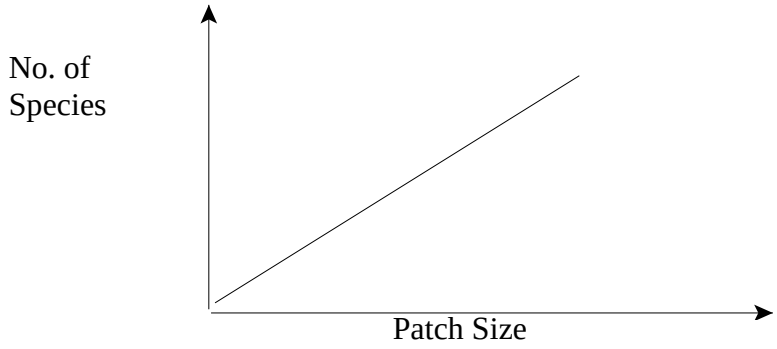
> lower wildlife diversity within large geographic regions because area-sensitive species will be lost. Conversely, the maintenance of large habitat blocks for area-sensitive species will not result in the loss of edge species as some edges will always be present in the landscape... If land use patterns and management continue to favor edge species, continued population declines and possibly local or regional extinctions of area-sensitive species are likely to occur.

Edge habitat on reclaimed mountaintop mining sites in southern West Virginia is utilized by bird species of different guilds depending upon the habitats creating the edge. For example, edge composed of grassland and fragmented forest tend to be dominated by birds of the grasslands bird guild while edge composed of forest and shrublands tend to be dominated by birds of the forest-interior and edge guilds (Canterbury, 2001).

c. Patch Size

Patch size refers to the area of a particular habitat or reserve within a landscape. The basic species-area relationship implies that larger patches capture a greater number of species of a region than do smaller patches [Figure III.F-4 - Relationship Between Species Richness and Patch or Island Area]. This is due, in part, to an increase in habitat heterogeneity as the patch size gets larger. Larger patches are also more likely to be able to accommodate disturbances than smaller patches. As patch size decreases, forest edge-to-volume ratios increase, thereby increasing edge effects and reducing the amount of true interior habitat.

Figure III.F-4.
Relationship Between Species Richness and Patch or Island Area



Adapted from MacArthur and Wilson (1963)
Adapted from MacArthur and Wilson (1967)

Another aspect of patch size is isolation. Small, isolated patches are more prone to local species extinctions than large patches and small groups of closely spaced patches, because they are less likely to be colonized. Therefore, when circumstances require or result in the creation of small patches, it is important to space them close together or to provide some form of connectivity between the patches.

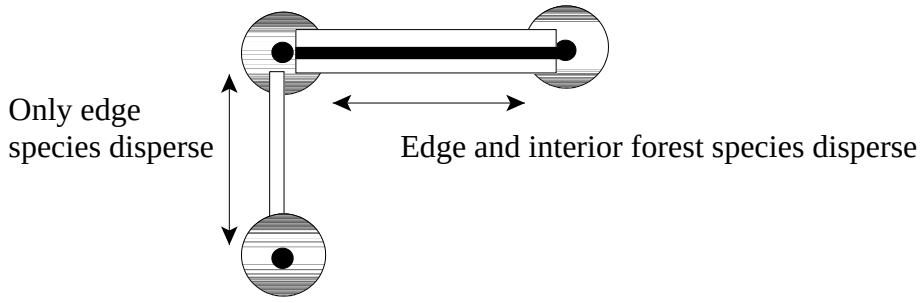
Many species require large patch sizes for their survival. For example, the cerulean warbler is a common bird of mixed mesophytic and Appalachian oak forests in West Virginia. This migratory species commonly occupies the heavily-leafed canopy of mature forests during summer months and is rarely seen. Studies suggest that a minimum area of 700 hectares (1,730 acres) is required for sustaining a viable population of this species (Buckelew and Hall, 1994). Reduction of forest patch size and the fragmation of habitats may greatly affect the distribution and abundance of the cerulean warbler. Conversely, smaller patch sizes are favored by many species, including many game species that depend upon food sources, nesting sites, and ground cover associated with small forest patches.

d. Corridors

As habitats become fragmented into small patches, there is a change in distribution and abundance of species, due to such factors discussed above as isolation and decreased interior habitat. An intuitive solution to this problem is the reconnection of these fragmented habitats through habitat corridors. Corridors allow for species movements, and thus, recolonization among isolated habitats.

Simple corridors, called line corridors, consist entirely of edge habitat and allow for the movements of edge species [Figure III.F-5 - Corridors Connect Patches in a Fragmented Environment]. In contrast, strip corridors contain some interior habitat that is required for the movements of many large animals, in particular, predatory mammals and forest interior species. Patches that are farther apart may require broader corridors in order to be effective (Harrison, 1992). Whereas, line corridors may suffice for closely spaced patches.

Figure III.F-5.
Corridors Connect Patches in a Fragmented Environment



Corridor width can act as a filter by selecting for the dispersal of some species while limiting the dispersal of other species.

Despite the obvious advantages of corridors, disadvantages do exist. For some species, like small mammals, predation may increase in corridors because of the reduction in interior habitat and cover. Furthermore, species may be pulled into a sink corridor where rates of survival and extinction differ from their source habitat (Soule, 1991). Another disadvantage of corridors is that they may provide access for unwanted species, such as, invasive exotics to invade once unoccupied areas.

Public concerns voiced before the conception of this EIS included fears that mountaintop mining may contribute to the spread of exotic and invasive species. One concern was that roads and fragmentation of the environment associated with mountaintop mining may act as line corridors aiding in the spread of exotic and invasive species. There is no evidence that mountaintop mining has contributed to the spread of invasive and exotic species in southern West Virginia (Handel, 2001).

6. Carbon Sequestration

The energy flow in terrestrial ecosystems depends on interactions between a number of biogeochemical cycles such as the carbon cycle and hydrological cycles. Terrestrial ecosystems play a role in the global carbon cycle. Carbon is exchanged between trees and the atmosphere through photosynthesis and respiration. The cycling of carbon as carbon dioxide involves assimilation and respiration by plants.

According to the World Resource Institute (1997), drawing carbon dioxide out of the atmosphere (sequestration) and into biomass is the only known practical way to remove large volumes of this greenhouse gas from the atmosphere. Reforestation could potentially achieve significant carbon sequestration. It has been estimated that temperate forests sequester 0.6 to 1.8 tons of carbon per acre per year as reported by the Intergovernmental Panel on Climate Change (2001).

G. RELATIONSHIPS OF MOUNTAINTOP MINING TO SURFACE RUNOFF QUANTITY AND FLOODING

The central Appalachian physiographic region is a highly dissected plateau characterized by high, tree-covered hills and deep, narrow valleys. Large watersheds often feed streams with narrow valleys and small flood plains. In such rugged terrain, people live near or adjacent to the streams and rivers, and they may consequently be flooded during large rainfall events.

MTM/VF mining causes alterations in the topography and drainage patterns in the mined areas. There are also changes in vegetation and ground cover that are associated with this type of mining. The combination of these alterations can impact the amount of runoff from the mined area for a given storm event. That impact and possible cumulative effects from similar or multiple projects has been raised as a concern for analysis in these watersheds.

As part of the background assessment of the effects of mountaintop mining on the environment, a number of studies were undertaken to evaluate whether MTM/VF operations resulted in an increased risk of flooding to downstream communities. The following summarizes the findings of these studies, along with an introductory background on the existing regulatory framework with respect to control of surface mine runoff and flooding risks.

1. Regulatory Background

Surface water impacts from surface mining were recognized during the development and implementation of SMCRA. These potential impacts were discussed in the Final Environmental Statement OSM-EIS-1 for SMCRA. The discussion noted that surface mining can have significant effects on surface hydrology. Removal of vegetation, new drainage patterns, storage of water on benches or in ponds, drainage of surface water into underground mines and alternate ground cover change the runoff characteristics. These changes in runoff may cause scouring and erosion of unprotected stream channels and can contribute to downstream flooding. Small tributaries with a high percentage of recently disturbed land may have somewhat higher flood levels as a result of the surface mining. Increased flooding might be attributed to inadequate reclamation or inadequate drainage control structures. However, there are also reports that document surface mining effects with a lower flood rate than a similar unmined watershed (Davis, 1967; Collier and others, 1970; Curtis, 1972, Curtis, 1977). Open pits at mines sites can provide significant runoff retention. Drainage control structures can also provide retention, plus longer travel times for overland flow. The increased infiltration provided by backfills can also retard or lessen peak flows.

Surface mining may cause isolated flooding events related to failure of erosion and sedimentation control structures. In a recent incident, a mine sediment ditch in Mingo County, West Virginia, ruptured during a rainfall event and damaged downhill properties, including fences, a bridge, and a vehicle (Associated Press, 2000). Storm water control structures on surface mine sites are designed to accommodate a given storm frequency event, a statistical abstraction of the largest storm event that can be expected to occur within a given time period. In reality, there is no reason that a larger storm could not occur within that time period, only that it is less likely, so a probability always exists that storm water control facilities on mining sites or in any other application can be

overwhelmed and fail. Mechanical failure due to improper construction is also a possible source of isolated flooding incidents.

SMCRA and USOSM regulations require that flooding potential be addressed in the design requirements of coal mine permits and the consideration of offsite impacts to the hydrologic balance. Water diversions are required to be designed and constructed to provide protection against flooding and resultant damage to life and property (30 CFR 816.43(a)(2(ii)). USOSM regulations also require the operator to make a "Probable Hydrologic Consequences Determination"(PHC) as part of the permit application (30 CFR 780.21(f)). The PHC is required to specifically address flooding and stream flow alterations as part of this determination. USOSM regulations further require the regulatory authority to provide a "Cumulative Hydrologic Impact Assessment"(CHIA) as part of the permit approval process (30 CFR 780.21(g)). This hydrologic assessment must include the impacts of the proposed operation and all anticipated mining on surface and ground water systems in the cumulative impact area. Currently, not all of the state regulatory agencies require a quantitative analysis of flooding impacts for proposed mine operations in either the PHC or CHIA assessments.

The USCOE routinely relies on state or SMCRA regulations to address flooding. The USCOE may evaluate flooding impacts from an individual mine. The USCOE districts routinely consider flooding impacts when they evaluate mining activities under the Individual Permit process. The need to do a separate flood impact analysis is determined on a case by case basis by the USCOE. Most districts will not conduct a separate flood analysis if such an analysis is required by state or SMCRA regulations.

2. EIS Peak Flow Studies

Previous studies of peak flow evaluated sites that were not specifically impacted by MTM/VF mining and were done prior to the implementation of SMCRA. To fill in this information and analysis gap several studies were done in preparation of this EIS. The EIS studies evaluate the impacts of MTM/VF mining on peak flow using computer modeling, continuous data collection using stream gages, post-flood highwater marks, on-site drainage control structure evaluation, and citizen complaint investigations. Each study analyzes discrete circumstances that help to create a more complete evaluation when coupled with the other EIS studies. The output from these efforts is summarized and discussed below. The complete studies are presented in Appendix H.

USOSM and the Army COE (Pittsburgh District) performed computer model analysis of peak flows at locations immediately downstream of several drainages where valley fills were planned in West Virginia. Specific design precipitation events were modeled for these drainages using a variety of scenarios. This study provided the predicted peak flows for several mining and reclamation plans. This is referred to as the "Peak Flow" Study.

The USGS - Water Resources Division (Charleston, West Virginia) installed and maintained three continuous recording stream gages and four rain gages in a small watershed in West Virginia. The stream gages were located to documented the stream-flows for a mined area with a valley fill, an adjacent unmined area, and the cumulative discharge downstream of these areas. This study provided the actual peak flows for the various rainfall events that occurred during the period of data collection. This is referred to as the "Fill Hydrology" study.

The USGS - Water Resources Division (Charleston, West Virginia) evaluated the peak flows for the July 8-9, 2001 flooding in southern West Virginia. Six small drainage basins were selected and the highwater marks were documented immediately after the floods. The highwater marks and stream channels were surveyed and peak flows were calculated from this data using "indirect discharge measurement techniques." This study provided the calculated peak flows for an individual extreme event that caused flooding and damage in and around the study area. This is referred to as the "July 2001 Floods" study.

USOSM and the KYDSMRE did a special study on drainage control at mine sites in Kentucky. Site selection was based on citizen complaints alleging that life-threatening "washouts" were caused by mining or otherwise significantly contributing to downstream flooding and/or flood-related adverse impacts to citizens, property or the environment. This is referred to as the "OSM/Kentucky Oversight" study.

USOSM did an evaluation of citizen complaint records for West Virginia, Kentucky, and Virginia where there were allegations of flooding from coal mine operations. Thousands of citizen complaints received and investigated by these states and those related to flooding were reviewed. This is referred to as the "Citizen Complaint" study.

a. Peak Flow Study

In November 1997, an interagency coordinating meeting of the Federal Regulatory Organization Group (FROG) was held in Berkeley Springs, WV. One of the topics for discussion was a more "pro-active" approach in response to valley fill permit applications with respect to Section 402 and 404 (CWA) permit applications, as well as related USOSM and state permitting and administrative procedures. The EPA, OSM, COE, and FWS formed a four-agency task force to evaluate valley fill issues. Flooding was one of the issues chosen for technical investigation by the four agency group.

OSM and the COE performed a model analysis of potential downstream flooding as a result of valley fills and large scale surface coal mining operations in Appalachia. The purpose of the Peak Flow Study was to evaluate the potential for flooding as a result of the construction of valley fills and the related hydrologic modifications to terrain associated with MTM/VF mining. The following summarizes the computer modeling studies that have been undertaken as part of the Peak Flow Study and the conclusions that have been reached.

Computer modeling simulations were performed to evaluate the impacts of rainfall events on three individual valley fills, as well as the cumulative impacts of two of these fills on a downstream area. The study used computer models to predict storm hydrograph peak discharges for two precipitation events (10-year and 100-year) during various scenarios of pre-mining conditions, conditions during mining, initial post-mining conditions with no change to the permitted regrading plan, future post-mining conditions with forest cover assumed for the permitted regrading plan instead, and initial post-mining conditions for a conceptual Approximate Original Contour Plus fill optimization process (AOC+ - also referred to as the WVDEP AOC Process) regrading plan. The USCOE-developed Hydrologic Engineering Center (HEC) computer model was used by the USCOE (Pittsburgh District), and the proprietary SEDCAD 4 model was used by USOSM, to evaluate three valley fill watersheds in southern West Virginia. Both models used the identical topographic and

land use conditions, which provided a useful comparison of the surface water modeling software. Both software models are readily available to private consultants. SEDCAD 4 is frequently used by the coal industry to design diversions and sediment control structures, while the HEC model is used for a wide variety of watershed hydrology studies.

The point of evaluation of the peak flows for the HEC-HMS and SEDCAD 4 modeling was the permit boundary downstream of each valley fill. The sites selected were all Arch Coal Company sites: the Samples Mine Valley Fill #1, Samples Mine Valley Fill #2, and Hobet Mine Westridge Valley Fill. The Samples Valley Fill #1 drainage area was 440 acres, with 72 percent of the area disturbed by mining operations or valley fill. The Samples Valley Fill #2 drainage area was 351 acres, with 56 percent of the area disturbed. The Hobet Westridge Valley Fill drainage area was 1600 acres, with 74 percent of the area disturbed.

As summarized by Table III.G-1, the storm runoff modeling using HEC-HMS and SEDCAD 4 both calculated that the post-mining peak flows would be higher than the pre-mining peak flows for the same design storms. However, the predicted increases in peak flow would not have caused flooding on the banks outside the receiving stream channel.

The USCOE (HEC-HMS) analysis predicted peak flow increases of about 3 percent for Samples Valley Fill #2, 13 percent for Samples Valley Fill #1, and 42 percent for Hobet's Westridge Valley Fill between pre-mining and permitted post-mining conditions. These results indicate the largest drainage area (Hobet Westridge Valley Fill) with the highest percentage area disturbed had the greatest increase in peak flow from pre-mining conditions. The results also indicate that the smallest drainage area (Samples Valley Fill #2) with the smallest percentage area disturbed had the lowest increase in peak flow.

The USCOE study also completed a cumulative analysis of the Samples Valley Fills #1 and #2. The fill drainage areas are adjacent to each other and form the headwaters of the same stream. The cumulative analysis indicates an increase in the peak flow downstream of the valley fills at a point below where the two drainages converge. However, the peak flow increase (8 percent) between pre-mining and permitted post-mining conditions represents influences of the individual valley fill drainage areas and any additional drainage area that flows to the cumulative analysis point. The influence of changes in the headwater areas will decrease as the point of analysis is moved further downstream. That is, the peak flow alteration would attenuate downstream from the mine site.

Table III.G-1
Comparison of HEC-HMS and SEDCAD 4 Models Peak Flow Results

Peak Flow Predictions in Cubic Feet Per Second (CFS)										
Storm Event	**Pre-Mining**		**During Mining**		**Permitted Post-Mining**		**AOC+ Post-Mining**		**Permitted Post-Mining Forested**	
Samples Mine Valley Fill #1										
	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4
10 Year	330	352	525	498	376	447	432	416	246	269
100 Year	742	739	931	844	832	864	932	790	580	583
Samples Mine Valley Fill #2										
	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4
10 Year	293	326	---	---	302	354	295	391	209	259
100 Year	664	768	---	---	671	688	658	744	502	563
Samples Mine Valley Fills #1 and #2 Combined										
	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4
10 Year	765	803	---	---	826	880	833	---	605	---
100 Year	1711	1693	---	---	1793	1722	1874	---	1331	---
Hobet Mine Westridge Valley Fill										
	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4	HEC-HMS	SEDCAD 4
10 Year	838	782	---	---	1193	855	---	---	---	---
100 Year	1736	1447	---	---	2459	1525	---	---	---	—

The USCOE documented channel capacity with measured survey sections for streams below each site. These measurements allow an evaluation of the effect of modeled peak flows on water levels of the receiving stream downstream from each fill. Changes in water level

are related to the flow volume and the cross-sectional area of the stream channel. The water level increases in the receiving stream were negligible for the Samples Valley Fill #2; 0.3 feet for the Samples Valley Fill #1; and 2.1 feet for the Hobet Westridge Valley Fill between pre-mining and permitted post-mining conditions. Routing design storm peak flows through these measured channel sections did not cause flooding because resultant water levels were below bank-full conditions within the receiving stream.

The same topographic and hydrologic conditions were used by USOSM to predict peak flows using the SEDCAD 4 hydrology model. Similar to HEC-HMS, the SEDCAD 4 model predicts the post-mining peak flows to be higher than the pre-mining peak flows. While the SEDCAD 4 percentage increases would not be expected to be identical to those predicted by the HEC-HMS model, the general finding that permitted post-mining peak flows will be higher was confirmed by SEDCAD 4 as well.

The one analysis of peak flows during mining for the Samples Mine Valley Fill #1 showed a 59 percent and 25 percent increase over pre-mining conditions for the 10-year and 100-year storm events, respectively. Water level increases were 1.7 feet and 1.3 feet, respectively, compared to pre-mining conditions. Again, this did not result in any predicted overbank flooding.

Predicted runoff for conceptual AOC+ conditions was 12 percent higher for the Samples Mine Valley Fill #1 than permitted post-mining configuration, whereas the peak flow was 2 percent lower for Valley Fill #2. For the combined valley fills, peak flows were 1 percent and 5 percent higher for the 10-year and 100-year storm events, respectively, for AOC+ conditions versus permitted post-mining conditions. In comparison, peak flow increases for AOC+ ranged from 1 percent less than pre-mining conditions to 31 percent more, whereas the permitted post-mining peak flows ranged from 1 percent to 13 percent more than pre-mining conditions. Water level increases ranged from negligible on the Samples Mine Valley Fill #2 to 1 foot on the Samples Mine Valley Fill #1, with no overbank flooding predicted.

The final analysis was made of future conditions if the Samples Mine sites were forested with the permitted post-mining configuration. This showed substantially lower peak flows than either the initial post-mining conditions or the pre-mining conditions. Predicted forested peak flows ranged from 22 percent to 29 percent lower than pre-mining conditions, and 25 percent to 35 percent lower than initial permitted post-mining conditions. Water levels at the receiving stream analysis points decreased from 0.4 feet to 1 foot compared to pre-mining conditions among the sites evaluated.

The storm runoff modeling using HEC-HMS and SEDCAD both calculated that the permitted post-mining and AOC+ post-mining peak flows would be higher than the pre-mining peak flows for the same design storms. However, increases in peak flow did not cause a rise in water level overtopping the receiving stream channels. Flooding typically occurs only when water levels exceed channel capacities and spread across the flood plain where residential settlements may occur. The cumulative analysis of two fills indicated an increase in the peak flow post-mining beyond the downstream confluence of the valley fill watersheds. Again, bank full capacity of the stream channel did not result. The influence of changes in the headwater areas will decrease as the point of analysis is moved further downstream.

b. Fill Hydrology Study

The USGS collected data in close proximity to several mountaintop mines to document the changes in flood peaks associated with these sites. Rainfall and runoff are being measured at four rain gages and three stream gages. The stations are in the Ballard Fork watershed near Mud, West Virginia. Data collection began in November 1999 and is continuing. The stream gages were located to document the stream flows for a mined area with a valley fill (0.19 sq. mi.), an adjacent unmined area (0.53 sq. mi.), and the cumulative discharge downstream of these areas (2.12 sq. mi.). The stream gages provide continuous records of water surface elevations for each station. These water surface elevations are converted to stream flow based on actual flow measurements taken at various water surface elevations. Peak flows and the hydrographs for each precipitation event can then be evaluated.

The precipitation gages provide a continuous record of rainfall that can be evaluated for total amount of rainfall and the rainfall intensity. These records also document and allow for the evaluation of time since the previous rainfalls to estimate the soil moisture conditions. Most of the intense rainfall in the study area occurred during summer thunderstorms.

The storm hydrographs for the mined watershed were distinctly different from the hydrographs for the unmined watershed and the cumulative watershed. The unmined and cumulative watersheds generally rose in response the rainfall events and was independent of rainfall intensity. In contrast, the storm hydrograph for the mined watershed had a double peak flow when rainfall intensity exceeded about 0.25 in/hour. The hydrograph would rise quickly to the first peak flow and recede quickly after the heavy rainfall stopped. There would then be a second peak flow that was not as high as the first but would occur hours after the first peak.

During most of the recorded storms (low intensity) the peak flows (per unit area) for the unmined watershed and the cumulative watershed were less than the mined watershed. However, during intense rainfall events the peak flows (per unit area) for the mined watershed were greater than those for the unmined and cumulative watersheds.

c. July 2001 Floods Study

The USGS investigated the effects of valley fills on the peak flows for the flood of July 8-9, 2001 in West Virginia. Six small basins (drainage areas ranging from 0.189 to 1.17 sq. mi.) within an area of about 7 sq. mi. in the headwaters of Clear Fork of the Coal River in southern West Virginia were investigated following the July floods. Three of the basins were downstream from the ponds at the toe of valley fills and three basins were not below valley fills.

The thunderstorm that produced the July 8-9, 2001 floods produced rainfall amounts between 3 and 6 inches in a 5 to 6 hour period. These rainfall amounts for this storm alone were approximately equal to the average monthly rainfall.

Within the six small drainage basins the highwater marks were documented immediately after the floods. The highwater marks and stream channels were surveyed and peak flows were calculated from this data using “indirect discharge measurement techniques.” From this information and the

roughness coefficients (ground-surface conditions) the peak flow can be calculated. These flows were divided by the drainage area for the basin to produce a unit peak flow.

The six basins were separated into a northern group and a southern group. They were grouped by geographic location and the relative difference in the unit peak flows for the unmined watersheds. There are four basins in the southern group where two had valley fills and two did not. The remaining two basins were in the northern group with one valley fill basin and one without.

The calculated unit-peak flows for the unreclaimed valley fill in the southern group was twice as high as the remaining sites. The remaining basins in the southern group had similar unit peak flows for the unmined watersheds and the reclaimed valley fill.

The calculated unit-peak flows for in the northern group showed a different relationship. The watershed without the valley fill had a unit-peak flow that was twice as high as the watershed with a valley fill.

d. Citizen Complaints Study

The citizen complaint records for West Virginia, Kentucky, and Virginia were reviewed for allegation of flooding from coal mine operations. Of the thousands of citizen complaints received and investigated by these states, a very small percentage were related to flooding. Of those flooding-related complaints found to be mining-related, the problems were caused by improper maintenance of the approved drainage control facilities or by not following approved drainage control plans. The WVDEP records for 1995-99 were assembled and reviewed where citizens alleged flooding was caused by mining. A total of 126 complaints were investigated. Sixty-two (62) complaints were associated with surface coal mine sites. Eight (8) of these investigations resulted in enforcement actions being taken to require corrections to drainage control structures. The KYDSMRE flooding complaint records for 1996-99 were also reviewed. Thirty-five (35) investigations resulted in 5 enforcement actions to require corrections to drainage control structures. The VADMLR flooding complaint records for 1995-99 showed 3 complaints investigated for surface coal mining sites. None of the investigations resulted in enforcement actions.

e. Other Studies

Two other flooding-related studies were completed in the EIS study area. The areas evaluated in these studies were in Kentucky and West Virginia. The Kentucky study, "Joint OSM-DSMRE Special Study Report On Drainage Control" was completed in December, 1999. The West Virginia study, "Runoff Analysis of Seng, Scrabble, and Sycamore Creeks" was completed in June, 2002. The studies were designed to determine whether mining caused increases in "peak flow" downstream from the mine sites and if so, the extent to which peak flows were increased. It should be noted that the West Virginia study also evaluated the impacts of logging on peak flows. In general, these two studies concluded that mining does influence the degree of runoff, but that the extent to which a change in runoff may have actually caused or contributed to flooding were site-specific. Site-specific factors may include topographic influences, stream channel conditions, distance downstream from the mine site, man-made channel restrictions, etc. The complete state studies, including conclusions and recommendations, are found in Appendix H.

Both states' studies recognized the need for the proper, thorough analysis of peak flow and flooding potential. Kentucky's mine regulatory agency has implemented a policy requiring that certain specific engineering considerations be evaluated when conducting a review of a proposed mine application. The policy has been included in Appendix K. West Virginia is evaluating their study conclusions and recommendations and considering regulations that would require peak flow analysis and other measures to minimize flooding potential downstream of mine sites and logging operations.

H. RELATIONSHIP OF MOUNTAINTOP MINING TO GROUNDWATER QUALITY AND QUANTITY

1. EIS Workshop Findings

Some public comments received during the EIS Scoping Process centered on the impacts from Mountaintop Mining/Valley Fill (MTM/VF) to the groundwater system. Principal among these were immediate and long-term changes to groundwater quality and quantity due to MTM/VF mining practices. Blasting effects to private water supplies and groundwater quality in general were concerns, as was migration of other contaminants from mine sites. In contrast, one comment expressed a belief that valley fills maintained baseflow during low flow periods by providing a more reliable groundwater reservoir.

In support of this EIS, the Workshop on Mountaintop Mining Effects on Groundwater was held in Charleston, West Virginia on May 9, 2000. The purposes of this workshop were as follows:

1. Identify potential impacts from mountaintop mining with valley fills on groundwater quality and quantity,
2. Review existing literature and current research studies focused on the effects from mountaintop mining on groundwater systems.
3. Review and assess public comments concerning mountaintop mining impacts on groundwater received during the EIS Scoping Process and,
4. In light of the recent workshop, identify potential technical and policy actions to be considered during the EIS process.

This section summarizes the results of this workshop and other available studies on the effects of MTM/VF mining on groundwater in relation to public concerns. A conceptual model of groundwater flow is examined and potential impacts from MTM/VF are explained. Note that blasting effects are discussed separately in Section III.

2. Pre-mining Appalachian Groundwater Flow System

The surficial geology of the Appalachian coal basin is dominated by layered sedimentary sequences of Mississippian and Pennsylvanian ages. These rocks encompass cyclic sequences of lithology that document the rise and fall of sea level and basin subsidence due to compaction and plate tectonics. These sequences are called cyclothem sequences and typically repeat themselves in 15 to 50 meter intervals. They emanate from changing energy conditions in the depositional environment resulting in stratigraphic facies changes (Brady et al, 1998).

Facies/lithological changes produce the layered rock sequence seen in Appalachian drill holes and road cuts. Cyclothem sequences show repeated sandstone, shale, limestone and coal lithology that vary laterally and vertically. The impacts of cyclothem sequences on the groundwater flow system are evident in the heterogeneous nature of the hydraulic properties found throughout this region.

Cyclothem sequences affect the permeability of the aquifer matrix by influencing the hydraulic conductivity and transmissivity properties of the aquifer matrix. Permeability refers to the water

transmitting properties of an aquifer unit and has two components: primary and secondary. Primary rock permeability refers to the interstitial openings between rock grains and is controlled by rock porosity. Secondary permeability refers to any form of fracture, bedding plane separation, or solution channel that occurs after sediment consolidation. Hydraulic conductivity refers to the ability of geologic strata to transmit water. Transmissivity is a related term and is calculated by multiplying the hydraulic conductivity by the saturated thickness to arrive at the total water transmitting capacity of an aquifer unit. Transmissivity embodies the ability of the unit to transmit water and the area through which it flows. As a result of cyclothem sequences, permeability varies in three dimensions, producing very heterogeneous flow systems. Aquifer testing in this region indicates a wide range of spatial attributes in hydraulic properties, often times within the same stratigraphic interval (Bruhn, 1986, USGS, 1991, Minns, 1993, Minns et al, 1995). These same studies indicate hydraulic conductivity declines with increasing depth due to changes in consolidation of the overburden. In the Appalachian basin, secondary permeability is the dominant pathway for fluid movement (USGS, 1981, USGS, 1991). The combined affect of stratigraphic changes and differing fracture density has been shown to produce lateral changes in the hydraulic properties of aquifer materials (Stoner, 1987, Minns, 1993).

An interconnected stress relief fracture network of varying density underlies the Appalachian basin. Ferguson (1967) was the first to propose a model of stress relief fracture systems in the Appalachian basin. His model indicated arching of the strata underlying valleys due to overburden unloading associated with major stream valley development. Ferguson's model shows horizontal fractures underlying stream valleys with vertical fractures along the valley walls and ridge tops. Hill (1988) proposed a distinction between wide stream valleys (> 500 ft) and narrow, V-shaped stream valleys whereby the valley floor experienced compressive stress instead of tensile stress found in broader valleys. This phenomena results in a decrease in fracture density under V-shaped valleys. Since the work of Ferguson, several researchers have proposed general models of groundwater movement for this region that incorporate the valley stress relief concept (Hobba, 1981, USGS, 1981, Kip et al, 1983, USGS, 1985). Several studies also indicate that the majority of groundwater flow occurs in the top 250 to 300 feet of strata (Stoner, 1987, USGS, 1991, USGS, 2001). Researchers have characterized Appalachian basin aquifer systems as fracture flow systems with numerous perched aquifers in the upper topographic intervals (Hobba, 1981, USGS, 1991, USGS, 1991a, Kipp and Dinger, 1991, Minns, 1993). Groundwater availability is limited on hilltops due to reduced areal recharge potential, depth to water and reduced transmissivity values (Stoner, 1987, Kipp and Dinger, 1991, Minns, 1993).

3. Impacts to Groundwater Quantity from MTM/VF

Mountaintop removal is a surface mining technique that removes a series of coal seams by removing all overlying strata down to an economical limit governed by the overburden to coal ratio. Contour and area mining of mountaintops removes <u>part</u> of the coal seams in the mountain or all of the coal seam in portions (e.g., in a narrow ridge) of the mountain—also to the economic limits of extraction. Auger mining conducted from the contour or area mining bench may remove additional coal within the mountain. As these types of mountaintop mining operations progress, overburden in excess of that required to reclaim the mine site is placed in an adjoining valley(s). The SMCRA regulations stipulate that overburden placed in valley fills must meet certain engineering criteria to ensure stability, drainage control and reclamation/re-vegetation of the valley fill. In addition, each respective state permitting program ensures any discharge from the individual mining permits adhere

to water quality standards as set forth under the various state and federal programs. The current EIS is an evaluation of the practices currently employed for MTM/VF techniques.

a. Conceptual Model of MTM / VF

Conceptually, MTM/VF mining is the complete or partial removal of mountaintops by breaking the strata into small blocks and placing the excess spoil in an adjoining valley. The physical effects of MTM/VF are clear; mountain slopes are radically decreased, both by removal of material and by filling adjoining valleys. The affects to the physical groundwater system are the elimination of the perched aquifer system in the mountaintops, and formation of an aquifer system in the valley fill.

The shallow, pre-mining perched flow system proposed by several researchers is located within the overburden strata associated with mountaintop topography (Hobba, 1981, USGS, 1991, Minns, 1993). This flow system forms the headwater areas of the region's streams and is a minor source of residential water throughout the Appalachian region due to the concentration of the majority of the population in stream valley settings. Removal of mountaintop strata removes the perched aquifer system and places the excess overburden in adjoining valleys, thus eliminating the perched system.

The placing of overburden in adjacent valleys of the MTM/VF regions of the Appalachian basin join two aquifer systems: the premining fracture flow system that underlies and adjoins the valley fill; and a postmining man made aquifer consisting of excess overburden removed during mining. Wunsch et al (1996) proposed a model of groundwater flow through a valley fill in eastern Kentucky. They determined water moved through the Star Fire mine site at differing velocities depending on the nature of spoil, preferential sorting of the spoil upon placement and degree of compaction during placement. This work corroborates work done by Carruccio et al (1984), Aljoe and Hawkins (1992), and Aljoe (1994) using pump tests and dye tracing in reclaimed surface mines. The change in spoil porosity affects the hydraulic conductivity distribution in the fill and ultimately dictates the groundwater flow regime that establishes within the fill. Groundwater gradients within the fill roughly follow the undisturbed topographic elevations; flowing along the pre-fill valleys. The type of fill material placed in these locations enhances this flow mechanism (Aljoe, 1994). Wunsch, et al (1996) noted at the Star Fire site that water recharges the site by way of surface water infiltration along the highwalls, groundwater infiltration through the highwalls, chimney drains placed in the fill, and along the headwater areas of stream courses covered during the operation. At the Star Fire site, groundwater discharges as spring flow at the toe of fill, into an adjacent active dragline pit, and into sediment ponds located on lower portions of the fill. The sediment ponds are used for dust suppression and are pumped on a continuous basis. The Star Fire site is a typical valley fill scenario.

b. MTM/VF impacts to the physical Ground Water system

Valley fills create aquifer systems that perform two functions: 1) store a larger percentage of water that would normally run off the landscape; 2) serve as separate aquifer systems. Overburden placed in valley fills consists of broken strata that are disposed of in an adjacent valley. These fills are large-scale, generally primary porosity-driven flow systems although some studies have indicated a dual porosity flow system (Caruccio, 1984, Aljoe, 1994). Water moves through them under hydraulic gradients (i) derived from the hydraulic conductivity (K) and storage (S) properties of the rock fragments. The storage (storativity) properties of the man-made aquifer are significantly greater than the original rock mass due to the increase in pore space. Total porosity may be similar

between pre and post-mining scenarios but increases in pore size and connectedness create greater *effective* porosities allowing more water to freely move through the aquifer unit. Effective porosity values for undisturbed Appalachian fractured rock aquifers range from 0.001% to 0.1% (MacKay and Cherry, 1989). Brown and Parizek (1971) found laboratory-measured porosities of coal bearing strata to range from 0.8% to 9.4% with a mean of 3.9%. Several authors have found insitu effective porosities in surface mine spoil ranging from 14% to 36% spoil aquifers (Cederstrom, 1971, Wells, et al, 1982, Hawkins, 1995). Using the laboratory derived effective porosity for insitu strata of 3.9% and an average effective porosity of spoil of 25% equates to an approximate 21% gain in porosity over premining values. A 1000-acre unmined site with a 30 foot saturated thickness stores approximately 12 million gallons of water at 3.9 % porosity, while the same size valley fill stores approximately 81 million gallons of water at 25% porosity. The valley fill site holds approximately 7 times more water than its premining counterpart.

The increase in storage of valley fill aquifers is also enhanced by a decrease in runoff volumes associated with slope reduction. Simple runoff calculations using Natural Resource Conservation Service techniques indicate runoff volumes theoretically decrease by approximately 50% for a reduction in slope from steep ($i > 8\%$) to flat ($i = 0$ to 3%) classifications and allowing the CN value (CN 70 to CN 75) to increase to account for decreased vegetation (Maidment, 1993). This decrease in runoff theoretically allows more water to infiltrate and/or re-saturate the surface of the valley fill. By diverting the runoff into the valley fill, water is effectively stored in the fill material and is released in a more subdued manner, thus affecting the peak flow volumes in adjacent streams. Wunsch et al (1996) and Wiley et al (2001) noted this phenomenon in their Appalachian basin fieldwork. Research by the USGS on stream flow characteristics in the Appalachian basin indicates similar trends (Paybins et al, 2002, Messinger, 2002).

Data from the Star Fire site indicate a greater percentage of precipitation is captured by the valley fill aquifer system compared to unmined settings. A flume located immediately downstream of the valley fill captures all the water leaving the site as discharge from the various groundwater discharge points. Measurements taken during normal baseflow conditions, that eliminate the influence of surface water, indicate 1000 gallons of water per minute (2.23 cfs) is discharging from the Star Fire site. The site has an approximate area of 1000 acres resulting in an effective infiltration rate through the valley fill of approximately 1.0 gallon per minute per acre (gpm/acre). Assuming 49.7 inches of rainfall per year, 1.35×10^6 gal/year of precipitation falls on this part of Kentucky. This total equates to 2.57 gal/min of rainfall per acre of land surface. The Star Fire site discharges approximately 1.0 gal/min/acre of valley fill, equating to 39% or 19.3 inches of the yearly precipitation falling on the land surface. Typical unmined Appalachian basin mean groundwater discharge rates range from 6.7 to 31.6 inches per year (18.8% to 50.9%) measured as the groundwater discharge component of stream baseflow in West Virginia, Virginia, and North Carolina (USGS, 1996, USGS, 2001, USGS, 2001). USGS (2001) report a band of the high mean infiltration rates (41.1% and 50.9% of total precipitation) located in a narrow band encompassing the eastern portions of West Virginia. The majority of infiltration rates cited by USGS (2001) range between 18.8% and 27.1% for the remainder of West Virginia based on 27 different stream stations. At a 39% infiltration rate, the Star Fire site directs a larger proportion of precipitation into the valley fill than is implied in recent research in unmined scenarios.

Insitu infiltration rates determined by infiltrometer studies performed on contour surface mines also indicate spoil infiltration rates increase through time; ameliorating the affects of compaction on the

surface (Jorgenson and Gardner, 1987, Ritter and Gardner, 1993). Ritter and Gardner (1993) showed through modeling, that hydrograph curves evolved over time to closely mimic runoff curves associated with saturation overland flow processes. They also concluded that runoff processes at surface mined sites are dominated by saturation overland flow which cause decreased peak runoff and increased time to peak runoff that result from the lagged response of return flow to the surface water network. Recent field studies on the effects of valley fills on peak stream discharge indicate similar trends and responses to their modeling research (Messinger, 2002).

Increases in effective porosities of spoil also lead to increases in hydraulic conductivity. Hawkins (1995) found spoil conductivities were 1 to 2.5 orders of magnitude greater than the adjacent rock mass. Herring (1977) and Weiss and Razem (1984) also noted similar findings in spoil related research. Aljoe (1994) noted that increases in the percentage of sandstone overburden in a fill also increase porosity and hydraulic conductivity. The increase in hydraulic conductivity and storativity leads to increased water velocity and reduced hydraulic head in the postmining spoil aquifer (Hawkins, 1995). The reduction in hydraulic head is related to the decrease in hydraulic energy required to drive water through spoil aquifers compared to undisturbed strata. Booth and Spande (1992) and Kendorski (1994) noted similar overburden aquifer response in longwall mining areas due to a similar increase in hydraulic conductivity and storativity.

Interaction between spoil aquifer systems and the underlying aquifer system is likely limited in areas compacted by mining equipment during active mining phases. In these areas, compaction has reduced infiltration capacity by providing an effective low permeability confining layer separating the underlying flow system from the valley fill. Wunsch et al (1996) found similar responses to rainfall runoff in areas of compacted cover material for a valley fill area in eastern Kentucky. Hawkins (Brady et al, eds., 1999) also points out similar phenomena in his chapter on hydrogeologic characteristics of surface mine spoil.

c. Impacts to Valley-bottom Groundwater Recharge From MTM/VF

Groundwater recharge to lower elevations may be impacted by mountaintop removal by reducing the amount of recharge available and/or diverting groundwater to the valley fill flow system. However, conceptual models of premining groundwater flow indicate the amount of water actually recharging valley aquifers may be limited and as such MTM/VF impacts on these aquifers would likely be similarly limited. A large percentage of precipitation falling on upland areas runs off, becoming surface flow in streams. Water that does infiltrate may or may not become part of the deeper groundwater system dependent upon existence and/or interception by valley sidewall fractures. Water that is not diverted vertically will flow horizontally on top of low permeability strata and emanate as spring flow on the valley sidewalls. Water that does get diverted into the valley sidewall fracture system infiltrates and becomes part of deeper flow systems. This water may be capable of providing a component of recharge to valley bottom aquifers. Further research needs conducted to determine the impacts from diversion / elimination of these perched systems to lower elevation alluvial aquifer systems.

4. Impacts to Groundwater Chemistry From MTM/VF

SMCRA mandates that all coal mining operations collect quarterly sampling for total iron, total manganese, total suspended solids and pH. These minimum parameters are collected at all approved mining related discharge sites and monitor the most significant components of typical coalmine drainage. The minimum list does not capture the entire expected range of chemical species emanating from coal mine drainage.

In its most basic form, overburden containing silicate and carbonate minerals is broken up, deposited into an adjacent valley, and water is allowed to flow through the fill material. The exposure of fresh mineral surfaces to a geochemically reactive material (water) produces the water chemistry produced at coal mine sites.

a. Geochemical Reactions

Coal mine drainage is produced by the oxidation of pyrite in an aqueous environment that dissociates the iron and sulfur found in the pyrite (FeS_2). Pyrite is a sulfide mineral commonly formed in the reducing environments associated with Bituminous coal fields. Coal mining and subsequent overburden removal exposes the pyrite to oxygen, which is summarized by the following reaction (1) (Brady et al, 1999):

$$FeS_2\,(s) + 3.75\,O_2 + 3.5\,H_2O = Fe(OH)_3(s) + 2\,SO_4^{2-} + 4\,H^+ + heat \quad (1)$$

Alkaline mine drainage can be produced when acidic mine water comes in contact with alkaline overburden and/or alkaline recharge migrates into the valley fill. The reaction (2) between pyrite, calcite, in limestone, and water is:

$$FeS_2 + 4\,CaCO_3 + 3.75\,O_2 + 3.5\,H_2O = Fe(OH)_3 + 2\,SO_4^{2-} + 4\,Ca^{2+} + 4\,HCO_3^- \quad (2)$$

This reaction will produce alkaline mine drainage with circumneutral pH, alkalinity greater than acidity, high sulfate and calcium concentrations and iron hydroxide as a precipitate.

Researchers have also noted high levels of sodium, magnesium, and calcium in coal mine drainage that were attributed to cation exchange (Winters et al, 2000, Perry, 2001). Divalent calcium and magnesium ions are exchanged at surface sites of clay minerals for monovalent sodium ions and can be summarized by the following reaction:

$$2\,Na^+ \_\ 1\,Ca^{2+}\,(Mg^{2+})$$

Preliminary research by the EPA for the EIS document also indicates increased levels of selenium in bituminous basin discharge water (USEPA, 2002). Aluminum has also been documented in coal mine drainage at elevated levels (Brady et al, 1999).

No correlation was possible in an EPA statistical evaluation ("Ecological Assessment of Streams in the Coal Mining Region of West Virginia Using Data Collected by the U.S. EPA and Environmental Consulting Firms") of the amount and age of upstream disturbance on the character of water quality impacts; or the distance downstream that the mineralization persisted (USEPA,

2002). Further study is needed to determine the duration of the mineralization, which may be expected to decrease with time as backfill and valley fills are "flushed" of soluble materials.

b. Conceptual Geochemical Model

Overburden mineralogy determines the final geochemical signature of post mining water quality. Mining exposes fresh rock surfaces to water and oxygen allowing several reactions to occur, most notably pyrite oxidation, calcite dissolution and cation exchange. Silicate weathering may also provide chemical constituents to the final mine water chemistry, especially in acidic discharges.

Relationships between overburden mineralogy and groundwater composition lead to ionic dominance of various chemical constituents found in a water sample. Piper tri-linear diagrams provide a visual representation of the composition of the major constituents found in a water sample. Relative compositions of calcium, magnesium, sulfate, bicarbonate and chloride ions are plotted on triangular axes from which mineral provenance is estimated based on a comparison between discharge chemistry and the mineralogical composition of the aquifer matrix.

Geochemical modeling of Appalachian basin groundwater indicates several different geochemical facies are present in pre-mining aquifers. Geochemical sampling of pre-mine groundwater indicates three distinct geochemical zones within the aquifer system of the Appalachian basin. The deepest zone is characterized by sodium and chloride ions associated with brine water at depth (Rose and Dresel, 1990). Numerous studies indicate a brine – fresh water interface at depths of 1000 feet below surface with upconing under major stream valleys to depths of 100 feet (Stoner et al, 1987, Minns, 1995). The upconing area is a mixing zone but contains considerable quantities of sodium and chloride ions diluted by mixing with shallower water types. Intermediate geochemical zones are characterized by removal of the chloride ion by flushing, resulting in a sodium–bicarbonate ion dominated water chemistry. Wunsch (1993) and Minns (1995) geochemical models show this water signature was found at depths ranging from 50 to 150 feet below local base level. Shallow flow systems are dominated by calcium–bicarbonate ions due to flushing of the sodium ions from the system. Brady et al (1996) further subdivided this shallow zone into a low total dissolved solids (TDS) zone associated with stress relief/weathered regolith and a higher TDS zone associated with ridge cores. The difference between the two sub-systems is derived from water residence time and degree of weathering between the two sub-systems. Longer residence times in contact with unweathered material produces more ions in the water leading to higher TDS values whereas shorter residence time with weathered material leads to lower TDS values. Wunsch (1993) and Minns (1995) found similar geochemical zones but also found sulfate and magnesium were present in significant quantities in these shallow geochemical zones.

In Kentucky valley fills, Wunsch et al (1996) found that water emanating from the fills was a calcium–magnesium–sulfate type water resulting from pyrite oxidation and calcite dissolution along the groundwater flow path. Discharge data from Wunsch et al (1996) supports neutralization of pyrite oxidation products within the valley fill interior. Pyrite oxidation is likely occurring within the unsaturated portion of the fill as evidenced by the elevated sulfate (range: 300 to 2000 mg/l) concentrations in the discharge water quality. These oxidation products (Fe, SO^4) are then carried with infiltration and/or groundwater to the main flow paths through the fill. Alkalinity generating processes are also at work buffering the pH to approximately 6.2 (except well 14). The discharge chemistry contains significant concentrations of neutralization products (Ca, Mg, HCO^3) leading to

the calcium–magnesium–sulfate type water emanating from the Star Fire site. This conceptual flow model has been observed at surface mines throughout the Appalachian basin (USGS, 1990).

The Star Fire site also indicated increased concentrations of total dissolved solids in the discharge chemistry. This phenomena results from the release of ions due to exposure of unweathered minerals placed in the fill as spoil. Elevated TDS concentrations have been documented in surface mining discharge chemistry for more than 25 years (USGS, 1983, Quinones et al, 1981).

In the absence of neutralization materials, acidic discharges can develop whereby the main ionic constituents are iron and sulfate with lesser amounts of aluminum and manganese resulting in a sulfate–iron dominated type water. This water will have low pH (< 5.0) and very high TDS concentrations (> 2000 mg/l). This water can also be very reactive with overburden mineralogy: dissolving silicate minerals producing significant concentrations of dissolved silica, aluminum, magnesium and trace metals.

5. Summary of Groundwater Impacts

Mountaintop mining removes the perched aquifer system from the base of the target coal seam upwards. By placing this material into the adjacent valley, a new aquifer is formed. The valley fill aquifer system develops according to the physical properties of the spoil matrix and corresponding flow mechanisms that develop. Overburden placement techniques, material sorting and post-deposition compaction control the hydraulic conductivity and corresponding hydraulic gradient distribution within the valley fill. The valley fill is also capable of storing larger volumes of water compared to the original rock mass. These storage components affect stream hydrology by creating lag times in storm-induced runoff hydrographs. Sedimentary rock overburden mineralogy controls the discharge chemistry in the Appalachian basin. Exposure of fresh mineral surfaces to oxygen and water provide the geochemical mechanism for chemical evolution within the fill. The ultimate expression of the discharge is controlled by the amount and residence time of the water within the fill, which are governed by the physical properties of the spoil matrix. The Star Fire site in eastern Kentucky is a good conceptual model of an average valley fill aquifer system found in the Appalachian basin. It represents typical overburden mineralogy, mining technique and discharge chemistry of a typical Appalachian coal basin mountaintop mine.

EPA, in a 2002 statistical study of stream quality and macroinvertebrates mountaintop mine sites found correlations of stream impairment with mining disturbances upstream (USEPA, 2002). However, their report found certain data gaps for which no correlations could be evaluated. The study recommended additional evaluation to determine:

- The duration of mineralization of groundwater discharges from mountaintop mining sites. Improvements in water chemistry may be expected, with time, as the backfills and valley fills are flushed of soluble minerals on the fresh rock surfaces.
- The correlation of the size of mining disturbance and associated “mining aquifers” in a watershed with the amount of mineralization. That is, do larger backfill and valley fills increase mineralization beyond that occurring for smaller fills?

6. Groundwater Quantity and Quality Conclusions

Removal of the pre-mining perched aquifer system and associated valley fill will impact the headwater reaches of first order streams in the region by eliminating streams. Impacts to valley bottom aquifer may or may not occur depending on density of valley sidewall fractures.

Creation of valley fill aquifers change the hydrology of streams receiving baseflow from valley fill aquifers by diverting a greater percentage of precipitation into the fill, allowing water to be released at a much slower and less intense rate compared to normal storm-induced stream hydrographs (Ritter and Gardner, 1993, Wiley, 2001, Messinger, 2002).

Groundwater chemistry within valley fills changes from Ca–HCO_3 dominated water to a Ca–Mg–SO_4 dominated water reflecting pyrite oxidation and neutralization of oxidation products in the fill interior (USGS, 1990, Wunsch, et al, 1996).

MTM/VF water chemistry indicates increases in TDS resulting from groundwater contact with unweathered overburden fill material.

Further Study: Impact of MTM/VF on alluvial aquifer systems; interaction between valley fill and adjacent aquifer systems; sources of selenium in MTM/VF regions; geochemical effects from weakly buffered overburden in valley fills; correlation of mineralization characteristics with specific stratigraphic horizons, size and age of disturbance; and the duration of mineralization and distance of effects downstream.

I. OVERVIEW OF APPALACHIAN REGION COAL MINING METHODS

Mining has been conducted in the Appalachian coalfields since European settlers arrived in the region in the 1700s. Uses of coal have progressed from simple home heating and cooking, to fuel for railroads and steamships and industrial processes, and now to a predominant share of the electric power generation market. To keep pace with increasing demand, methods of mining coal have advanced from pick-and-shovel works to steam-powered equipment and now to mechanized deep mines and large-scale surface operations. National industry trends have favored surface operations over underground mining in recent decades, driven by the advent of very large earthmoving equipment, and surface methods now account for the majority of nationwide production. This trend is expected to continue, as surface mines generally provide better coal recovery than underground mines and have lower overall production costs per ton of coal.

UNDERGROUND MINING DOMINATES COAL PRODUCTION IN THE STUDY AREA

In Kentucky, Tennessee, Virginia, and West Virginia, underground mining still dominates coal production, comprising 61 percent of the combined production for the study area in 1998, while surface mining methods account for the rest (EIA, 2000). A significant percentage of these surface mines can be categorized as Mountaintop Mining/Valley Fill (MTM/VF) operations, and use of this mining method has become widespread in recent decades in response to increasing competition from western coal producers. MTM/VF operations are generally the most economical and efficient forms of surface mining in steep-slope Appalachia and provide for the highest possible recovery of multiple coal seams.

The term "mountaintop mining" used in the EIS encompasses three different kinds of surface mining operations (contour mining, area mining, and mountaintop removal mining) that create valley fills. This is a broader definition than the legal definition used in SMCRA "mountaintop removal mining." Mountaintop removal mining totally extracts underlying coal seams, and the reclaimed land is left in a flat or gently rolling configuration capable of supporting certain post-mining land uses, such as industrial, commercial, residential, agricultural, or public facilities (including recreational facilities). Since the reclamation of a mountaintop removal mine will leave flat or gently rolling land, the "approximate original contour" (AOC) standard of SMCRA does not apply. This is also true of steep slope AOC variances allowed under SMCRA-which may occur at area or contour mines. Thus, the reclamation required of a mountaintop removal or AOC variance mine is markedly different from that of an AOC steep slope area or AOC contour surface coal mine. Steep slope AOC variances and mountaintop removal operations, by their very nature, result in greater excess spoil disposal. This EIS will use the broader terms "mountaintop mining" or "mountaintop operations" to refer to all of these types of surface coal mining in the steep slope areas of the central Appalachian mountains.

Because of significant differences and much variability in geology, topography, and property ownership patterns, surface mining practices can vary from state to state within the Appalachian coal fields. For example, significant "overburden to coal" ratios often restrict the Kentucky mining industry to two or three coal seams that can be economically extracted by mountaintop mining methods. As a result, the typical surface coal mine in Appalachian coal fields of Kentucky is

approximately 350 - 400 acres in size. In West Virginia, as many as 18 seams might be mined in some permits of more than 1000 acres. In Virginia, the permit sizes are typically smaller than West Virginia and Kentucky mines, and coal removal may be limited to 3-5 seams.

Because there are a very large number of small surface owners in the eastern Kentucky coal fields, acquisition of consent to entry for the purpose of mining is often a very expensive, difficult, and very time-consuming process. This land ownership pattern is quite different than that found in adjacent coal producing states, and also serves to greatly limit both the permit size and the scale of mining conducted by the Kentucky coal mining industry.

Surface coal mining operations in Virginia differ significantly from surface coal mining operations in West Virginia and differ somewhat from those operations in Kentucky. Surface coal mining in Virginia has a long history, with most of the actively-producing coal region affected by pre-SMCRA strip mining activities. Almost all of the permit applications received by VADMLR contain AML areas that total between 50 % and 80 % of the area. Most of the streams on these proposed mine sites have been impacted by pre-SMCRA mining, and may be impacted by old spoil and/or dislocated by the prior mining. Often streams shown on the USGS topographic maps no longer exist or may have been moved by placement of spoil into the stream. Often there are long segments of stream that have no defined stream channel: the stream may spread into a wetland, it may disappear under spoil, or it may have been affected in other ways by the pre-SMCRA mining activities that occurred in the vicinity.

The size of mining operations in Virginia is limited by several factors. These include factors such as geologic conditions, steep slopes, and fragmented mineral and surface property ownership. The remaining reserves are also fragmented by prior AML and underground mining operations creating relatively small non-contiguous areas of coal available to be mined. Proposed permit areas usually consist of second cut areas that are separated by AML highwalls that cannot be mined due to prior augering, the proximity of underground mining, or excessive ratios of overburden to coal. Companies in Virginia often mine ratios exceeding 20:1 in order to recover what coal is available. These AML benches and highwalls that are not mined are used to dispose of excess spoil generated by the adjacent remining operations. There are a few permits that have first cut areas proposed, but these are usually limited in extent and are adjacent to second cut areas. VADMLR requires companies to minimize valley fills by using the excess spoil to reclaim adjacent AML highwalls and benches. Virginia mining operations reclaim nearly all areas to AOC. There are no drag lines operating in Virginia.

Current technology achieves nearly the highest possible recovery of the coal reserves beneath a typical tract of Appalachian land; however, this is neither always economically feasible nor acceptable from an environmental standpoint. Modern coal mining combines a variety of approaches to coal extraction that reflect the maximum amount of coal that can be recovered from a given land parcel within current market conditions and the regulations that govern coal mining. The two basic approaches are underground mining, where the coal is extracted without removing the overlying soils and rock, and surface mining, where this material, known as *overburden*, is removed to expose the coal for extraction.

In this section, Appalachian coal mining methods are first reviewed to provide background for further discussion. Typical mountaintop mine complexes are then described. The typical

characteristics of MTM/VF operations are presented to summarize this composite mining practice in section III.J. Section III.L presents a review of the factors influencing the feasibility of coal mining on a given site and the typical approach to developing a mine plan.

1. Underground Mining Methods

A description of underground mining methods is provided in the EIS as background to facilitate the discussion of whether underground mining methods would be able to take the place of surface mining methods. This section also provides background to the description of the synergism between underground and surface mining methods for purposes of blending coal. In underground mining, also known as *deep mining*, coal is extracted by excavating within the horizon of a coal seam and without removing the overlying overburden for reasons other than primary seam access. This approach is practical for seams of greater than 100 feet in depth, as underground mining of shallower seams can encounter difficulties with roof integrity and surface cracking (Suboleski, 1999a). Underground mines can be categorized by the manner in which access to a coal seam is made, and by the manner in which a coal seam is extracted. Access methods can include drift, slope, and shaft mines, and extraction methods can include room and pillar (conventional and continuous) and longwall mining. The method of coal extraction is not dependent on the method of access, and multiple methods of access and extraction may be present in an individual mine. Although not directly related to the focus of this EIS on surface mining valley fill impacts, underground mines are part of the overall coal industry within the study area, representing at times a constraint on the extent of surface mining or an alternative to surface mining.

a. Underground Mine Access

The method of accessing a coal seam for underground mining depends largely on its vertical position relative to the ground surface. The three basic options are summarized by Figure III.I-1. A *drift* mine enters a coal seam horizontally, requiring that the access be where the coal outcrops on the side of a slope or mountain. This is generally the simplest and most economical mine access method due to the fact that there is no significant excavation into the overburden. A slope mine utilizes an inclined entry to access the coal seam and is employed where the coal outcrop cannot be directly accessed, but is still within a reasonable vertical distance from the ground surface. Slope entries are usually driven at angles of less than 16° from the horizontal, in order to facilitate conveyor haulage, and must tunnel through the rock above the coal, or overburden, to achieve this access (Suboleski, 1999b). A shaft mine consists of a vertical opening driven from the ground surface to the coal seam and is employed where the coal seam is relatively deep or cannot be otherwise accessed due to topography or property limitations. This elevator arrangement, known as a *hoist*, is used to transport coal and miners to and from the surface through the shaft, with coal carried in hoist cars known as *skips*, and miners riding in hoist cars known as *cages*. An individual mine may have more than one of these access types, depending on safety, coal haulage, ventilation, and supply requirements.

b. Room and Pillar Mining

The defining principle of a room and pillar mine is that portions of the coal seam remain in place to support the mine roof while coal is extracted. Room and pillar mines are developed by driving parallel series of *entries*, usually four to eight in a series, with perpendicular *crosscuts* that connect the entries to form a grid-like pattern in a panel of coal, which can be more than 400 feet wide and

half a mile long. Figure III.I-2 shows an example of a typical room and pillar mining plan. The coal blocks that remain within this pattern after primary coal extraction are referred to as *pillars* or *stumps* and serve to support the roof of the mine. The coal pillars are generally 20 to 90 feet wide, and the entries average 20 to 30 feet wide. Room and pillar mines are best suited to relatively small reserves, or reserves where variable coal quality requires selective extraction within the seam, and can be applied to seams from 28 inches to 13 feet in thickness. The equipment required for room and pillar mining has a smaller capital investment requirement than that for a longwall mine and can be more easily moved to other mine sites (Suboleski, 1999a).

After a panel has been fully developed, the mining direction is usually reversed for retreat or secondary extraction. During secondary extraction, some of the remaining coal pillars are removed in a systematic manner in order to maximize the amount of the coal seam that is recovered from the panel. Secondary extraction can result in roof collapse and subsidence as the roof support of the pillars is removed. The amount of secondary mining performed at a mine depends on safety, subsidence, geology, and coal market considerations. Room and pillar mines with both primary and secondary extraction can achieve approximately 70 to 80 percent recovery of a coal seam, while primary extraction alone can achieve only about 40 to 60 percent (McDaniel & Kitts, 1999). Within this general mining type, the two basic extraction methods employed in room and pillar operations are conventional and continuous mining.

b.1. Conventional Room and Pillar Mining

Conventional room and pillar mining employs a combination of mechanical cutting machines and blasting to extract coal from coal faces exposed within an advancing panel. Once the predominant mining method in the Appalachian coal fields, it now accounts for only about 10 percent of total production (Suboleski, 1999b). The conventional process is conducted in five distinct steps:

1) Cutting – the coal face is undercut, side, center, or top cut by a mobile machine that resembles a large chain saw. Cutting of the coal allows another open face into which the rock can be blasted.
2) Drilling – the coal face is drilled in a pre-determined pattern to insert a blasting agent or compressed air.

3) Blasting – the cut coal face is blasted to free the coal for loading and hauling.

Figure III.I-1
Basic Options for Underground Mine Access

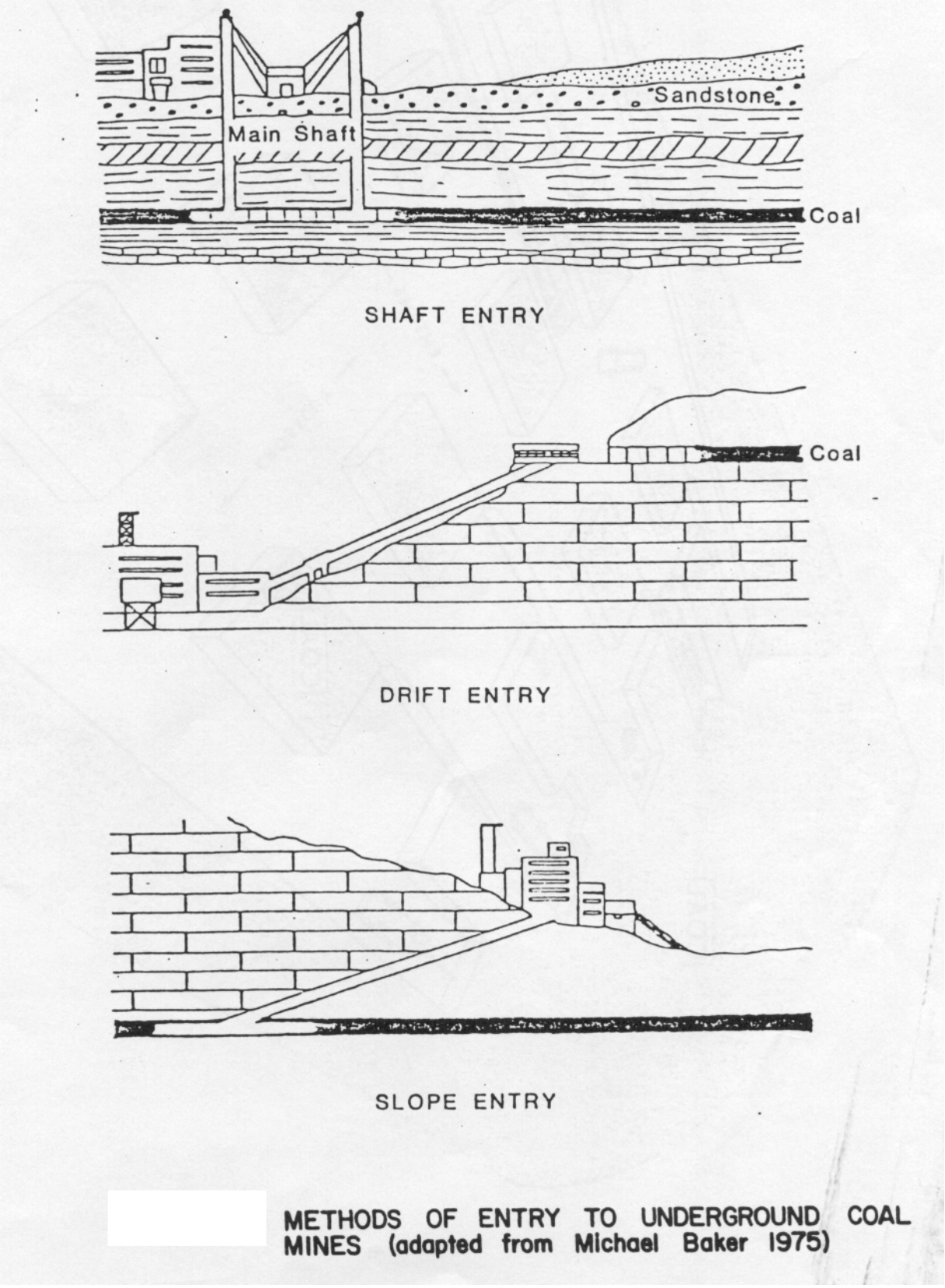
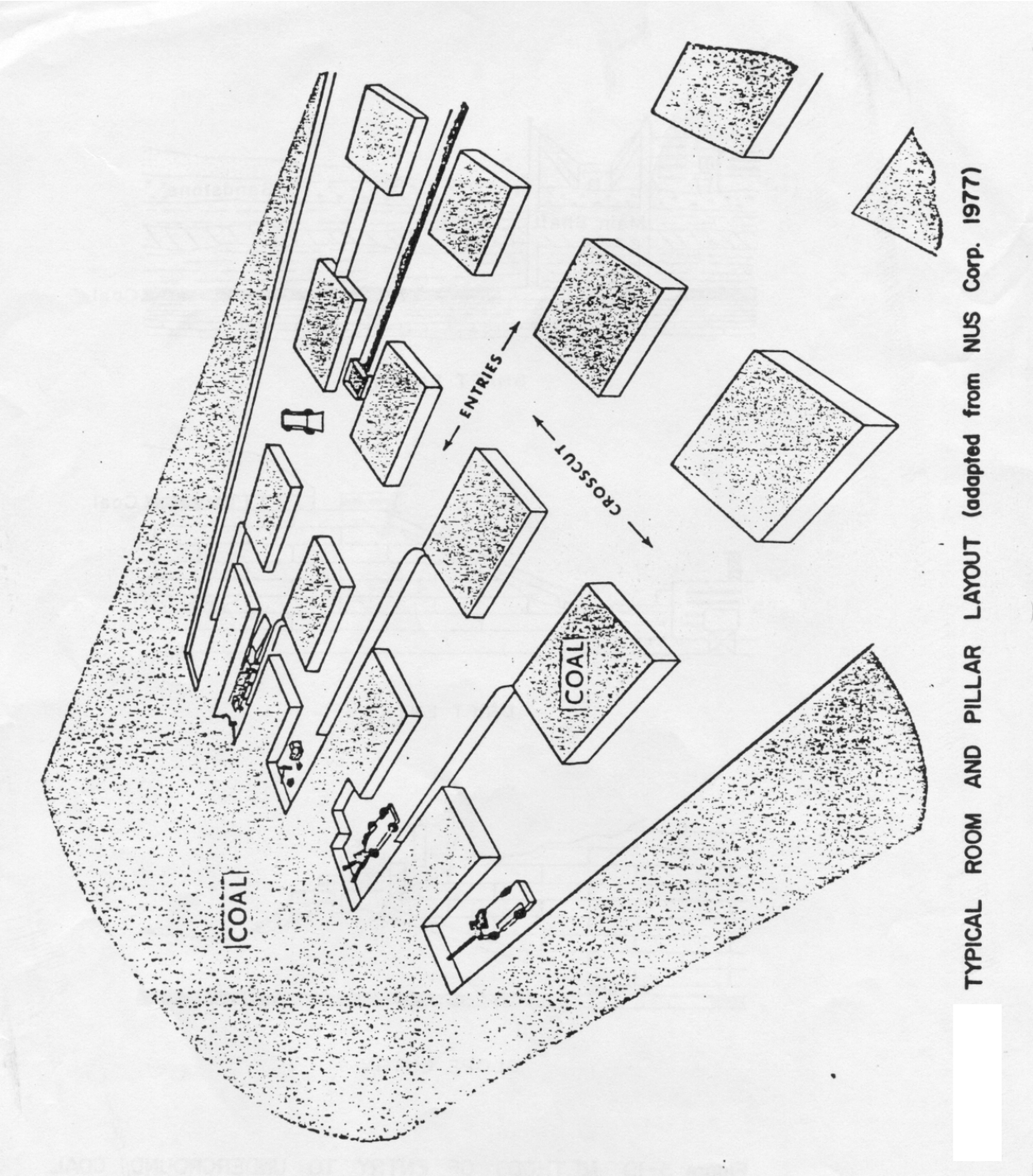


Figure III.I-2
Typical Room and Pillar Mine Plan



4) Loading and Hauling – the loose coal is transported to a belt conveyor or mine-car loading point and hauled out of the mine.

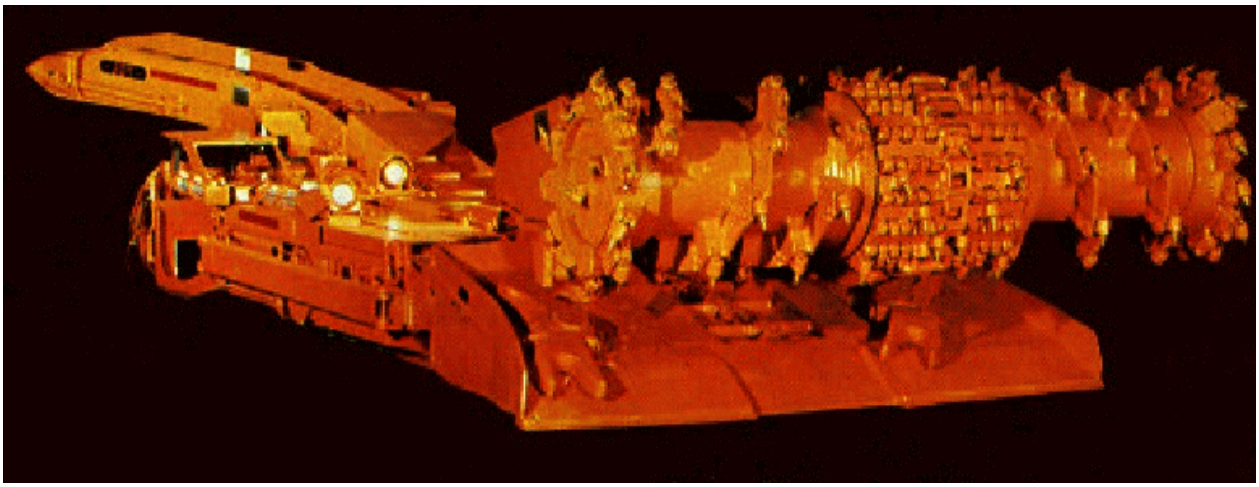
5) Roof Bolting and Advancement of Support Services – roof support is installed, ventilation is extended to the new working face, and supplies are brought in to develop the next set of entries and coal faces.

The conventional method is advantageous where the coal seam is irregular in thickness or quality, or if there is a parting (a layer of rock separating the seam) associated with the seam. The conventional method also allows for a certain amount of control over the product size, which is tied to the design of the blasting pattern.

b.2. Continuous Room and Pillar Mining

A more popular coal extraction technique of the room and pillar system is the continuous method, which utilizes a continuous mining machine to mechanically break the coal from the face and load it onto haulage equipment or belt conveyors. Figure III.I-3 shows a typical continuous mining machine, with cutting heads in the front and conveyor loader in the rear. When a cut into a coal face is completed, the continuous miner is removed from the face and roof support, usually roof bolts, is installed and ventilation is advanced. The continuous mining method has fewer operational steps than the conventional method, therefore reducing the number of required working faces in the coal seam. Continuous mining reduces manpower requirements, concentrates activity, and reduces support service problems. However, it is not as flexible for addressing variations in coal quality or the presence of partings.

Figure III.I-3
Typical Continuous Mining Machine



Modified from Suboleski, 1999a

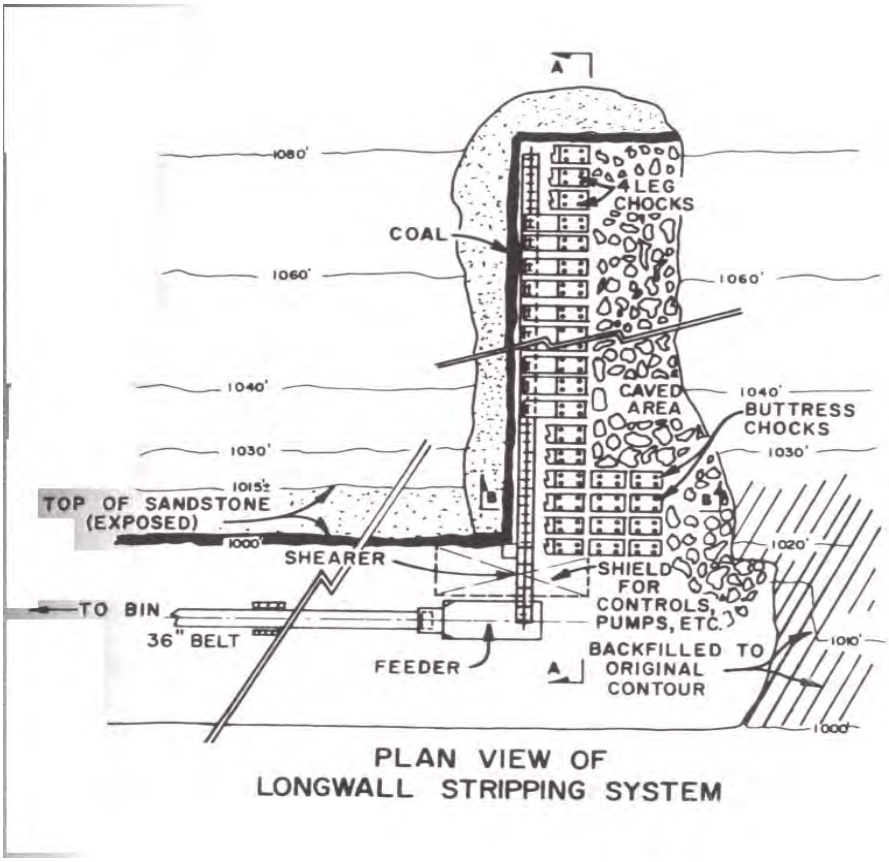
c. Longwall Mining

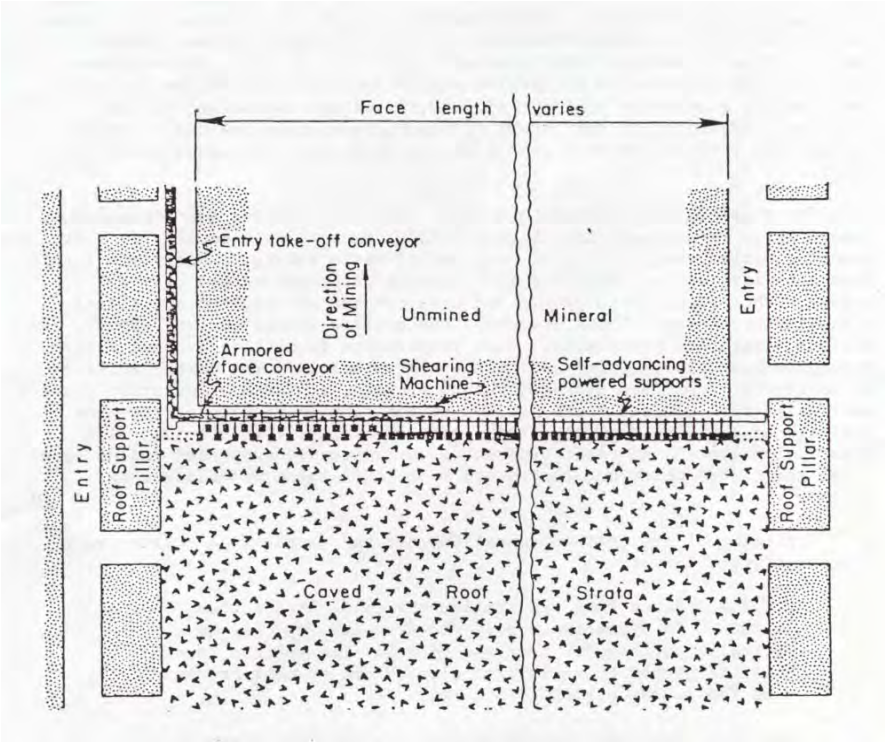
Longwall mining is characterized by use of mobile mechanical supports for the mine roof and provides essentially complete coal extraction within the working area of the longwall equipment. In the longwall mining method, two or three parallel entries, or *headings*, are driven into the coal seam via continuous room and pillar methods to a planned maximum extent, where a cross heading is driven between the ends of the entry headings to create a *panel*. These panels are usually 850 to 1,100 feet in width and 7,500 to 15,000 feet in length (Suboleski, 1999b). A shearer or plow-type cutting head mounted on a track then travels back and forth across the cross heading, cutting the coal off in strips and working backwards towards the origin of the panel. Shearers are the more popular of the two heads, cutting 30 to 42 inches of coal per pass compared to 6 inches per pass for a plow. In both cases, the traveling cutting head is mounted on an armored face conveyor, which stays parallel to the coal face being mined and transports freshly cut coal to the mine's main haulage system. When the end of the coal face is reached, the cutting direction is reversed, and the longwall miner moves back across the coal face in the opposite direction. The conveyor and cutter head are protected by a line of hydraulic roof supports, or *shields*, that are advanced with each progressive cut and keep the equipment parallel to the coal face. As the shields advance, overhead stresses cause the roof in the mined-out area behind them to collapse, filling the mine void with broken rock known as *gob*. Cracks resulting from the mine roof collapse do not generally propagate to the surface, but the entire surface area over a panel will subside to some degree as mining progresses. Subsidence is normally about two thirds of the thickness of the seam being mined (Suboleski, 1999a). Figure III.I-4 shows a working cutting head and shield arrangement at a coal face, and Figure III.I-5 depicts a typical longwall mine plan.

Figure III.I-4
Longwall Cutting Head with Shields

Modified from Suboleski, 1999a

Figure III.I-5
Typical Longwall Mine Plan





Longwall mining has several advantages over room and pillar mining, including a higher coal recovery rate of up to 85 percent (McDaniel & Kitts, 1999) and higher production rate when the longwall is operating. Longwall mining is the only practical method for seams of greater than 1,500 feet in depth (Suboleski, 1999b). This method of underground mining does require a relatively high capital investment and is not practical for reserves of less than 50 million tons, with double that figure preferred. A reserve of six feet or greater in thickness and of sufficiently regular shape to accommodate rectangular panels is also required (Suboleski, 1999a). Longwall mines are generally safer due to the overhead protection of the shields, provide better subsidence control over local pillar removal, and have lower support requirements, such as roof bolting, rock dusting (for fire suppression), and ventilation controls. However, longwall mines can suffer production delays when moving equipment between panels, and may not be suited to coal seams with many irregularities or in difficult geologic conditions. The equipment is also specific to the mine and may not be transferable to other sites after mining is completed. Some room and pillar mining is usually associated with longwall mining to extract coal reserves between the panels.

2. Surface Mining Methods

Surface mining involves removal of overburden to expose underlying coal seams for extraction, although surface mines may also employ surface-directed underground equipment, called augers or thin-seam (highwall) miners, for secondary extraction of coal without overburden removal. Surface mining is categorized by three basic operational methods: contour mining, area mining, and mountaintop removal mining. Secondary extraction associated with surface mining, collectively known as *highwall mining*, occurs after the final highwall limits have been reached. Underground mining entries may sometimes be employed when the limits of surface mining are reached. Surface mines can employ any combination or all of these methods to maximize the coal recovery from a given land parcel. Because excess spoil disposal can be potentially associated with any of these mining methods, this topic is discussed separately in Section III.K. Prior to discussing the individual mining methods, several common features of surface mines are reviewed for background.

a. The Surface Mining Process

Although approaches to surface coal mining can very greatly between individual mine sites, all share a series of common site development, operational, and reclamation activities, as follows:

1) Access Development – The first step in mine development is construction of a primary haul road to the mine site to provide public road access for equipment, employees, and supplies. Other internal haul roads allow movement of equipment and the haulage of coal and overburden, and these are developed as access is needed to working areas within a mine site.

2) Erosion and Sedimentation Controls – These controls include sedimentation ponds constructed to prevent siltation of receiving streams, and ditches constructed to convey runoff from disturbed areas to the sedimentation ponds. Diversion ditches are also built around areas affected by mining to divert runoff from upslope areas to natural drainageways. These facilities must be constructed prior to initiation of earth disturbance in a given area. Ditches may be temporary or permanent, and sedimentation ponds may also be left in place after mining if required for long-term

runoff control or to serve as an ecological component of the reclamation plan. In some cases, permanent stream relocations are also employed to reroute streams around working areas in reconstructed channels.

3) Clearing and Grubbing – This activity involves the removal of trees, stumps, shrubs, and other vegetation from the area to be affected. This allows for more efficient removal of topsoil, if topsoil salvaging is employed on a mine site for later use in reclamation. If topsoil is segregated, a dozer will typically strip the upper 1 to 2 feet of soil from mining areas for placement in stockpiles, which may be temporarily seeded with fast-growing grass species until needed for reclamation. On many sites within the study area, the existing topsoil is very thin and cannot be efficiently stripped or segregated for later use. Marketable timber is usually harvested prior to clearing and grubbing, and residual vegetative material may be wind-rowed and burned, disposed of in mine pits prior to backfilling, or reserved for reclamation uses. Valley fill areas are cleared and grubbed prior to fill placement to prepare the foundation to ensure stability of the fill.

4) Excavation – This activity is the physical removal of overburden soils and rock overlying the coal seams to allow equipment access for removal and haulage. Unconsolidated surface material and weathered bedrock can usually be excavated by equipment without blasting. To access seams in deeper, unweathered bedrock blasting is employed as part of the excavation process. In the blasting process, bedrock areas are first benched to create a level working surface, and a rotary drill then drills a pattern of holes, also known as "shot holes," to the next planned bench or coal seam to be exposed. A blasting agent (typically ammonium nitrate and fuel oil) is placed in the blast holes and connected by a electric or non-electric energy distribution system. Timing of individual detonations within the blast pattern allows for control over the fragmentation and intensity of vibrations. The void left after excavation is referred to as a mine *pit*. The broken rock that is removed is known as *spoil*.

5) Backfilling – After coal removal, mine pits are backfilled to dispose of spoil from new excavations and restore the ground surface. Backfilling, also known as *backstacking*, may be accomplished by a variety of methods, including casting by draglines or shovels, cast blasting, dozer pushes, and truck haulage and dumping. Normally, mining will advance through a mine site in a series of adjacent excavations, or *cuts*, with the spoil from each new cut being placed in the pit void left by the previous cut. Almost all sites generate excess spoil that must be hauled to valley fills or other disposal fill types adjacent to the immediate mining area.

6) Regrading – This activity is the leveling of spoil areas to final reclamation contours. After spoil casting or haulage and dumping, spoil areas usually have a very irregular surface that must be smoothed to better resemble a natural land surface. Regrading of spoil is primarily accomplished by dozers, with the final site topography determined by the site reclamation plan and postmining land use. These plans generally aim to achieve the SMCRA definition "Approximate Original Contour," or AOC, which is discussed in greater detail later in this section.

7) Topsoil Redistribution or Substitution – The final earthmoving activity is redistribution of stockpiled topsoil over the reclamation surface, or preparation of a rock-based topsoil substitute, if topsoil replacement is not employed. Where topsoil has been stockpiled, it is redistributed by dozers or scrapers at an application rate determined by available quantities, usually between 4 and 12 inches. On many mine sites in the study area, the existing topsoil is very thin or scattered among rock outcrops and cannot be efficiently stripped or segregated during clearing and grubbing, or has a low initial productivity. In these cases, a method of soil substitution has been developed, whereby acceptable strata in the overburden are placed on the regraded spoil surface. This material is then mechanically broken by passage of tracked equipment to produce a relatively fine-grained growing substrate. Use of topsoil substitutes requires a variance during the mine permitting process.

8) Revegetation – Following spreading or preparation, the topsoil or topsoil substitute is amended with fertilizer to create a fertile growing substrate, and planted and seeded with species mixes reflecting the intended postmining land use. Most mine sites in the study area occur in forested areas, and tree planting is sometimes part of the revegetation process. Other shrub and herbaceous species may be included in the revegetation mix for wildlife habitat. Planting is normally conducted by hand or with tractor-towed mechanical planters, and seeding accomplished using hydroseeders that concurrently apply a stabilizing cellulose mulch and fertilizer. Revegetation planting and seeding mixes are approved as part of the mine permitting process. If vegetation types or postmining land uses are proposed that differ from the premining land use of a site, then variance for postmining land use change must be approved.

a.1. The Importance of Stripping Ratios

Another commonality between surface mines is the method of determining the extent to which a coal seam is economically feasible for mining, and consequently determining which mining method or methods are best applied to that seam as it relates to other seams on a mine site. The principle method of assessing mining economics for a coal seam is its *stripping ratio*, which is typically expressed as bank cubic yards (in-place volume) of overburden moved per clean ton of coal produced. The higher the stripping ratio, the higher the cost of producing coal. When setting *highwall limits*, or the maximum horizontal distance into the hillside to which a coal seam will be mined, the stripping ratio of the seam is integrated between its low cover outcrop and potential high cover highwall limits until an overall stripping ratio is achieved that will allow acceptable production costs and profit. When an overlying coal seam is present, its coal production volume is added to that of the underlying seam and reduces its stripping ratio. Thus, removal of multiple coal seams may allow economical mining of areas of an underlying coal seam that otherwise could not be mined to that extent. Determination of stripping ratios and mine practicality for a given mine site is now largely accomplished by three dimensional modeling using mine planning software.

The determination of what stripping ratio represents an economically mineable situation depends on overburden type, excavation costs, coal market value, topography, and haulage distances. Stripping ratios of 15:1 to 20:1 are generally considered the upper limit for mine feasibility by any

method (Suboleski, 1999a). Changes in production costs and coal market conditions may result in differing economic stripping ratios over the life of a mine, and mine plans must retain the flexibility to respond to these variations by increasing or decreasing the extent of mining within the scope of the original mine plan.

a.2. Approximate Original Contour

Under SMCRA, surface mines are required through the process of backfilling and regrading to restore the mine site to AOC, defined by SMCRA as follows:

> "AOC means that surface configuration achieved by backfilling and grading of the mined area so that the reclaimed area, including any terracing or access roads, closely resembles the general surface configuration of the land prior to mining and blends into and complements the drainage pattern of the surrounding terrain, with all highwalls and spoil piles eliminated." Section 701(2)

Because the AOC concept is not quantified, interpretation of what constitutes AOC is open to subjective determination. In general, maximization of spoil placement in the backfill areas on the mine benches and a rolling regrade configuration resembling surrounding topography is accepted as AOC. When these conditions are not met, an AOC variance is necessary. The regulations and policies regarding achieving AOC are discussed in greater detail in the No Action Alternative of this EIS.

b. Contour Mining

Contour mining takes place in mountainous or rolling hill areas where it is uneconomical or unfeasible due to property ownership conflicts to remove all of the overburden from a particular coal seam, and mining is limited to the side of a mountain or to the end of a ridge line. When occurring on the end of a ridge line, this method may also be referred to as *point removal*. In contour mining, operations progress along the outcrop of a coal seam, removing overburden inward towards the mountaintop or ridge core to the highwall limit of that coal seam as determined by its stripping ratio. This results in mine cuts that wrap around mountaintops or ridge lines parallel to contour in a sinuous pattern dictated by topography. Contour cuts may be conducted on multiple seams on a given mountain or ridge line, stepping upward in elevation in a layer-cake pattern and extending to greater depths because of the stripping ratio benefits of overlying seam mining. The contour method is highly dependent on mobile equipment and does not employ draglines. The lateral movement, or *haulback*, technique is the most common contour mining style. A picture of a typical contour cut is provided by Figure III.I-6.

Figure III.I-6
Typical View of a Contour Mine Cut

Source: Carr, 1999

To begin a contour mine, an initial cut, known as a *box cut*, is opened at the coal outcrop and excavated to the highwall limit, forming a mine pit. Spoil material from this first cut may be temporarily stockpiled on site for use in later backfilling, but is usually hauled to an excess spoil disposal area. On steep-sloped sites, some spoil from almost all succeeding cuts must be disposed of in fills as well. After the coal is removed from the first pit, a second cut continues along the contour following the coal outcrop, and spoil from the second cut is placed in the first pit area. The preferred methods of spoil movement are shovel, hydraulic excavator, or loader and truck combinations. Pan scrapers may also be used in a cycling pattern, but this approach is now largely obsolete. The selective placement of spoil by trucks allows for secondary extraction activities, such as highwall mining, to take place on the usually narrow contour mine bench. Successive cuts continue along the contour, with new spoil being placed in the previous pits. Where multiple seams are being mined, the spoil may also be placed in the downhill pits of lower seams. Final reclamation grading of the highwalls follows the approximate original slope of the hillside that was mined.

Contour mining may be employed for the entirety of a mine operation or found in association with the other surface mining methods to develop areas for larger equipment, recover low elevation coal seams on steep slopes, and seams from areas of valley fills prior to fill placement. Contour mines offer the advantages of mine plan flexibility, generally lower capital costs, at least partial recovery of coal reserves from steep sites, and the ability to adjust stripping ratio

limits in response to market changes. The economic stripping ratio limit for contour mining is approximately 10 to 12 (Suboleski, 1999a). This method is not suitable for large coal reserves and does require a disposal area for spoil on steep-sloped sites. If used for the entirety of a mine operation, contour mining may also leave deeper coal reserves isolated from future recovery within the cores of mountaintops and ridge lines.

c. Area Mining

Compared to contour mining, area mining takes place over a range of slope conditions and is not restricted to the side of a mountain or ridge line. Area mining occurs when relatively low slopes and/or multiple coal seams produce stripping ratios favorable for mining across topography, rather than around it. Although area mining may affect an entire mountaintop or ridge line, it is considered a separate entity from mountaintop removal in that an area mine site must be reclaimed to AOC. All coal seams may not be mined across their entire extent. The area mining method will generally have larger working areas than the contour method and may employ large earthmoving machines for primary coal production.

Area mines may use a cross-ridge approach, where mining progresses parallel to the long axis of a ridge; or a side-ridge approach, where mining progresses perpendicular to the long axis of a ridge. In both cases, cuts are oriented perpendicular to the direction of advance. The cross-ridge technique provides consistent operational costs and coal production by simultaneously mining the high stripping ratio coal at the ridge crest and the low stripping ratio coal at the coal outcrops. Consequently, each perpendicular cut averages out to an economically acceptable stripping ratio. The side-ridge approach allows for easier cast or other movement of spoil into valley fills paralleling ridge lines, but generally progresses from low stripping ratios to high and back to low on the opposite side of a ridge, requiring a balance of mining costs over a longer time period. Both approaches and several directions of advance may be present on a given mine site to make best use of the local topography with regards to overburden removal efficiency and equipment travel distances.

Area mining may begin by excavation of an initial cut across the entire width of a mountaintop or ridge line containing coal reserves. This initial cut may start as a contour cut on the basal coal seam and progress inward until a linear primary highwall is established perpendicular to the direction of advance. Smaller equipment, such as hydraulic excavators, loaders, and dozers, makes these initial cuts and works in advance of the primary highwall to remove upper strata and coal, and to create a flat working bench for blast hole drilling. In steep slope areas, spoil from development activities is often placed in a valley fill or other type of disposal fill. Successive highwalls are opened by taking smaller block cuts from and parallel to the face of the primary highwall. Spoil movement at the primary highwall uses larger equipment, such as draglines, electric shovels, hydraulic excavators, or large loaders, with the latter three loading haul trucks for spoil transport. Spoil may also be moved by the cast blasting method, where the force of the blast is used to cast material (30-60 percent) into an adjacent open pit, and dozers then used to push remaining spoil onto the backfill to expose the coal. Where potentially acid-forming overburden is encountered, this material may be segregated for special placement in backfill pods to isolate it from oxygen and water. Figures III.I-7 and III.I-8 illustrate how an area mine will progress using the various methods for spoil movement. Figure III.I-9 provides a photograph of this type of mining progression using a dragline, with development equipment

working to the far left, bench drilling in preparation for blasting in the left center, active spoil movement in the center, and backfilling occurring to the right.

Figure III.I-7
Multiple Seam Surface Mining Sequence - Dragline, Shovel/Truck, and Loader/Truck Operation

Modified from OSM AOC Presentation, 1999

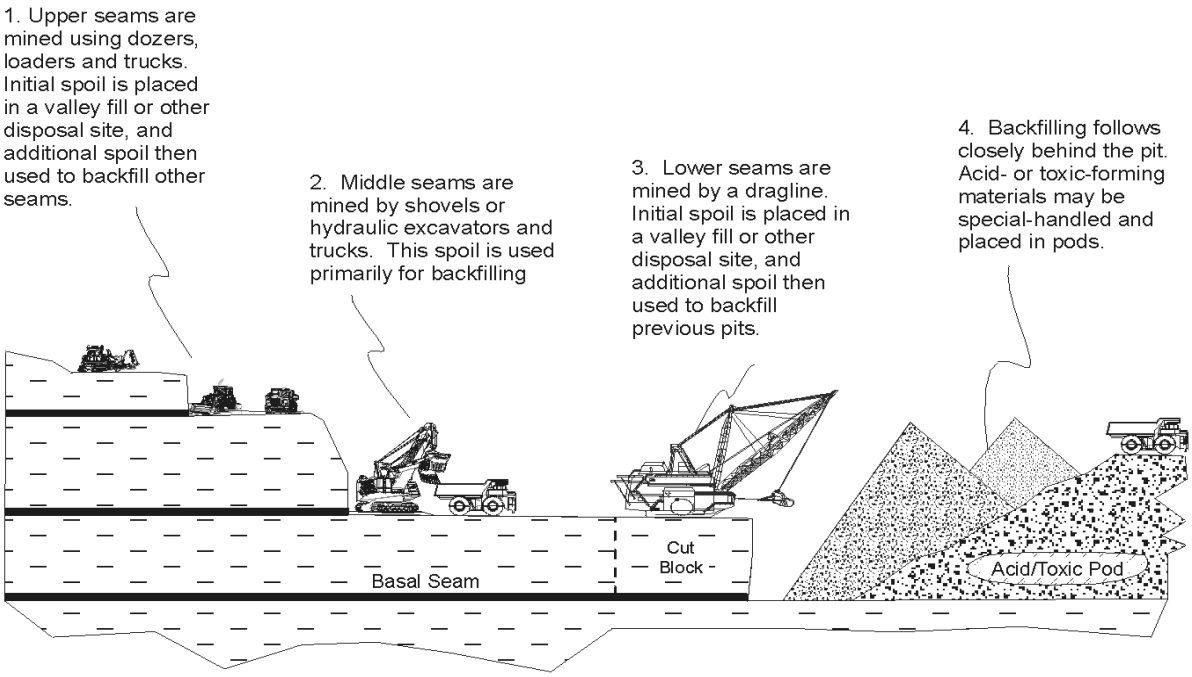
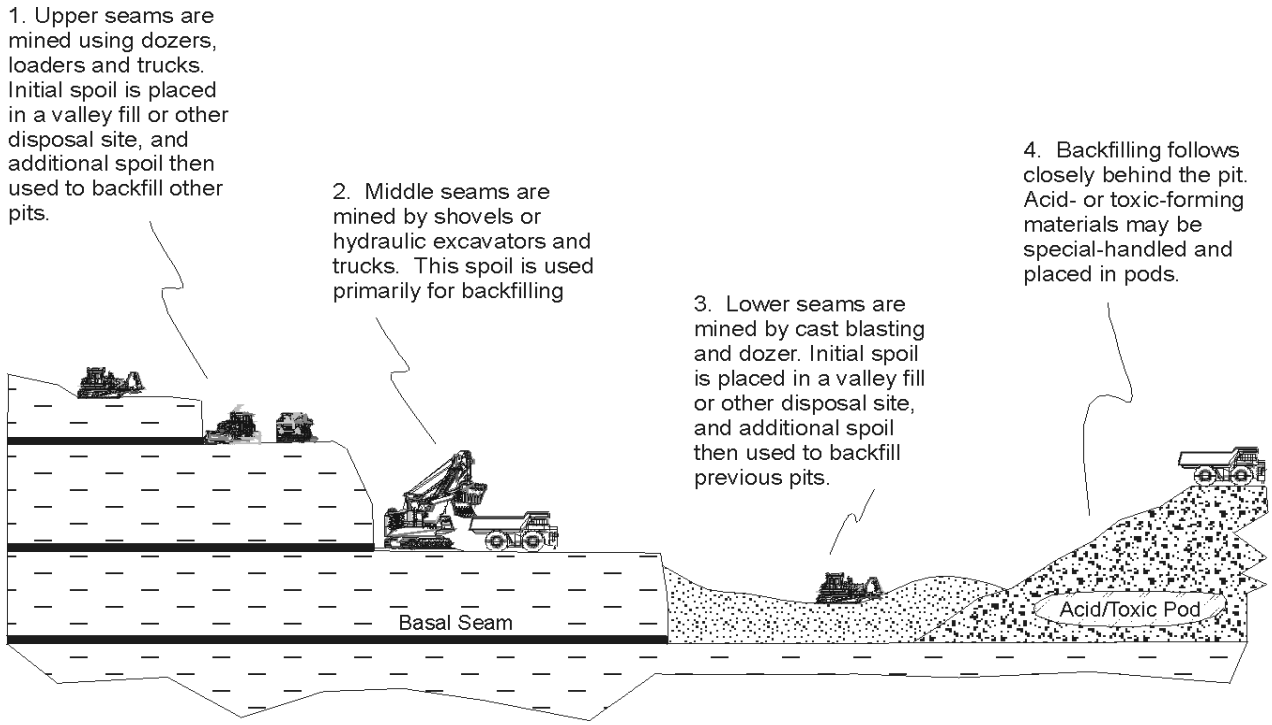


Figure III.I-8
Multiple Seam Surface Mining Sequence - Shovel/Truck, Loader/Truck, and Cast Blasting/Dozer Operation



Modified from OSM AOC Presentation, 1999

Figure III.I-9
Typical View of Area Mine Progression

Modified from Arch Coal, Inc., 1999

As with contour mining, spoil from new cuts is used to backfill previous pits. When cast blasting is employed, spoil is moved away from the currently open highwall, rather than against it, leaving a single, long open pit ready to receive spoil from the next cast blast. If a dragline is used with cast blasting, it usually rests on a prepared pad on the spoil within a cut that has been blasted. For a conventional blast, where a highwall is broken in place, the dragline usually rests on the adjacent intact highwall.

Shovels, hydraulic excavators, and loaders work within the pit. Movement of spoil by dragline results in long, linear ridges of spoil across the backfilled surface, while truck placement associated with the other types of production equipment may be more selective. Regrading of backfilled spoil for reclamation progresses behind the working areas.

If this basic mining approach were carried completely across a mountaintop or ridge line on the basal coal seam, crop to crop, it would be considered a mountaintop removal mine. However, an area mine will typically encounter high stripping ratios on the upper seams as topography changes or other restrictions that preclude complete removal of the basal seam. Secondary extraction, such as highwall mining, may be conducted to recover part of these otherwise inaccessible reserves. Most area mine operations will also contain components of contour mining to recover low elevation seams on steep slopes and those that would otherwise be buried in valley fills.

Area mining offers the advantages of a high recovery rate from the reserve, high production rate potential, and the potential to restore a site to AOC. However, area mining requires a large capital investment and large reserve base to be practical ($\geq$1,000,000 tons), and can entail disposal of large volumes of excess spoil.

d. Mountaintop Removal Mining

Mountaintop removal mining (MTR) is considered a special case of area mining that results in complete recovery of coal reserves above a basal coal seam. Coal extraction must be accomplished by removing all of the overburden above the basal seam. Reclamation creates a level plateau or gently rolling contour that both has no highwalls remaining and is capable of supporting certain post-mining land uses. In practice, the term mountaintop removal is used more broadly and sometimes applied to sites not meeting these criteria if still descriptive of the overburden removal method.

The basic operational sequence, highwall progression, and backfilling methods used in MTR are the same as those used for area mining, and so are not repeated here in detail. The progression of equipment shown by Figures III.I-7 and III.I-8 would simply continue working through the mountaintop or ridge line until the outcrop of the basal coal seam was encountered on the opposite side. To illustrate the concepts of excess spoil disposal and topographic changes that may be associated with MTR, Figure III.I-10 shows on a broader scale the sequence of steps in a hypothetical MTR operation that uses the side-ridge technique with a valley fill. Note that the quantity of spoil available for backfilling, and consequently the regrade elevation, diminishes in the latter cuts because of the initial movement of excess spoil to disposal areas.

Figure III.I-10
Typical Mountaintop Removal Mining Sequence

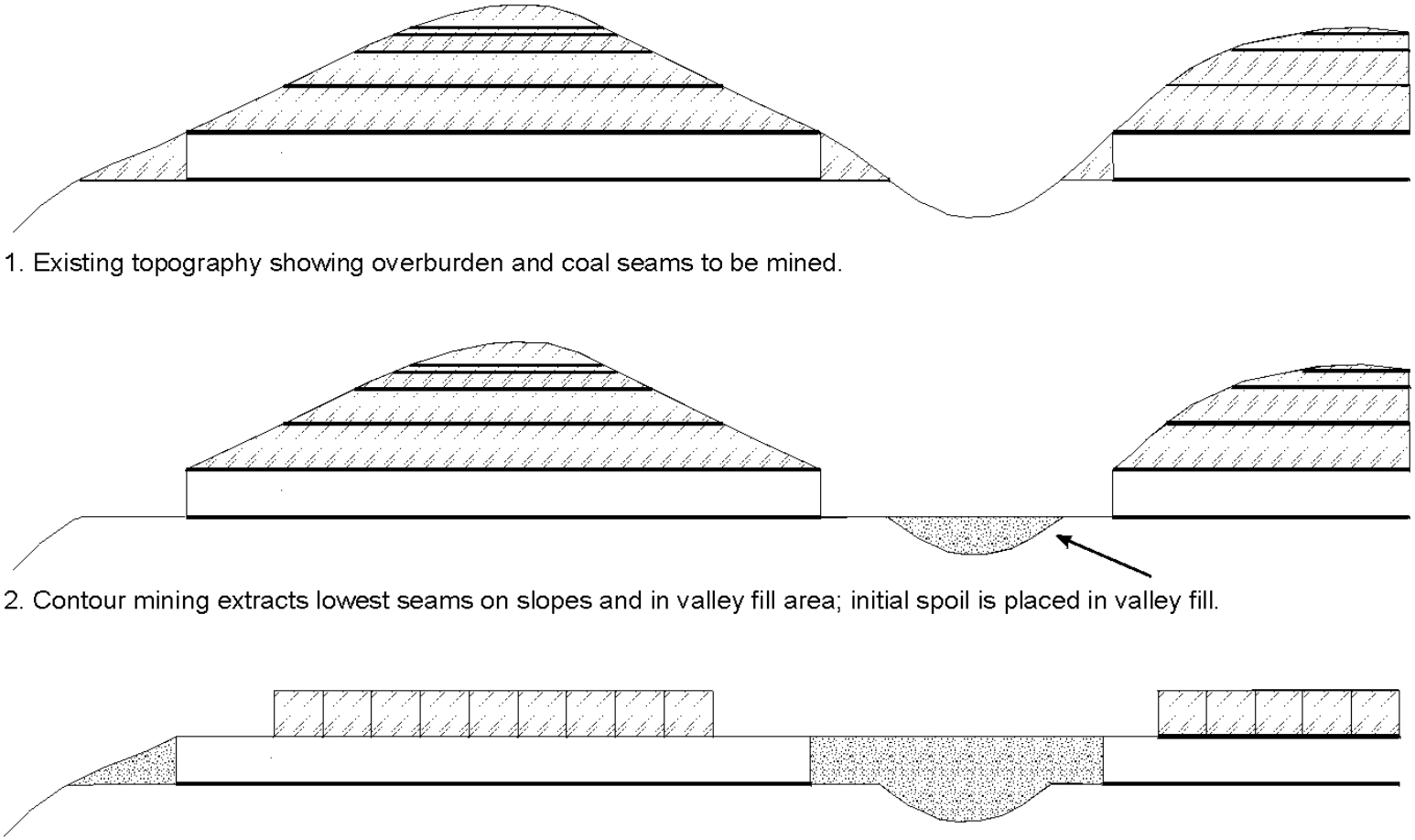
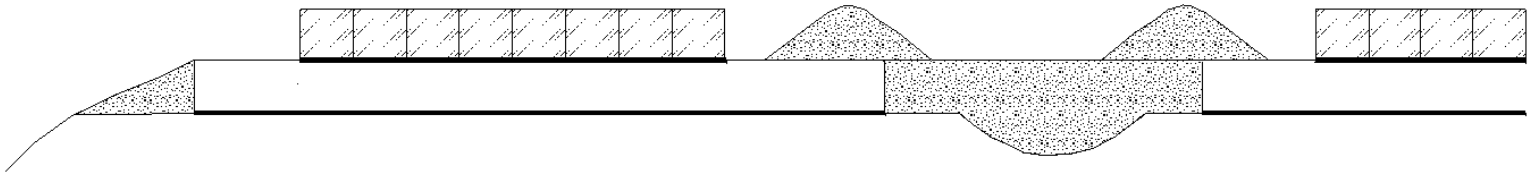
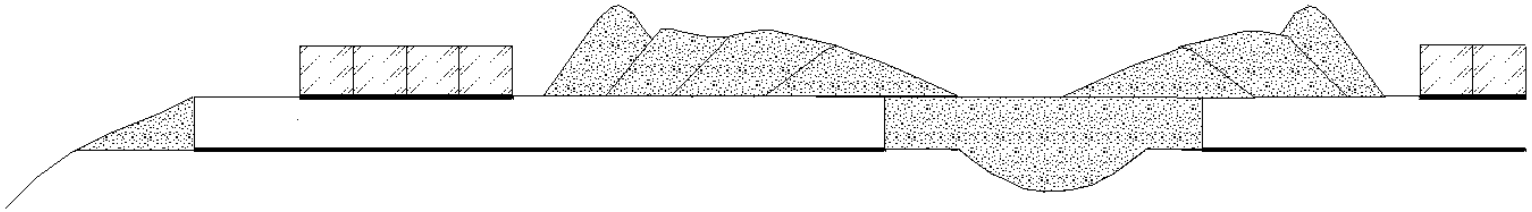


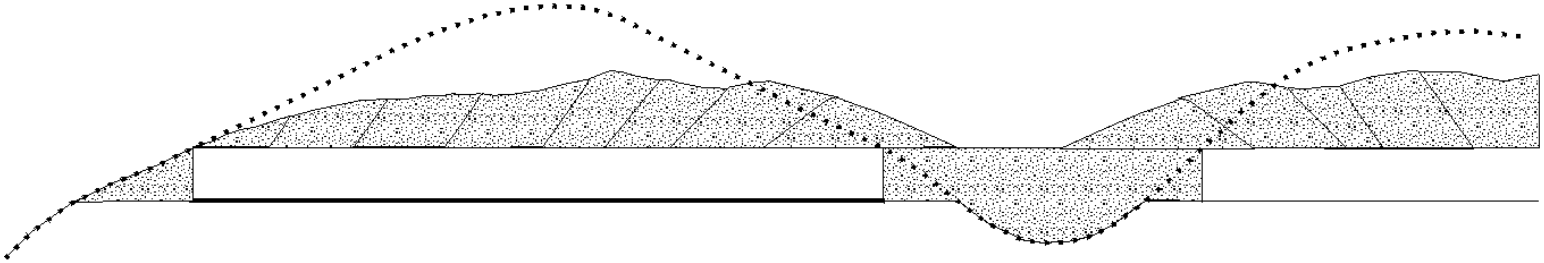
Figure III.I-10 (continued)
Typical Mountaintop Removal Mining Sequence



4. First cuts are mined, with spoil placed on top of valley..



5. Subsequent cuts are mined, with spoil used for backfilling and regrading.



6. Mining is completed, along with backfilling and regrading (original topography is superimposed).

Because MTR operations can balance mining costs between high and low stripping ratios, this mining method can achieve essentially 100 percent recovery of coal reserves, a portion of which might otherwise be permanently isolated beneath the reclaimed mine site. Stripping ratios of 13 to 20 may be economically feasible for large operations (Suboleski, 1999a). Reclaimed MTR sites generally have lower slopes and topographic relief than original conditions, and must be authorized only where intending agricultural, residential, industrial, or commercial uses. This type of operation also precludes any future disturbance of the site by re-mining, since no coal remains to be feasibly recovered from the surface. MTR operations account for approximately one quarter to one third of Appalachian coal production (Suboleski, 1999a).

Like area mines, MTR operations require large capital investments and working reserves to be feasible, and can require disposal of substantial amounts of spoil in valley fills. Mine planning can also be more complicated to achieve a net profit from the overall operation.

e. Highwall Mining

Augering and continuous highwall mining are secondary extraction methods that allow additional coal extraction from beneath highwalls after their stripping ratio limit has been reached. This is the last activity to be conducted in a mine pit before it is backfilled.

In auger mining, horizontal holes are drilled into a coal seam with auger stems driven by a rotary shaft with a hydraulic ram, working on the principle of an Archimedes screw. The auger head diameter is usually two-thirds the coal seam thickness, and augers may come in single, dual, or triple head configurations. While auger holes can reach a distance of 400 feet, 200 feet or less is a more practical limit, as the auger may intersect the bottom strata or wander laterally into adjacent holes as its depth of penetration increases. Augers have a maximum recovery rate of about 33 percent (Suboleski, 1999a). As coal is produced from an auger hole, it is usually loaded directly into haul trucks using a front end loader. Figure III.I-11 shows typical components of an auger system.

A continuous highwall mining machine, or “highwall miner,” may be used in place of an auger when coal seam characteristics permit. A continuous highwall miner typically has a front set of rotary cutting heads that cut coal from a seam beneath a highwall and direct it onto following conveyor cars for delivery to the pit area, where a stacking conveyor piles the coal in preparation for truck loading. A launch vehicle may be used to direct the initial entry of the miner, with a dedicated wheel loader to move the vehicle to the next position. Depth of penetration for a continuous highwall miner is variable depending on geologic conditions, but can reach 400 to 1,000 feet. Continuous highwall miners have a better recovery rate than augers, up to 45 percent of the reserve (Suboleski, 1999a). Typical components of a continuous highwall mining system are shown in Figure III.I-12.

Figure III.I-11
Typical Auger System Components

Single Stem Augers

Dual Stem Augers

Triple Stem Augers

Auger Driving Rig

Modified from Carr, 1999

Figure III.I-12
Typical Continuous Highwall Miner System Components

Continuous Miner

Conveyor Cars

Launch Vehicle

Stacker Conveyor

Modified from Carr, 1999

Highwall mining can reach coal reserves that are not economical to mine from the surface and is relatively inexpensive compared to other production methods. However, highwall mining has a low recovery rate due to the coal pillar, or *web*, that must remain intact between each hole. Maintaining this web is critical in preventing the intersection of holes, maintaining highwall stability, and preventing loss of equipment in collapsed holes. In many cases, highwall mining negates any possibility of future surface mining at a site because of mechanical damage to the coal seam and higher stripping ratios resulting from removal of part of the reserve. Normally, highwall mining can only be conducted in a down-dip direction to prevent excessive dewatering of the overlying strata or potentially dangerous dewatering and contamination from intersection of deep mine workings. Both augers and continuous highwall miners are specialized machines with sporadic use on a mine site, so they are normally provided by contractors rather than owned by a coal company.

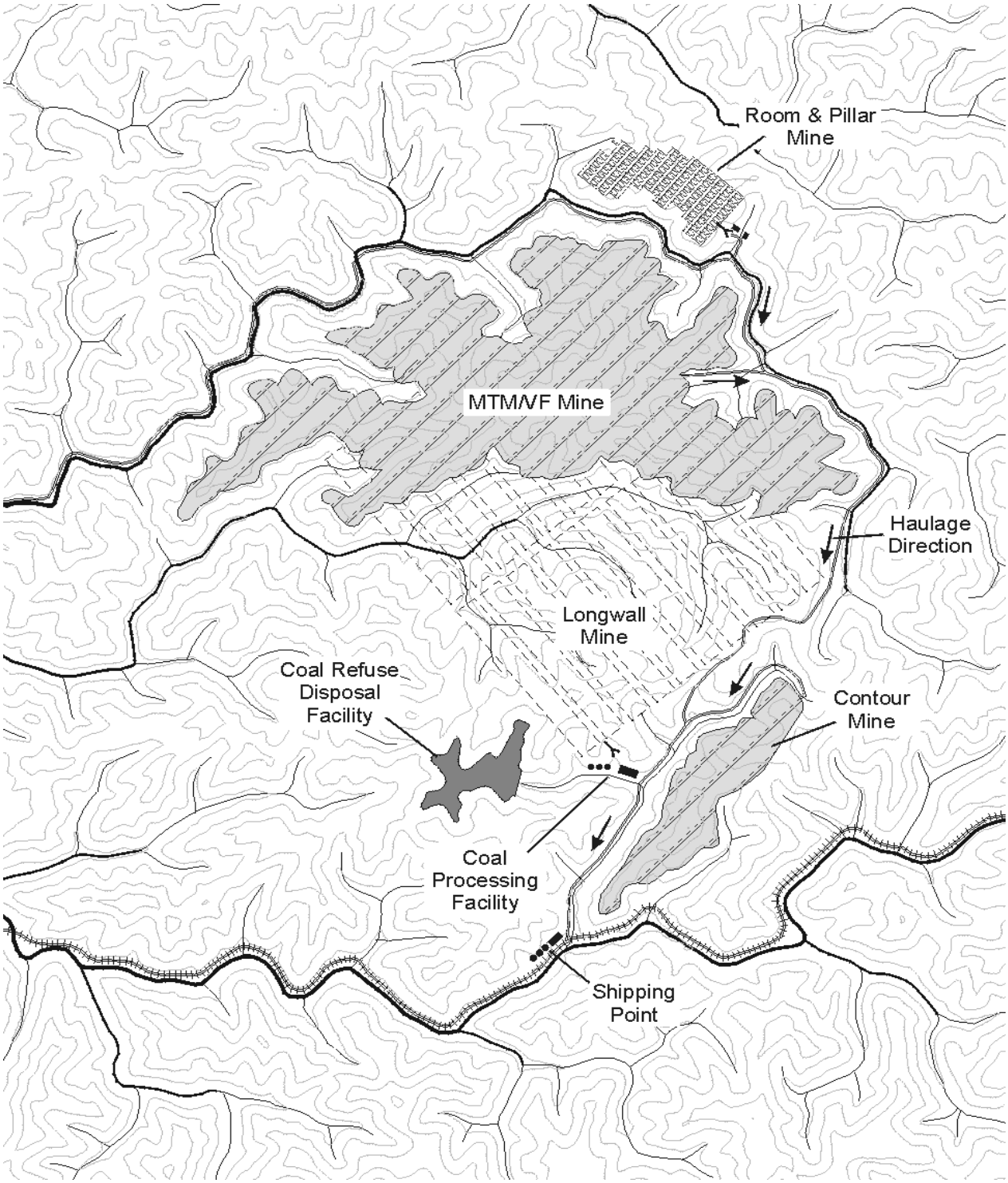
3. Mountaintop Mining Complexes

As defined for use in this EIS, MTM/VF mines are contour, area, or MTR operations that generate excess spoil and dispose of it in the heads of hollows or valleys of streams. Because MTM/VF mines are a relatively recent development compared to centuries of underground mining and other surface works, they typically rely on existing transportation (railroad or barge) and marketing infrastructures from earlier mining periods. Multiple independent surface and underground mine sources may contribute to a single shipping point directly or via a coal processing facility. These mines and facilities are seldom owned or operated by a single corporation, but rather are tied together by economic necessity in a loose production-processing-transportation group sometimes referred to as a *mining complex*. (Note that this term is not used in the same context as the Kentucky AOC term “mining complex.”) The major components of a typical mine complex are shown in a hypothetical layout presented on Figure III.I-13 and summarized in the following.

a. Shipping Point

Long distance coal transportation to consumers normally occurs by way of railroads or river barges, with river barges being the less expensive of the two alternatives. Local transportation, within about 10 to 12 miles of a mine site, is usually by truck. When railroads or barges are used, a shipping point is required to provide transfer facilities from truck haulage or belt conveyors to rail cars or barges. In some cases, a processing facility may serve as a shipping point if it is located on a rail line or a navigable river. Shipping points require a large capital investment to initially develop and are very dependent on location in major stream or river valleys to allow access by railroads or barges. As such, they are a consideration in the geographic siting and extent of mining complexes and may form the hub of mining development.

Figure III.I-13
Typical Mining Complex Components



b. Processing Facility

Both underground and surface mine coal may contain excessive sulfur or other impurities and not be suitable for immediate use by the consumer in its state at the mine mouth. This coal must be processed to remove impurities or blend with higher quality coal before delivery to the shipping point. Processing facilities may include such mechanisms as screens to separate coal into acceptable size grades, crushers to further reduce coal to desired size grades, and washing plants to clean rock and sulfur impurities from coal. Washing plants use a high density medium, usually magnetite, to float and separate low density clean coal from these contaminants with a closed-loop water recycling system. Reject materials from screens and crushers and residue from washing plants are hauled or pumped to coal refuse disposal facilities. Processed coal may then be blended with other coal stock to achieve the desired market quality grades. Blending may be accomplished by mobile equipment, such as loaders, or using a system of mobile stacking conveyors. Stockpiles and/or silos are typically present on site to store raw, cleaned, and blended coal prior to transport to the shipping point.

Coal processing facilities may be associated with older underground mines and may pre-date the surface operations from which they receive coal. In most cases they are owned by the MTM/VF operations which they serve or a related company. Larger MTM/VF operations often construct their own on-site processing facilities.

c. Coal Refuse Disposal Facility

Reject material, or coal refuse (impurities from the cleaning of coal, often consisting of shale), is typically disposed of off-site of a coal processing facility due to land occupancy requirements. Most older coal refuse disposal facilities are a large impoundment formed by constructing a berm across an existing hollow or valley, and essentially become “valley fills” by the time refuse disposal is completed. The berm is often constructed from the coarser refuse material in a series of lifts as new material accumulates behind the berm. Refuse with small particle sizes, known as *fines*, is usually pumped in slurry form from the processing facility to the refuse impoundment behind the berm. Aside from storage, the refuse impoundments serve to settle fines and decant clean water from the pumping slurry. Anecdotal evidence indicates that few facilities of this type have been permitted in the last 15 years, and that combined refuse disposal is more common today.

Coal refuse disposal facilities are most often operated by the attendant processing facility. Coal refuse disposal facilities are long-term investments because of their size, support facilities, and reclamation requirements. The typical life of a coal refuse disposal facility is approximately 20 years.

d. Surface Mines

One or more surface mines may contribute to a single coal processing facility and/or shipping point. For the hypothetical example on Figure III.I-13, both a large MTM/VF operation and a smaller contour mine contribute to the single processing facility and shipping point. Because of multiple seam mining and in-pit blending capabilities, surface mines can more readily meet changing market demands for coal quality blends than underground mines. Under normal circumstances, about 10 to 15 percent of surface mine output will go to a processing facility for cleaning and blending, and the rest will be transported directly to the shipping point. Both transport systems rely on overland

truck haulage more frequently than belt conveyors. Anecdotal evidence suggests that the combined haulage distance to the processing facility and processing facility to shipping point is usually about 12 miles and can be 50 miles or more when coal prices support it.

e. Underground Mines

Usually, one or more large underground mines will be associated with a coal processing facility, and may deliver their output to it by overland trucks or belt conveyors. Additional smaller underground operations may also be present, relying exclusively on overland truck haulage and sometimes referred to as "road coal" operations. The hypothetical example on Figure III.I-13 includes a large longwall mine feeding its output directly to the processing facility by belt conveyor, and a small room and pillar mine hauling its output to the facility by truck. Underground mines will be at approximately the same distance from coal processing facilities and shipping points as surface mines.

J. MTM/VF CHARACTERISTICS

As defined for use in this EIS, MTM/VF mines are surface coal mine operations in steep terrain that generate excess spoil and dispose of it in the heads of hollows or valleys. The general mining methods used for MTM/VF operations have been presented in Section III.I.2. Because all of the surface mining methods previously discussed may generate excess spoil over a wide range of mine sizes, there is considerable variation in individual mine site characteristics associated with MTM/VF. Topographic and geologic differences also produce significant variations in mining practices and scale of excess spoil disposal between regions and states within the study area. This section focuses closer on the typical settings, mine site components, and operational characteristics that are associated with MTM/VF mining in the study area.

1. General Setting

For the most part, trends in topography, geology, and demographics have produced a relatively consistent setting for MTM/VF mine sites and their surroundings within the study area. The following summarizes some of the specific site features that these mines have in common.

a. Topography

By the definition applied in this EIS, MTM/VF mines are/will be located on mountaintops and ridge crests with attendant hollows and valleys in which excess spoil is/will be disposed. The exact topographic setting will vary from site to site, but can be expected to follow this theme. Degree of topographic relief varies within the study area, generally increasing from southeast to northwest. Refer to the Physical Setting section of this EIS for a detailed description of study area topography and distribution of steep-slope conditions.

b. Coal Reserves

MTM/VF operations include single-seam contour mining, multi-seam area mining, or multiple seam mountaintop removal mining, or, combinations of all of these in a single permit. The actual number of seams mined is dependent on thicknesses and depth intervals. Some mountaintop removal operations may mine as many as 18 seams. The depth to the lowest, or basal, seam to be mined is normally about 250 feet, but may be as much as 600 feet on sites with favorable stripping ratios (Meikle & Fincham, 1999). The depth to the uppermost seam to be mined is usually around 60 feet. The numbers and depths of coal seams mined are generally greater in West Virginia than in Kentucky and Virginia.

Some previous mining may be present within the permit and operational areas of a MTM/VF mine. If previous mining is present, the deeper, thick coal seams will most likely have been mined by underground methods, and some may still be in active production. Readily accessible shallow seams may have been removed to some extent by contour methods during the 1900s, and some more recent contour cuts will have employed highwall mining to extract additional coal. Local small room and pillar workings, or “punch” mines, may also be present on the seams to be extracted by surface methods. Natural gas wells are common throughout the coalfields of the study area, and most MTM/VF mine sites will possibly contain one or more active or abandoned gas wells.

c. Transportation Access

MTM/VF mine sites are not typically accessed by public road service, but are generally within several miles of a public road. A coal company will develop its own permitted haul roads and a connection to the public road system, based on the optimum route to coal processing or shipping facilities. Where truck haulage traffic travels on public roads, a coal company may enter an agreement with the road authority to perform certain maintenance activities as compensation for damages from increased truck traffic. In some cases, variances are granted to: 1) close portions of public roads for mine traffic; or, 2) relocate or permanently close a public road to accommodate mining activities. Mine haul roads may also be released for public use after completion of mining, with the local road authority assuming maintenance responsibilities. In these cases the mine company often completes the grade work for the road, and the road authority completes the paving. Where alternative post-mining land uses are approved, the haul road may be upgraded by the operator to state highway department standards as a condition of bond release, in order to fulfill infrastructure requirements.

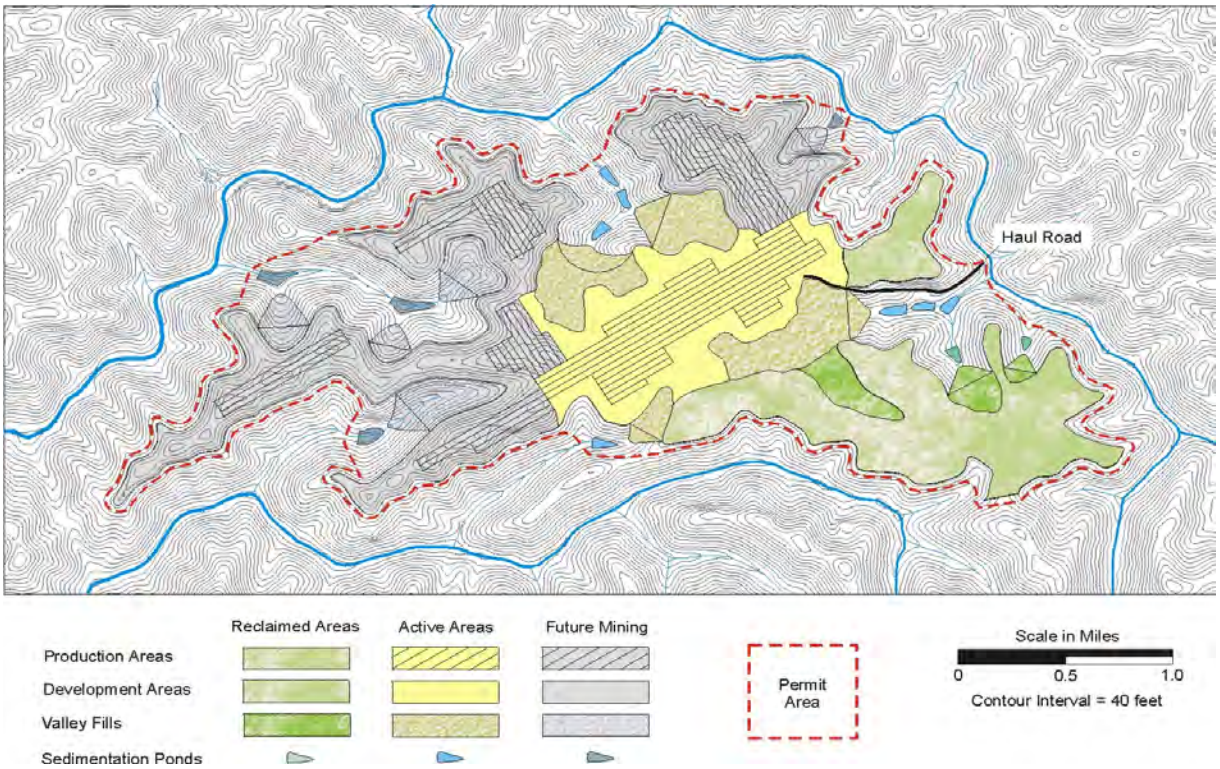
d. Occupied Structures

Private residences and other occupied buildings will not typically be present within the actual mine permit area, but can be adjacent to the permit area. Residential and other forms of development tend to cluster in the bottoms of hollows and valleys, with ready access to public roads, rather than on mountaintops and ridge crests where access and water are more difficult to obtain. The primary constraints imposed on mining by occupied structures are blasting safety, potential for dust migration, drainage control and downstream flooding, well and water supply protection, sediment control structure, backfill, and excess spoil disposal stability. Structures within one-half mile must be offered a survey to document their condition prior to blasting activities. Downstream properties in hollows and valleys may limit the extent to which excess spoil may be placed in these areas, and coal companies will sometimes offer to purchase these lands to increase spoil disposal capacity.

2. General Mine Layout

The typical large MTM/VF mine site will be divided into development areas, production areas, excess spoil disposal areas, reclamation areas, and support areas. The net coal extraction area, consisting of the development and production areas, normally accounts for about two thirds of the total area under permit. Excess spoil disposal areas will account for about one-fifth to one-quarter of the total permit area, with the remainder occupied by support areas, erosion and sedimentation control facilities, haul roads, and areas included within the permit because of geometry but not otherwise disturbed by mining activities. The sum of support areas is generally small relative to the entire permit area. Figure III.J.-1 provides a hypothetical layout for a mine site with a typical scale and features found in mountaintop removal operations.

Figure III.J-1
Typical MTR Mine Site Layout

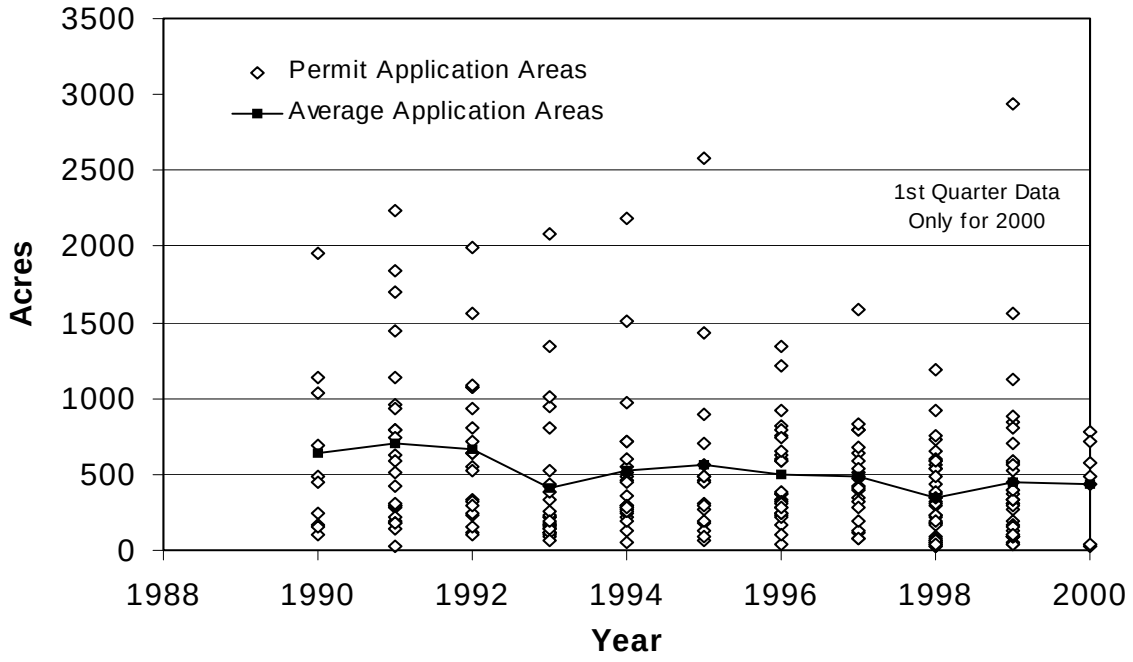


a. Permit Area Trends

Many mine permit applications are extensions of or contiguous additions to existing permitted mining areas, so permit areas themselves do not necessarily represent the size of individual mines. However, they can be generally representative of trends in the scale of mine operations over time, so a discussion of the trends in mine permit size is provided here for each of the four states in the study area.

Permit applications for mine sites in Kentucky having associated excess spoil disposal averaged approximately 500 acres between 1990 and 1998, ranging from a low of about 20 acres to a high of 2,582 acres. The summary of individual and average permit application areas on Figure III.J-2 shows that the size of permit applications in Kentucky has remained relatively consistent over this period, with an overall declining trend in average application size where associated with excess spoil disposal. Permit application size data for Kentucky was taken from a database printout provided by the KYDSMRE for mines proposing excess spoil disposal between 1990 and 1998, and statistics from three valley fill studies prepared by the OSM Lexington Field Office for 1998, 1999, and the first quarter of 2000.

Figure III.J-2
Trends in Kentucky Permit Application Areas



OSM reports only eight issued surface mine permits between 1988 and 1999 in Tennessee with excess spoil disposal. As shown by Figure III.J-3, there are years when no permits with valley fills were issued. The largest application during this time was 664.5 acres in 1999, and the smallest was 78.58 acres in 1991.

Based on a database printout provided by the VADMLR, permit applications for Virginia mine sites with excess spoil disposal fills proposed averaged approximately 218 acres for the 1995-1999 period, having a low value of only about an acre and a high of 1,940 acres. Permitting activity summarized by Figure III.J-4 shows no discernable trends for this period.

A database printout from the WVDEP shows permit applications for steep-sloped mine sites in West Virginia to average approximately 500 acres during the period of 1988 to 1998, ranging from a low of about 15 acres to a maximum of 3,113 acres. As shown by Figure III.J-5, the majority of permit applications cluster around the 500 acre average throughout the analysis period, with a slightly increasing trend in average size over time up to 1997. A discernable increasing trend is also present in the upper envelope of permit area size up to 1997. Permit application sizes appear to sharply decrease in 1998.

Figure III.J-3
Trends in Tennessee Permit Application Areas

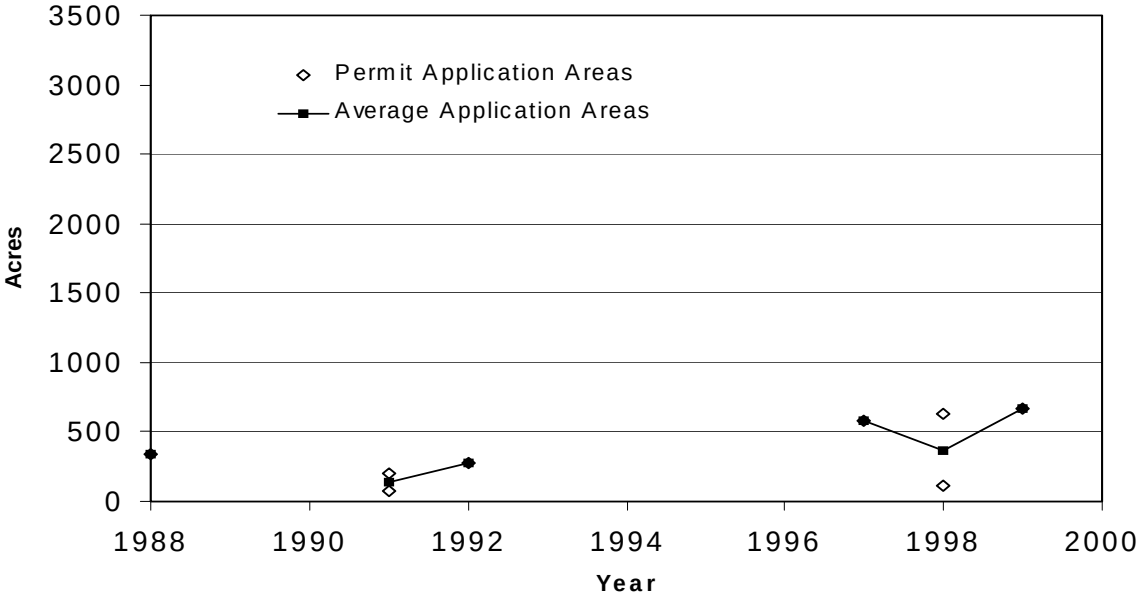


Figure III.J-4
Trends in Virginia Permit Application Areas

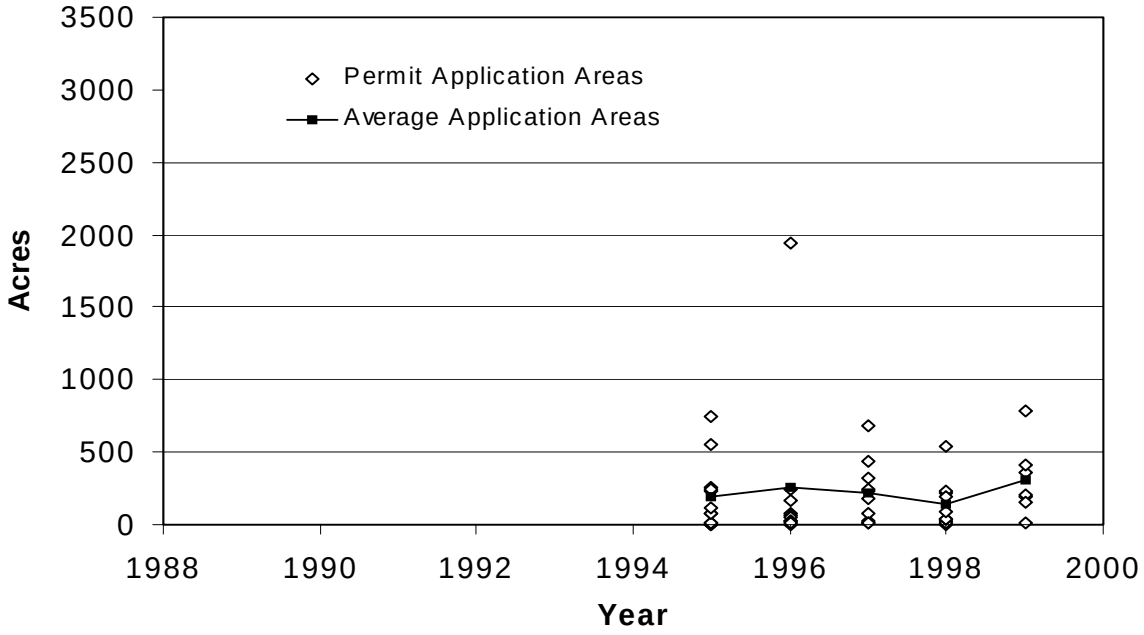
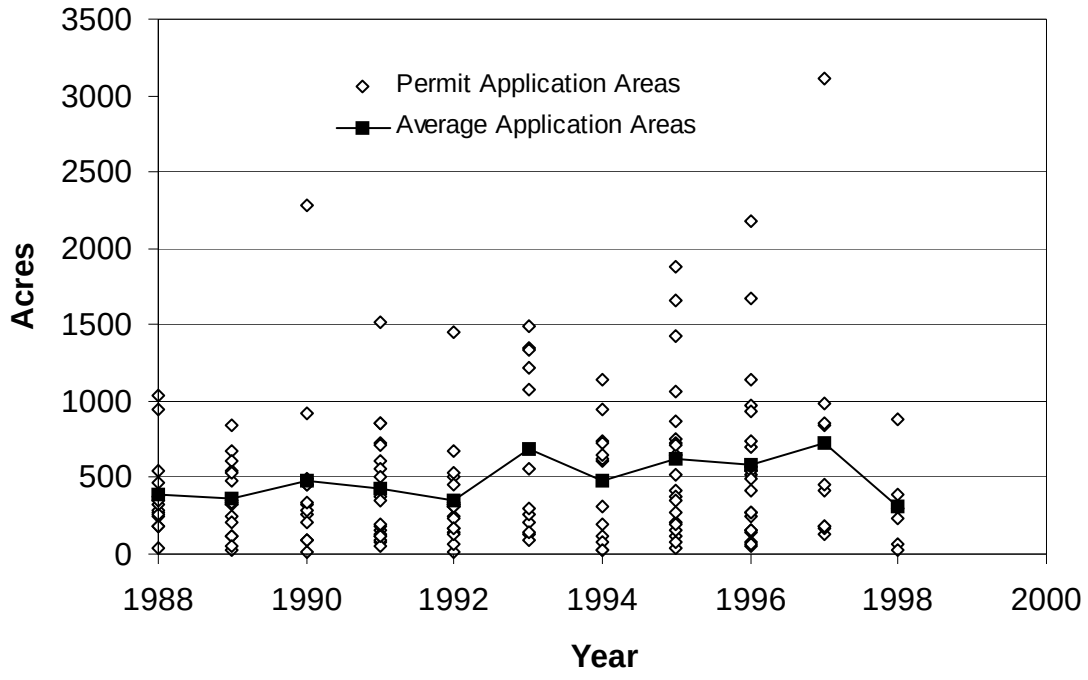


Figure III.J-5
Trends in West Virginia Permit Application Areas



b. Support Facilities

Most MTM/VF mine sites will have at least an office trailer on site to serve as a foreman's office, record and equipment storage, and general meeting point. Temporary sanitary facilities are also fairly common, as a mine site is seldom permanent enough to justify development of in-ground septic disposal systems. On larger sites with long life expectancies, a permanent building may be erected for administration and engineering. However, the corporate administrative headquarters will typically be located off site. Larger sites may also have enclosed garage-type structures for truck and equipment maintenance.

Other buildings that may be present on an MTM/VF mine site include small trailers or sheds, usually mobile to maintain proximity to working areas as mining advances. Trailers or skid sheds are used for storage of parts and supplies, or isolated and used as explosives magazines. Blasting agents, boosters and high explosives, and detonators are stored separately for safety reasons. On large sites, equipment storage may also be provided by the permanent office/maintenance building complex, and explosives may be stored in silos in addition to trailers or sheds.

Small, moveable fuel tanks in the 5,000 to 10,000 gallon range may be located in close proximity to working areas to service mobile equipment. On larger sites, fuel may be stored in a central location and carried to equipment by fuel trucks. A spill prevention plan is required for on-site storage of petroleum fuels, lubricants, and other chemicals used in the mining process.

c. Erosion and Sedimentation Control Facilities

MTM/VF operations employ the standard water diversion ditches found in other types of mine sites, with diversion ditches uphill of disturbance areas and collection perimeter ditches downhill. Because of the long length of the perimeter ditches on large mine sites, these ditches are normally constructed with sediment trapping structures, usually shallow depressions, at intervals along their length. This reduces the sediment load transported to the sedimentation ponds as well as retarding water velocity.

As discussed in Section III.K, valley fills have their own specialized system of erosion control ditches designed to carry a 100-year storm runoff. Groin ditches (located at the intersection of the fill and natural ground) carry runoff from surrounding slopes and the surface of the fill to the toe of the fill and on to the attendant sedimentation ponds. In West Virginia, fills are designed using either groin ditches or center flumes depending on site conditions and company preferences. Both features drain to the attendant sedimentation pond, designed for a 10-year storm runoff.

Under both SMCRA and CWA requirements, all discharges leaving a mine site must pass through a sediment control structure to assure compliance with water quality standards. Sedimentation ponds are constructed below the toe of all valley fill areas and may be used in other areas of a mine where diversion and perimeter ditch flows must be intercepted prior to discharge. Figure III.J-6 displays a typical valley fill toe sediment pond. Sedimentation ponds serve to settle sediment entrained in mine area runoff and attenuate storm surges. Ponds must be designed with sufficient storm surge storage and detention time to prevent violation of the EPA settleable solid standards and be designed to minimize sediment-laden water entering downstream or offsite areas. MSHA regulations place additional permitting and engineering requirements on sedimentation ponds with impounding berms of greater than 20 feet in height or that impound more than 20 acre-feet of water, so sedimentation ponds with large contributary watersheds may be constructed in series to reduce the berm height requirements of the individual ponds.

Drainage from all valley fill areas is required to past through a sedimentation pond, and additional ponds may be present on a mine site where needed to control sediment and runoff from other disturbed areas. Sedimentation control must be in place prior to any disturbance at coal mining sites, but, since mining is not to be permitted where CMD discharges are projected, water treatment systems are not required unless a pollutional discharge develops. When the necessity arises for some form of chemical treatment, the sedimentation ponds are normally used for treatment basins.

Figure III.J-6
Typical Valley Fill Toe Sediment Pond

Source: McDaniel & Kitts, 1999

SMCRA 816.46(c)(1)(ii) requires that sedimentation ponds be located as near as possible to the disturbed area and out of perennial streams, unless approved by the regulatory authority. In practice, the mine operator proposes sedimentation pond locations during the permitting process based on engineering design, drainage course, operational, and construction access constraints. From an operational standpoint, location of sedimentation ponds immediately adjacent to the toe of a fill is not always the most practical alternative. In the case of multiple fills within a drainage course, a single sedimentation pond or downstream pond series may be adequate for drainage from all the fills if located below the discharge from the lowest fill in the drainage course. Narrow valley conditions may also favor placement of sedimentation ponds farther from fill toes in locations where they can be more easily constructed and attain a higher storage volume.

Based on a review of 12 West Virginia mine permit applications having a combined total of 51 valley fill sedimentation ponds, it was determined that over half of these ponds were located within 100 feet of their associated valley fill toes or less, and approximately 90 percent were located within 200 feet of valley fill toes. Greater separation between ponds and valley fill toes occurred primarily where a single pond or pond series was used for multiple fills. These cases ranged between 500 and 1,500 feet of separation. In one case a single pond was identified 3,200 feet from its associated fill toe.

Styles of sedimentation pond construction varied between permits, but most typically involved ponds consisting of a single constructed berm across the drainage below the fill area. In other cases, ponds were constructed across higher order stream drainages receiving discharge from lower order stream with fill area. Several ponds were also outside of a drainage course, constructed by diversion and excavation (called incised ponds). In one permit, up to six ponds in series covered up to 5,200 feet of stream channel. This situation may represent a case where an individual pond sufficient to store a 10-year, 24-hour rainfall event would exceed the MSHA size restrictions. Although observed as proposed in only one of the selected permits, anecdotal information from the WVDEP indicates that this practice of ponds in series is relatively common.

Sedimentation ponds ranged between 150 feet and 5,200 feet (series case) between the toe of berm and end of projected water impoundment. Typical sedimentation ponds averaged placement in about 375 feet of stream, and approximately 75 percent of the reviewed ponds were 400 feet in length or less. Series ponds represented the greatest length of channel occupancy, ranging from 1,600 to 5,200 feet in length. Nine individual ponds were identified with lengths over 400 feet, ranging from 500 to 800 feet. Actual channel occupancy requirements are site-specific, with narrow, low bed-slope channels producing longer impoundment lengths than broad or steep bed-slope channels.

d. Haul Roads

Haul roads within a mine site are constructed to the widths required for passage of vehicles of the size used on that particular operation, and are usually 50 feet or more wide. The overall grade of a haul road normally does not exceed 10 percent for ease of haulage and to minimize brake wear/failure. Lengths of haul roads vary according to the distances necessary to access development, mining, and fill disposal areas. A typical haul road length on an MTM/VF mine site is about 2,500 feet. Ditches are constructed on the uphill sides of haul roads to collect runoff, and culverts placed at intervals to convey runoff under the road to the downhill side. A sediment trap is placed at the inlet to each culvert. Temporary haul roads to working areas are usually surfaced with pit-run crushed overburden materials, while primary haul roads connecting to public roads may be surfaced with gravel or asphalt depending on their permanence and traffic type. Additional small service roads may be constructed to access erosion and sedimentation control facilities or support areas.

3. Mining Equipment

Selection of mining equipment depends on mine design and layout, overburden handling requirements, reserve size, production objectives, cost minimization, and the desire to maximize return on investment (Meikle & Fincham, 1999). Equipment categories are generally divided between heavy equipment used for development and primary production, haulage equipment for spoil and coal transport, and support equipment used for maintenance, and reclamation activities.

a. Production Equipment

Although draglines are often portrayed in association with MTM/VF mines, the majority of MTM/VF operations are contour mines and do not use them. These machines are very expensive and require very large reserves to operate efficiently. Most MTM/VF operations now prefer electric shovels, hydraulic excavators, or large front end loaders for primary production equipment, with shovel/truck combinations predominating (Meikle & Fincham, 1999). Combinations of production equipment and attendant haul trucks are often referred to as equipment *spreads*. Where cast blasting is feasible, large dozers or spoil-side draglines are used for primary spoil movement. Pan scrapers, once used for excavation on smaller sites and contour mines, have virtually disappeared as production equipment. Figure III.J.-7 shows examples of each of the primary types of production equipment in operation.

Relative costs of spoil movement decrease in the following order: overburden loading and haulage, production dozing, dragline movement, and cast blasting. In general, the larger the equipment used, the lower the production cost. However, large equipment is not efficient for mining small areas.

MTM/VF operations will employ more than one type of production equipment to meet different scales of spoil movement within the excavation areas. Meikle & Fincham (1999) provide an example of an MTM/VF operation using shovel/truck, backhoe/truck, loader/truck, and cast blasting/dozer methods on a single site:

Equipment Spread	Production Rate
25 yard hydraulic shovel	7.5mm BCY/year
18-1/2 yard hydraulic backhoe	5.8mm BCY/year
16 Yard front end loader	4.1mm BCY/year
4 - 54 yard dozers	7.8mm BCY/year

Additional front end loaders and dozers will normally be working in advance of the primary production equipment to mine shallow seams and prepare cut benches for drilling and blasting. Rotary drills are used in conjunction with development equipment for drilling blast patterns on advancing cuts. The ratio of drills to working equipment spreads is approximately 1-1/2 per spread. Drills may be either owned by the coal company but are more commonly leased, as needed. Figure III.J.-8 shows the drilling and loading of blast holes on a bench.

b. Haulage Equipment

Spoil haulage within a mine site is accomplished almost exclusively by off-road trucks, since loaders are not efficient for long transport distances, and shovels and excavators are not efficient for transport outside of their swivel radii. Each piece of production or development equipment will have a set of attendant haul trucks in its working spread. The typical ratios of trucks to equipment are 3-1/2 trucks per shovel or excavator spread, and 2-1/2 trucks per loader spread, with fractional differences shifting between spreads. Shovels and excavators have a larger bucket capacity than loaders and require larger haul trucks, usually in the 150- to 320-ton range. Loaders generally operate with trucks in the 85- to 150- ton range.

Figure III.J-7
Typical MTM/VF Mine Production Equipment

Source: Meikle & Fincham, 1999, and Arch Coal, Inc., 1999

Figure III.J-8
Typical Drilling and Shot Hole Preparation on Bench

Source: Meikle & Fincham, 1999

In addition to overburden haulage, trucks will be present on site to haul the extracted coal to either a processing facility or shipping point. These may be on-road or off-road trucks, depending on the type of road connection, but are usually on-road capable trucks supplied by independent contractors. Contracting of coal haulage is generally cheaper for the coal company by eliminating possession of excess trucks during periods when no production is occurring, and the contractors may service multiple mine sites simultaneously with the same truck fleet. Approximately six contractor trucks will be operating per loader during times when coal is exposed on the pit floor and is being loaded out. A small loader will generally be used for the actual coal extraction and loading at each site. Figure III.J-9 shows a typical coal extraction and loading operation.

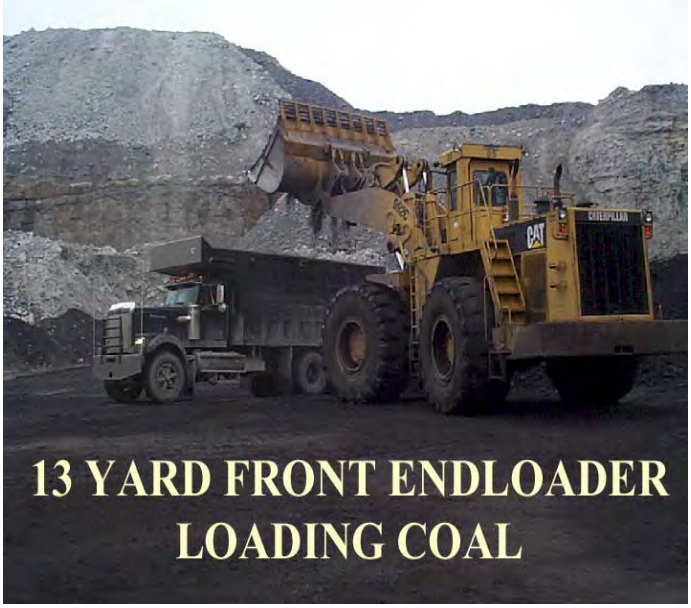
c. Support Equipment

MTM/VF operations will have a number of other types of equipment on site in addition to those involved with direct production. These may be engaged in road maintenance, construction of erosion and sedimentation control facilities, clearing and grubbing of mine advance areas, reclamation activities, and general maintenance. The primary workhorse of any surface mine site is the dozer, and about five small support dozers can be assumed for the typical larger MTM/VF mine site. Other types of equipment that are found on a mine site will vary depending on the type and size of operation, but a number are commonly found on all sites and used in the capacities listed below:

Graders – road maintenance
Water Trucks – dust control on haul roads
Lubrication and Fuel Trucks – delivering fuel to equipment
Mechanics Trucks – repair and maintenance of equipment
Bulk Explosive Trucks - delivering explosives to blast holes
4 x 4 Pickup Trucks – transportation for foreman, equipment operators, and laborers

Figure III.J-9
Typical Coal Preparation and Loading in the Pit

Source: Meikle & Fincham, 1999



4. Operational Characteristics

A typical larger MTM/VF mining operation may employ all four of the basic mining methods previously discussed: mountaintop removal, area, contour, and auger/highwall mining. Definitions and methods of reporting for the types of mining methods vary between states, so percentages of utilization for each method cannot be reliably determined. Contour mining is normally limited to development areas or valley fill areas where steep slopes preclude any more extensive extraction. Extent of highwall mining is also variable between sites, but may comprise 20 to 30 percent of the total coal production over the life of a mine site. The following section discusses the operational characteristics of a combined-method MTM/VF mine with emphasis on the development of backfilled spoil profiles and excess spoil disposal in valley fills.

a. Working Areas

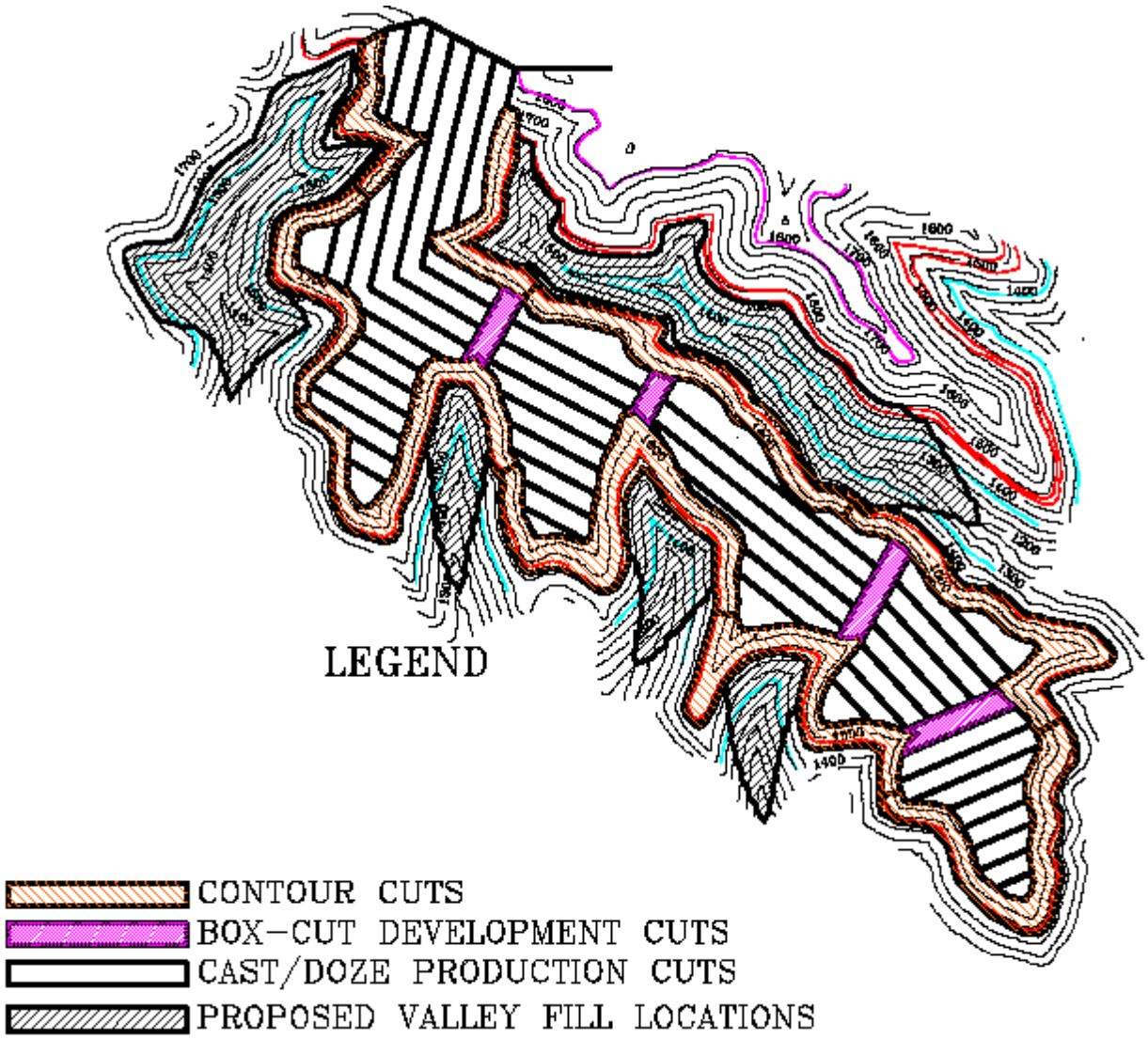
Most larger MTM/VF mining operations are divided between development and production cut mining activities. A typical layout of development and production cut areas that would be used for an MTR operation is shown by Figure III.J-10. Development mining progresses along contour cuts on the outer perimeter of the site slopes and also removes the upper strata from the production cut areas. At intervals, box cuts will be made through the core of the mountaintop or ridge line to open the ends of the production cuts. Production mining then progresses in a back and forth pattern in each production cut area.

The primary goal in mine operation planning is to balance stripping ratios for a reasonably consistent production cost and to prevent equipment from being idled for lack of working areas. Cast blast/dozer operations, in particular, need two working areas at all times for maximum efficiency, such that the dozer fleet can rotate between working areas in the production cuts. After blasting and dozer excavation, it usually takes 2 to 3 weeks to remove the uncovered coal before the next cycle of blasting and excavation can begin in a pit (Meikle & Fincham, 1999). Other production equipment systems, particularly draglines, may be able to progress in a more linear fashion with a single piece of primary equipment.

b. Mining Progression and Backfill Configuration

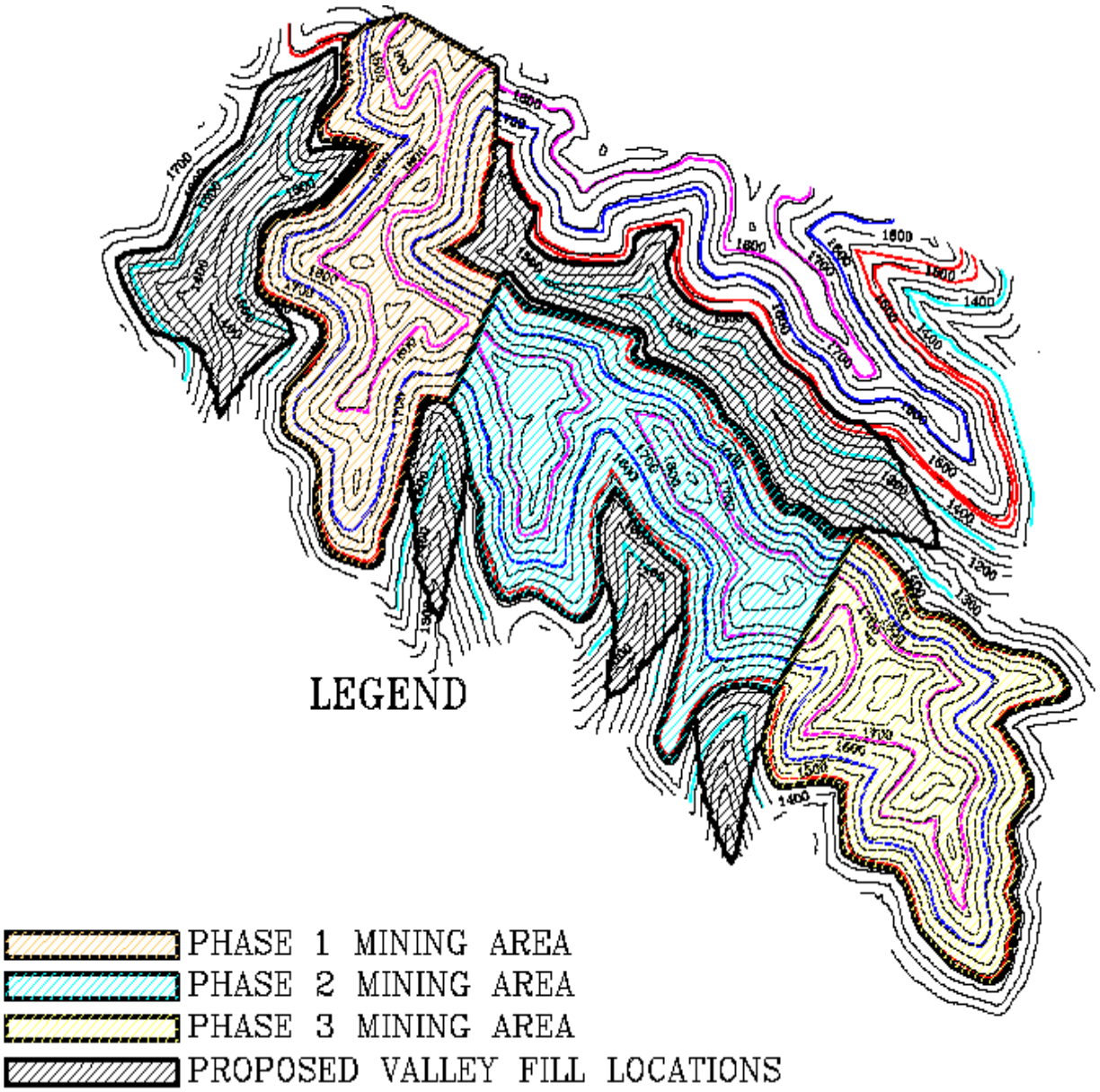
Mining on large MTM/VF sites is usually divided into operational phases. This allows easier planning and presentation of mining and reclamation progression during the permitting process. Figure III.J-11 shows a typical phase layout for the example MTR operation on Figure III.J-10. Note that the first two phases have valley fills along their perimeters, while the third phase does not.

Figure III.J-10
Typical MTR Mine Plan Layout



Source: Meikle & Fincham, 1999

Figure III.J-11
Typical MTR Mine Phase Layout



Source: Meikle & Fincham, 1999

In reference to Figure III.J-11, actual mining will begin at the upper end of Phase 1 with contour and "pre-stripping" cuts immediately adjacent to the two valley fill areas. All spoil from these initial operations will go to the valley fills to make space for spoil from future cuts to be placed on the mine bench. Excavator/truck or loader/truck spreads most commonly work at this stage, with limited dozing production adjacent to the valley fills. Some preliminary mining may take place in the area of the valley fill itself if coal seams are present and accessible for recovery.

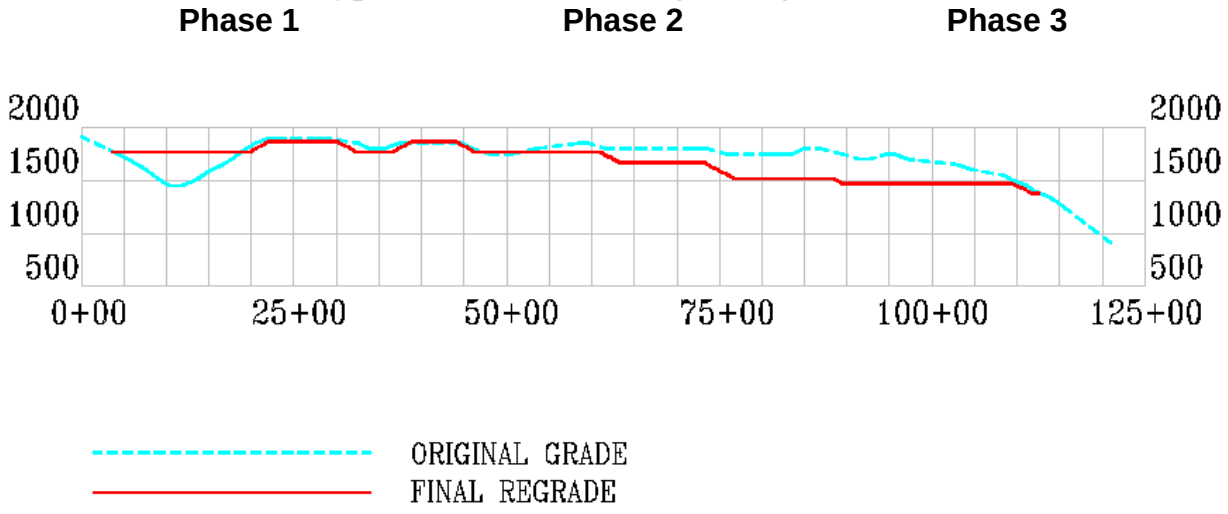
As development activities create the first cut benches in Phase 1, primary production will begin with larger equipment. A progression of cuts will then continue as described in Section III.I.2.b-c towards Phase 2, with development activities continuing in advance of the main production area. Much of the spoil from the ongoing Phase 1 development activities and bench cuts will still go to the valley fills to compensate for excess spoil generation in later areas of the mine.

At a point during Phase 3, a balance will be reached between excess spoil disposal and new spoil generation. By the midpoint of Phase 3, all of the spoil generation will be returned to the mine bench immediately adjacent to the advancing cuts. The latter cuts of Phase 3 are oriented perpendicular to the axis of the ridge to reflect that their spoil will remain on the bench. These cuts will have little overburden remaining after development activities, so their final spoil regrading elevations will be lower than those of the regraded benches in Phases 1 and 2. Thus, the reclamation grade surface will tend to step down from the start of mining to the end. The overall effect of this progressive diminishment of spoil volume and elevation is illustrated by the example MTR regrading profile shown by Figure III.J-12. Because of the movement of spoil to accommodate later stage production cuts, the reclamation elevations of a larger MTM/VF mine site may deviate significantly from the original ground profile and, therefore, may not qualify as AOC. This tends to be the case more on large sites or those with deep excavation of multiple seams than on small sites or those with shallow excavation of fewer seams.

c. Coal Production and Duration

Based on West Virginia permit data, a larger MTM/VF mine will produce approximately 10,000 tons of coal per acre under permit. Production rates can vary considerably over the life of a mine, but a typical mine will produce between 1,000,000 and 2,500,000 tons per year. Permitting of new reserves is ongoing in advance of active permits to maintain mine production at a relatively constant rate. Coal production during the development and primary production phases is chiefly by surface methods. Towards the latter stages of activities in a working area, secondary production by augering or highwall methods may be employed to maximize recovery, after which any remaining reserves in that area are considered to be inaccessible for future production. Secondary mining on true MTR sites (ones where the coal seam is mined from crop to crop in a 360 degree radius) can only occur in those areas that are not MTR.

Figure III.J-12
Typical MTR Mine Regrading Profile



Source: Meikle & Fincham, 1999

The life expectancy of mining in a given permit area varies proportionally to its size. Since MTM/VF mines are usually ongoing projects, the duration of mining on a site will be longer than the life of the individual mine permits covering the site. The typical larger MTM/VF mine site has a total life expectancy of around 10 to 15 years, and may involve a total lifetime production of between 10,000,000 and 40,000,000 tons. Smaller mines with MTM/VF characteristics do occur in single permitted areas with much shorter life expectancies, some lasting only one or two years in active production. Very large sites may allow mining to continue for 20 years or more.

d. Site Reclamation

This section deals primarily with the controls imposed on site reclamation and postmining land uses, and on the methods employed to achieve revegetation on regraded spoil.

d.1. Contemporaneous Reclamation

SMCRA does not have a specific limitation on the area that a mine operation can actively disturb, but does require that reclamation efforts, including backfilling, grading, topsoil replacement, and revegetation, occur as contemporaneously as practicable with mining operations. Larger MTM/VF operations may require large active disturbance areas to allow completion of valley fills, which may have to remain open for extended periods of time to allow completion of coal extraction at multiple bench/seam levels. Multiple working areas may also be necessary to allow efficient cycling of equipment between blasting and excavation areas. A typical larger MTM/VF mine site will have between 300 and 500 acres in active disturbance during its production phase. Reclamation activities follow progressively behind backfilling and regrading operations. Figure III.J-13 shows examples of progressive contemporaneous reclamation.

d.2. Topsoil Replacement/Substitution

Based on permit data, the majority of MTM/VF operations in West Virginia use topsoil substitution for reclamation. Use of topsoil substitutes is usually based on analysis of overburden samples to identify strata with acceptable grain textures to produce a growth substrate. These materials either end up on the surface during spoiling or are placed on reclamation surfaces by dozers following regrading. Mechanical breakdown of the overburden materials into a finer-grained growth substrate occurs during both excavation and regrading.

Both topsoil substitution and topsoil redistribution methods spread the soil materials at a typical thickness of about 4 to 12 inches-although experts in revegetation for reforestation recommend placement of topsoil and the top 10 feet of oxidized overburden/subsoils in a loose-dumped manner to promote rooting and exceptional tree productivity. Topsoil substitution will usually require application of lime and fertilizer, and topsoil redistribution may require these amendments for initially acidic or low-productivity soils. Lime and fertilizer addition rates maybe determined by laboratory testing of surface samples or applied at a constant rate established in the mine permit application. The typical fertilizer application rate is 600 pounds per acre of 10-20-10 or 10-20-20 NPK analysis fertilizer.

d.3. Revegetation Plan

Revegetation usually commences immediately following completion of topsoil or soil substitute spreading and preparation. Species mixes vary considerably depending on the intended postmining land use and the preferences of the coal company or surface owner. Forestland, commercial woodland, and fish and wildlife habitat land uses will be planted with woody species and seeded with herbaceous species, while hayland, rangeland, and postmining development land uses may receive only seeding.

Figure III.J-13
Examples of Progressive Contemporaneous Reclamation

Source: Meikle & Fincham, 1999

Mine reclamation plans typically have two categories of seed mixes: temporary and perennial. Temporary seed mixes are used for temporary stabilization of disturbed areas and stockpiles, and may be applied with the perennial seed mix for initial stabilization of reclamation areas before the permanent cover becomes established. The perennial seed mix may include some annual species, but overall, is intended to produce the permanent herbaceous cover for the reclamation site. Seed application rates vary between 30 and 110 pounds per acre depending on the species mix, but are normally about 75 pounds per acre. Seeding is usually conducted by a hydroseeder, using wood fiber mulch, applied at a rate of 1,000 pounds per acre. Broadcast methods and straw mulch may also be applied at 2,000 to 4,000 pounds (1 to 2 tons) per acre.

Woody species are planted by hand crews or mechanical planting machines prior to or concurrent with seeding activities. Species are typically planted in alternating row groups according to a planting plan map submitted with the mine permit application. Density of planting varies by species, but shrubs typically planted on 5 to 6 foot centers and trees on 8 to 10 foot centers. The total number of woody plants per acre is normally 600 to 700, intended to achieve a survivorship of approximately 450 woody plants per acre. Row planting does not generally produce uniform coverage, and open herbaceous areas are commonly interspersed in the completed site planting layout. The woody species black locust and lespedeza are also introduced by seeding, particularly on the faces of valley fills.

Tables III.J-1 and III.J-2 were developed from a review of twenty West Virginia mine permit applications and summarize the herbaceous (seeded) and woody (planted) species proposed by these applications. These are presented by common and scientific name, category (temporary or perennial for seeding and shrub or tree for planting), relative frequency of use (very common, common, or uncommon), and native status. Native status is interpreted from Reed (1988), Hitchcock (1971), and other sources. Where applied, the term “introduced” refers to species that are not originally native to the study area. It is noted that many of these introduced species have become naturalized to the study area from historic use in agricultural activities.

Table III.J-1
Typical MTM/VF Mine Reclamation Herbaceous Species

Species Name	Category		Application Frequency	*Native Status
	Temporary	Perennial		
Bermuda Grass (*Cynodon dactylon*)		X	U	introduced
Birdsfoot Trefoil *(Lotus corniculatus)*	X	X	V	introduced
Buckwheat (*Fagopyrum spp.*)		X	V	introduced
Clover, Ladino *(Trifolium spp.)*		X	U	introduced
Clover, Red *(Trifolium pratense)*		X	V	introduced
Clover, White *(Trifolium repens)*		X	C	introduced
Fescue, Tall (KY 31) *(Festuca spp.)*	X	X	V	introduced
Foxtail Millet *(Setaria italica)*	X	X	V	introduced
Lespedeza, Bicolor (Lespedeza bicolor)		X	V	introduced
Lespedeza, Kobe (Lespedeza bicolor var.)		X	C	introduced
Lespedeza, Sericea (Lespedeza cuneata)		X	U	introduced
Oats, Common *(Avena sativa)*	X		C	introduced
Orchard Grass *(Dactylis glomerata)*		X	V	introduced
Redtop *(Agrostis alba)*	X	X	C	introduced
Rye *(Secale spp.)*	X		C	introduced
Ryegrass, Annual *(Lolium spp.)*	X	X	V	introduced
Ryegrass, Perennial *(Lolium perenne)*	X	X	V	introduced
Smooth Bromegrass *(Bromus spp.)*	X		U	introduced
Timothy *(Phleum pratense)*		X	U	introduced
Weeping Lovegrass *(Eragrostis curvula)*		X	U	introduced
Winter Wheat *(Triticum spp.)*	X	X	C	introduced
Yellow Sweet Clover *(Melilotus officinalis)*	X	X	C	introduced

V - very common, C - common, U - uncommon
*Reed (1988), Hitchcock (1971)

Table III.J-2
Typical MTM/VF Mine Reclamation Woody Species

Species Name	Category		Application Frequency	*Native Status
	Shrub	Tree		
Autumn Olive (*Elaeagnus umbellata*)	X		U	introduced
Bigtooth Aspen *(Populus grandidentata)*		X	C	native
Black (European) Alder *(Alnus glutinosa)*		X	V	introduced
Black Locust *(Robinia pseudoacacia.)*		X	C	native
Black Oak *(Quercus velutina)*		X	U	native
Black Walnut *(Juglans nigra)*		X	U	native
Chestnut Oak *(Quercus coccinea)*		X	U	native
Chinkapin Oak *(Quercus muhlenbergii)*		X	U	native
Crabapple *(Malus spp.)*	X		V	hybrid
Gray Dogwood *(Cornus spp.)*	X		V	native
Hybrid Poplar *(Populus spp.)*		X	U	hybrid
Japanese Barberry *(Berberis thunbergii)*	X		C	introduced
Pitch Pine *(Pinus rigida)*		X	U	native
Red Maple *(Acer rubrum)*		X	U	native
Red Oak *(Quercus rubra)*		X	U	native
Scotch Pine *(Pinus sylvestris)*		X	C	introduced
Sugar Maple *(Acer saccharum)*		X	U	native
Sumacs *(Rhus spp.)*	X		C	native
Sweet Gum *(Liquidambar styraciflua)*		X	U	native
Virginia Pine *(Pinus virginiana)*		X	C	native
Washington Hawthorn *(Crataegus phaenopyrum)*	X		V	native
White Ash *(Fraxinus americana.)*		X	U	native
White Oak (*Quercus alba*)		X	U	native
White Pine (*Pinus strobus*)		X	C	native
Yellow Poplar *(Liriodendron tulipifera)*		X	V	native

V - very common, C - common, U - uncommon
*Reed (1988), Hitchcock (1971)

K. EXCESS SPOIL DISPOSAL

Excess spoil disposal is a common component of surface mining operations occurring on steep-sloped coal mining sites. Several options are available for disposing of excess spoil, including the valley fills that are the focus of this EIS. Excess spoil may also be disposed of on adjacent pre-SMCRA mining benches, and on adjacent active mine permits and abandoned mine land reclamation projects.

Valley fills offer a means of disposing of excess spoil in the immediate vicinity of its point of generation. The costs of truck haulage of spoil are directly related to haul distance, and from an economic standpoint it is desirable to locate spoil disposal sites as close to the production areas as possible. The impractical alternative would be haulage to a disposal location on another mountaintop or ridge crest. These sites are not available within reasonable haul distances because of topographic or property ownership constraints, and backstacking on undisturbed sites would significantly elevate the land surface and might bury other unrealized coal reserves. Secondary reasons for valley fills relate to equipment operation and postmining land use goals. For production and cost optimization, mining cuts may cross intervening hollows to advance through more than one ridge line at a time, eventually forming a single advancing highwall as the ridge lines merge at the head of the hollow. Movement of equipment between the individual ridge line cuts is greatly facilitated by having the valley fills in place as a travel surface. This is particularly true for walking draglines, which move at a rate of about one mile per day. Equipment relocation would be significantly delayed by less direct routes around the headwaters of a hollow. If agriculture, residential, industrial, or commercial postmining land uses are proposed, it is also desirable to use valley fills to aid in creating the greatest area of usable level ground.

Filling of valleys results in the loss of ephemeral, intermittent and in some cases perennial stream reaches along with their associated aquatic habitats. Toe-of-fill sediment ponds, although normally temporary, also change the habitat and profile of stream valleys beyond the fill itself. Valley fills significantly change the headwater topography of affected streams and can alter surface water runoff and groundwater recharge and discharge patterns. There is also concern regarding long-term fill stability. This section summarizes the principles behind excess spoil generation and disposal practices, and discusses their related hydrologic impacts, stability, and trends in excess spoil generation within the study area.

1. Characteristics of Excess Spoil Generation and Valley Fills

Head-of-hollow fill, valley fill, and durable rock fill are terms used by OSM regulations to describe excess spoil fills placed in steep sloped mining areas [see 30 CFR 816/817.71-74 performance standards; 30 CFR 701.5 definitions, and 30 CFR 780.35 permitting rules]. The common factors between the terms head-of-hollow and valley fill are that the side slopes of the existing hollow or valley measured at its deepest point are greater than 20 degrees, or that the average slope of the profile of the hollow or valley from the toe of the fill to the top of the fill is greater than 10 degrees. A head-of-hollow fill is simply a fill occurring in the uppermost reaches of a hollow, whereas a valley fill is essentially any fill occurring in a hollow or valley downstream of its headwaters. Head-of-hollow fills less than 250,000 cubic yards are required to set the top of the fill level with the coal seam to be mined. Head-of-hollow fills larger than 250,000 cubic yards must set the top of the fill at or near the level of the adjacent ridge line.

Head-of-hollow and valley fills must be constructed in lifts of spoil no greater than four feet in thickness. The face of the fill is thus constructed in stages with a 50% slope and 20-foot terraces at 50-foot intervals. Surface drainage control is provided by a rock core chimney drain for the head-of-hollow fill and by diversions at the junction of the fill and natural ground for valley fills. The terrace surfaces may slope into the fill face at a slope of approximately 1 percent, and towards the center of the fill face at a 3 to 5 percent slope. In these cases, surface runoff from the terraces and fill face may be carried to the toe of the fill by a central rock-lined channel, and from surrounding slopes draining to the fill by side channels known as diversions or *groin ditches*. In other cases, the fill crest and terrace surface may slope towards the sides and discharge via the groin ditches. Both fill types also require installation of sub-drains prior to lift placement in order to control seepage (springs or seeps) and any internal drainage resulting from infiltration of rainfall into the fill mass. An underdrain is typically a sizable ditch, first lined with geotextile or filter fabric, and then filled with graded rock. The filter fabric is then overlapped on top of the rock-filled trench to assure water, but not dirt, silt, or sediment fines, can get into the drain. Underdrains assure desirable low levels of water within the fill and increase stability. These techniques are standard geotechnical practices to assure stability and erosion controls. All excess spoil fills must achieve a factor of safety against mass movement of 1.5.

The head-of-hollow and valley fill method of fill construction was developed to some degree prior to the passage of SMCRA in the mid- to late-1960's because of waste rock disposal practices utilized in Interstate highway construction in West Virginia, and continued throughout the 1970's. Prior to SMCRA passage, controlled excess spoil disposal was not practiced in Virginia, and overburden excavated by mining was typically place/dumped indiscriminately on the out slope below the mining bench. In Kentucky, pre-SMCRA excess spoil fills were typified by a technique of dumping (similar to durable rock fill construction described below, but without the classification of spoil as durable) and subsequent regrading of “angle of repose” excess spoil to a more stable slope. The face of these fills were then benched or terraced. Figure III.K.1-1 shows a typical completed section of a valley fill toe and face parallel to the valley profile. Center drains are typically only used in West Virginia, with groin drains being used in the other states of the study area. Figure III.K.1-2 provides a photograph of these drainage features showing both center drains and groin drains.

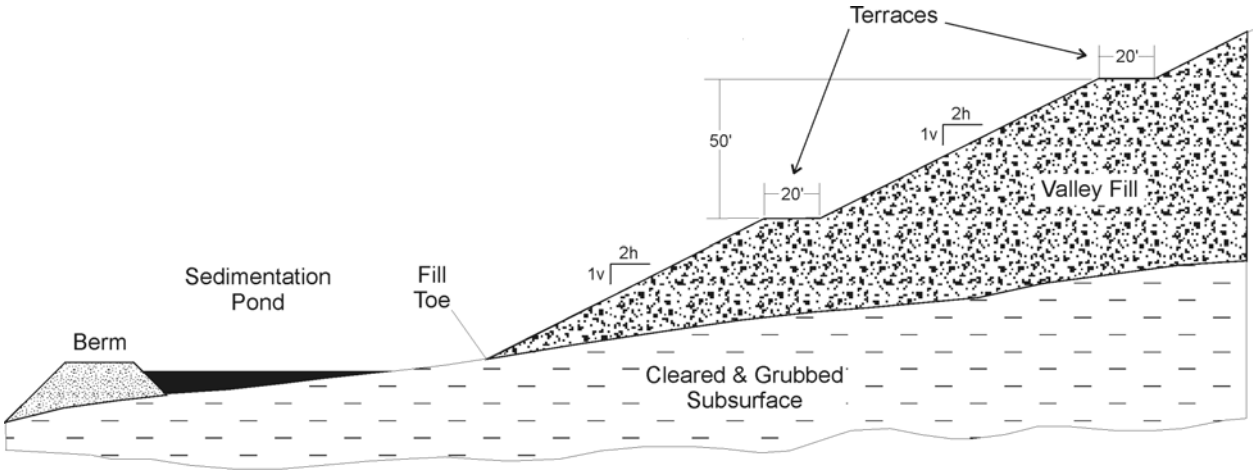
In the late 1970's and early 1980's the durable rock fill method became the predominant excess spoil disposal technique due to the cost efficiencies of the technique. Durable rock fills are the most commonly-constructed type of valley fills and advance from the head of a valley downstream by gravity segregation of dumped *durable* overburden. Durable overburden is classified as consisting of at least 80 percent *durable rock* on a unit volume basis, or rock that can pass certain strength and weathering tests, such as a slake durability test. Durable rock fill construction creates a free face of end-dumped spoil at the angle of repose--which is subsequently regraded when the limits of disposal are reached. The EIS Fill Stability Study [see Appendix H] recorded lifts of existing fills to range between 30 to over 400 feet in thickness. Regrading results in a 2 horizontal to 1 vertical slope ratio with terraces every fifty feet. Surface drainage control is established with the same diversion and groin ditches (100-year storm capacity) as head-of-hollow and valley fills, except West Virginia has a unique state program provision to create a single rock chimney drain to handle all runoff above and on the fill. Internal drainage is assured by the formation of a thick rock blanket drain during end dumping. Figures III.1-3 and III.1-4 show a construction sequence and representative photographs of durable rock fills, respectively.

a. Swell Factor and Excess Spoil Generation

The primary reason for using valley fills is that excavation of overburden results in a greater volume of material than was present on the mine site before mining. When bedrock is broken up forming spoil, void spaces are left between the individual rock fragments, causing them to occupy a greater volume than the original, unbroken rock. This expansion is referred to as *swell* and typically represents a volume increase of about 40 percent. Compaction of spoil during backfilling partially offsets swell as the rock fragments are squeezed together by the weight of overlying material, but this *shrinkage factor* will not completely return the spoil to its solid, or *bank*, volume. The net difference between swell and shrinkage is known as the *bulking factor* of the overburden, which is about 25 to 40 percent for sandstone and 15 to 25 percent for shale (Miekle & Fincham, 1999). Bulking factors vary from mine site to mine site depending on the overburden geology, but the industry average is about 25 percent. In other words, 100 cubic yards of overburden will typically generate about 125 cubic yards of backfilled spoil. Within the mining industry, the term *swell factor* is commonly used in place of the engineering term bulking factor, and will also be used herein. These concepts are illustrated by Figures III.K.1-5 and III.K.1-6.

Particularly on steep-sloped mine sites, the excess spoil generated by the swell factor cannot be completely backfilled on the mine bench without construction of potentially unstable slopes or substantial deviation from AOC. The maximum amount of spoil that can be returned to the mine bench is constrained by SMCRA slope stability and design requirements (i.e, the slope at which backfills can be constructed), perimeter areas occupied by erosion and sediment control structures, as well as access roads.

Figure III.K-1
Typical Profile Section of a Valley Fill Toe

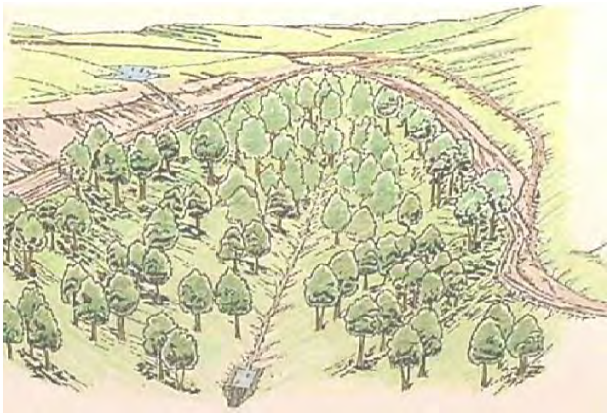


Source: Meikle & Fincham, 1999

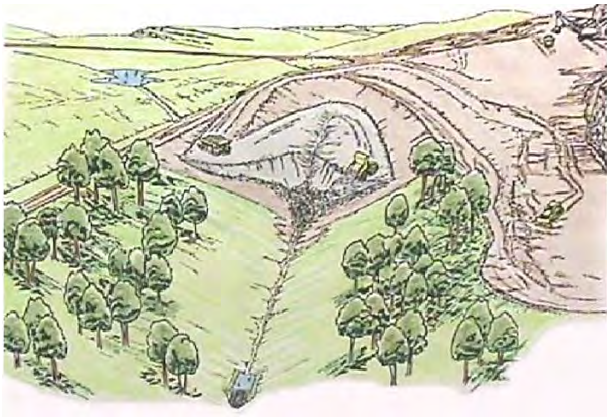
Figure III.K-2
View of Typical Center Drains and Groin Ditches

Source: McDaniel & Kitts, 1999

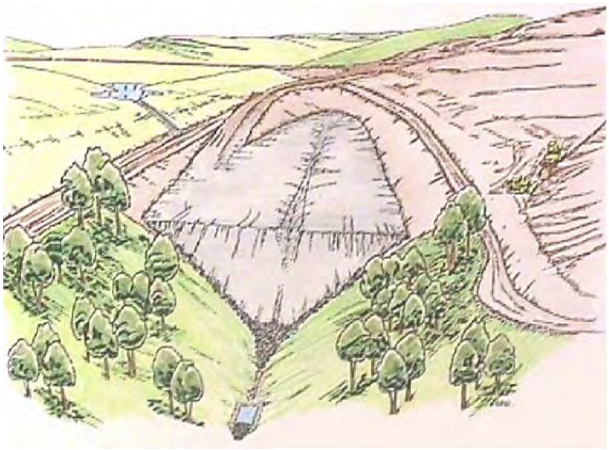
Figure III.K-3
Center Drain Durable Rock Valley Fill Construction Sequence



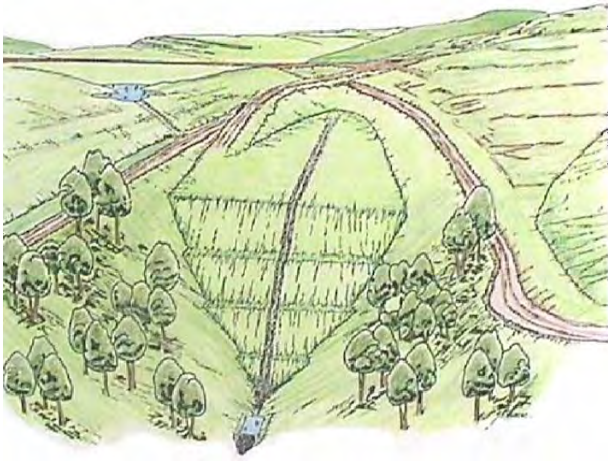
(1) Sediment Pond Construction



(2) Fill Placement



(3) Completed Fill Placement



(4) Completed Regrading/Revegetation

Source: Arch Coal, Inc., 1999

Figure III.K-4
Durable Rock Valley Fill Photographs

(1) Valley Fill Construction

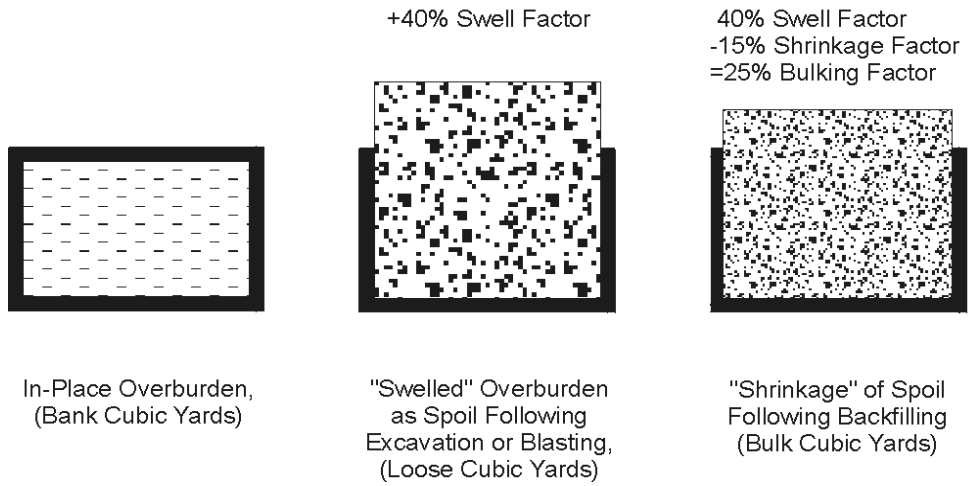
(2) Close-up of End-dump Fill

(3) Completed Regrading

(4) Completed Revegetation

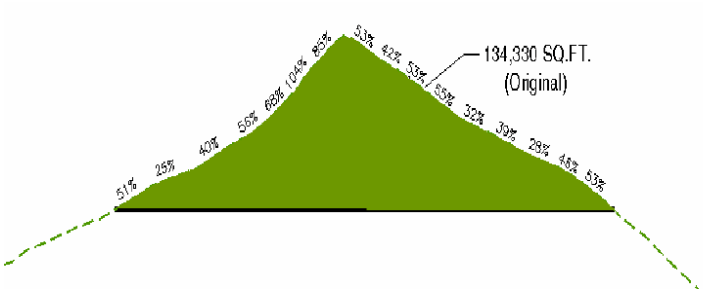
Source: Arch Coal, Inc., 1999

Figure III.K-5
Example of Swell, Shrinkage, and Bulking Factors in Overburden Excavation and Spoil Backfilling

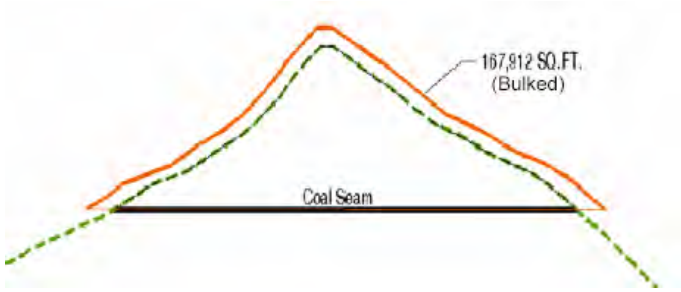


Source: USOSM AOC Presentation

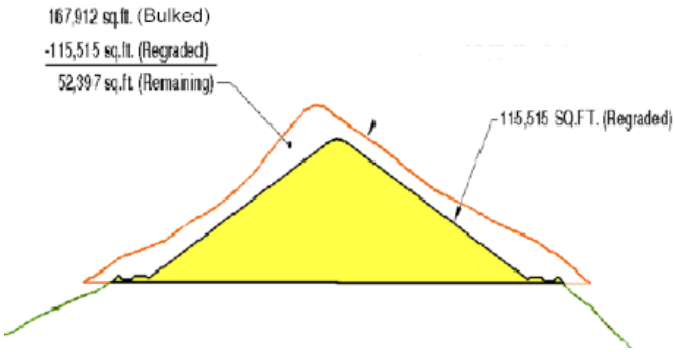
Figure III.K-6
Example of Excess Spoil Generation on a Steep-Slope Mine Site



(1) In-Place or "Bank" Cross Section



(2) Bulked Cross Section



(3) Backfilled Cross Section Showing Excess Spoil

Source: Arch Coal, Inc., 1999

b. Relationship of Valley Fill Construction Technique and Water Quality

Valley fills are required to be constructed from non-toxic spoil materials; therefore, sedimentation is the typical consideration for water quality during their construction rather than chemical impacts. Fills built using the conventional lift-construction method have an advantage for sedimentation control in that they are contemporaneously completed, topsoiled, and revegetated from the toe up as construction progresses. This results in significantly less disturbance upstream of the sediment pond, and requires less frequent cleaning of the pond. Some durable rock fills use a hybrid approach for sediment control by placing several initial lifts at the fill toe location, then end-dumping material progressively toward the toe. This creates a temporary sediment trapping area behind the initial lifts and reduces sediment loading to the downstream sedimentation pond. Sedimentation impacts are primarily a concern for the stream reach between the fill toe and the sedimentation pond, if the pond is not located directly below the fill toe. When a central chimney drain is constructed for the head-of-hollow fill using large boulders, a sixteen-foot wide porous conduit in the center of the fill is created. This chimney core is an excellent sediment trap thus reducing sediment loading to the downstream pond.

c. Valley Fill Stability

There has been anecdotal evidence that valley-fill instability (landslides or land slips on fills) are neither commonplace nor widespread; and, that properly constructed valley fills are well-engineered and stable structures.

The EIS Steering Committee chartered a study of fill stability to corroborate anecdotal perception with empirical information. The complete report is included in Appendix H and is presented on the mountaintop mining website, web address (www.epa.gov/region3/mtntop).

The fill stability investigation evaluated the effectiveness of SMCRA-based regulations through the use of geotechnical indicators of fill stability in the permitting process and in the field. The scope of the study included the identification and analysis of past and existing cases of instability in valley fills in Appalachia. It also included the collection and analysis of indicator data from approximately 120 fills relating to fill designs, present-day construction practices, and the existing conditions of as-built embankments. The fill stability investigation evaluated the current state and federal regulations, policies, and practices; government documents that identify and discuss issues related to the objective of fill stability; and pertinent geotechnical literature. The procedures undertaken by OSM included: (1) discussions with state/federal inspection-and-enforcement (I & E) and permit-review personnel and federal geotechnical experts; (2) review of permits, inspection reports, and other relevant documentation; and (3) aerial and ground-level site inspections.

For the purposes of this study, a fill instability is defined as any evidence that: (1) part of the fill's mass has separated from the rest of the fill; (2) the separation occurs along a continuous slip surface, or continuous sequence of slip surfaces, intersecting the fill's surface; and (3) some vertical displacement has occurred. The instabilities, or "slope movements," identified with these criteria have been further distinguished between critical and non-critical. Critical slope movements are those judged to occur over a large fraction of the fill face (e.g. over at least a few outslope benches) and/or require a major remediation effort (redistribution of the spoil from one part of the fill to another, construction of rock-toe buttresses, extensive reworking or augmenting of the drainage

systems etc.). Non-critical cases of instability are those covering a small area on the fill (e.g. not more than one bench on the fill face) and only necessitating minor reworking of the fill material (i.e. without significantly changing the fill's original configuration).

The word "instability" is a general term used in the field of engineering when an engineered construction material or structure fails to remain intact (e.g., without deforming, cracking, or breaking) under stress. For valley fills, commonly used terms descriptive of instabilities include landslide and slip. These types of slope movement are distinguished according to distance and rapidity of material transport. The more dangerous of these is the landslide, which involves sudden, rapid, and relatively distant movement of material. A slip has many features that are similar to a landslide but is characterized by a gradual movement over a shorter distance. Although this type of movement is at first less of a safety hazard compared to a landslide, it can turn into a slide if left unremediated. Both landslides and slips can be considered critical slope movements if they are large enough and costly to remediate. Relatively small events, i.e. non-critical instabilities, are simple to repair. However, if left unattended to, they can become critical.

Although most valley fills occur in relatively remote areas, some of them are above or adjacent to buildings (primarily residential) and public roads. Structures at these locations risk severe damage, if not total destruction, if the fill is not stable. People in or on these structures during a landslide may experience injury.

It is important to note that the danger posed by fill instability is limited in areal extent. Those people or structures on or very close to an unstable fill can be affected. However, catastrophic impacts over a great distance down-valley of a fill instability, as occurred during the Buffalo Creek coal waste dam failure, should not occur. Slope movement on a valley fill would not be expected to impact distant areas because:

- Fill designs build in a substantial, long-term factor of safety against instability and have specific drainage control measures.

- No large quantity of water should be present in properly designed valley fills to "lubricate" the fill material into a flowing mass that could transport for any great distance. The regulations prohibit ponds on fills or fills impounding water behind them. Even improperly-designed fills should have minimal impounding potential.

- Dam failures may release large volumes of water with little or no warning. Fill embankment failures can also be sudden, but are often characterized by the presence of warning signs of instability (cracks, increased seepage, etc.) and a slow creep.

Proper design of stable excess-spoil fill structures is dependent upon accurate characterization of rock strength and durability (30 CFR §816.73). Excess spoil consists of overburden or interburden (soil and rock excavated during the mining operation) not needed to reclaim the disturbed area to the approximate original contour of the land. The excess spoil material forming the rock fill is generally made up of angular blast rock. Before the enactment of SMCRA, excess spoil disposal structures were generally constructed with minimal engineering guidance. Often these structures were placed at locations selected strictly to optimize the mining operation. Since the passage of SMCRA, regulations require increased engineering effort directed toward design and construction

of excess spoil disposal areas to improve safety. The fill stability study found only a very small percentage of excess spoil fills that experienced instability over the past 18 years.

2. Trends in Valley Fills

To determine the actual extent of valley fills within the EIS study area, the EIS Steering Committee commissioned a Fill Inventory. The inventory is to develop an accurate, Geographic Information System (GIS)-based database of valley fills constructed or proposed for construction in mining permits. A GIS is queried like any computerized relational database to show statistics about the information in the database, such as valley fill size, numbers, date of construction, etc. As such, the inventory was used to illustrate impacts within the EIS study. The fill data for the inventory were gathered by the states of Kentucky, Virginia, and West Virginia under special efforts funded by OSM and EPA, and gathered by OSM for Tennessee. The inventory was obtained from maps and databases maintained by each of the regulatory authorities. The specific metrics from this study were as follows for each state:

Total number of fills
- Approved each of the years, 1985 through 2001, and cumulatively.
- Fills constructed.

Area of fill "footprint," i.e., fill extent, or acres of ground covered by fill
- Total acreage for the years 1985 through 2001, and by year of permit issuance.
- Range of individual fill footprint sizes for the years 1985 through 2001, and by year of permit issuance.
- Average of individual fill footprint sizes for the years 1985 through 2001, and by year of permit issuance.

Watershed size, or the acres of land upstream, or upslope, of the fill, i.e., between the fill and the ridgetops within each valley
- Total watershed acreage for all fills for the years 1985 through 2001, and by year of permit issuance.
- Average watershed size for each fill for the years 1985 through 2001, and by year of permit issuance.

Miles of stream under fill footprints
- Total miles of 30-acre watershed stream net affected 1985 through 2001, and by year of permit issuance.

The following data were assembled as a part of the inventory effort:
- digital maps of the footprints of the fills,
- acreage of the footprints of the fills,
- volume of fill, if available,
- length of streams covered by footprints of the fills,
- size of the watershed (measured from the toe of the fills),
- permit numbers,
- permit status,
- fill identification numbers,
- current status of each fill (constructed or not), and
- original permit issue dates for each fill.

The scope of the inventory was originally established for fills permitted between January 1, 1982, and December 31, 1999. The initiation date was intended to approximate the dates on which the Secretary of the Interior approved the permanent programs under SMCRA for the states in the study area. The permanent programs went into effect on the following dates: West Virginia on January 21, 1981; Virginia on December 15, 1981; and Kentucky on May 18, 1982. After administering its approved permanent program, Tennessee relinquished its program and a Federal program was implemented on October 1, 1984. Upon approval of a permanent SMCRA program in a state, all existing mining operations had to obtain a new, permanent program permit in order to continue operations. Data from the years immediately following approval of a permanent program in a state show a high level of permitting activity representing this "repermitting" requirement rather than useful information on the trends of permitting new mines. Therefore, the beginning date of June 1, 1985, was established. The ending date has changed to provide more current data for the inventory. As a consequence, the analysis in this section of the EIS will be mostly for the period from January 1, 1985, through December 31, 2001, so as to present valid trend information. There have been several changes in the inventory since the original version was first completed in 1999. First, the inventory now contains data for the years 1999, 2000, and 2001. Second, the additional time has allowed for additional review of the data and several changes have been made because of errors in the original inventory, discovery of fills that were not originally included, and changes in the status of fills and the permits under which they were approved. These changes are minor but they may be confusing to those who received copies of the original inventory report.

An industry practice is to permit more surface area for disturbance than is likely to be affected by the operations planned. This allows the mining operation to respond more quickly to changing market conditions. The rationale is that it's simpler to amend permits to reduce the affected area than it is to increase the affected area. Because of this practice, comparisons are made of the number of fills constructed to the number of fills approved or permitted. For permits where the entire bond has either been released to the permittee (because the site has been fully reclaimed) or has been forfeited (so the site can be reclaimed by the regulatory authority), the number of fills that will be constructed on that permit area is definite because the mining operation is complete. For all other permits, the fills permitted are either constructed or may be constructed because the mining operation is not complete. The reader should note that the proportion of completed fills on newer permits will be significantly less than those on older operations. This is primarily due to the fact that these newer fills just simply have not been built because mining operations have not progressed to the point where they are needed. Also, construction of fills approved prior to 1995 was verified using satellite images, while verification of fills approved after 1995 has been done using data bases that may or may not be updated in the most expeditious manner.

Another common practice is to repermit surface coal mining and reclamation operations using the same facilities, such as valley fills. This happens for a number of reasons including changes in ownership, sale of mining companies, closure and reopening of operations based on market conditions, etc. This practice results in a high number of valley fills being identified under two or more permit numbers. Since the purpose of this inventory was to develop an accurate count of valley fills that actually exist, and not just a listing of valley fills approved under all permits, this practice of repermitting had to be considered. Also, the inventory was to allow its users to have a sense of how valley fills have been approved by the various permitting agencies over time. To account for this, each valley fill was only counted the very first time it was permitted. If the same facility was repermitted, it retained the permit number and issue date of the original permit. Most

state regulatory agencies and OSM maintain inventories and data bases of valley fills approved by permits. Since this results in each valley fill being included every time it is repermitted, these inventories will seldom correspond on a one to one basis with the inventory presented in this report.

This inventory was an attempt to identify fill structures placed in valleys or heads-of-hollows. It includes fills approved or constructed on all surface coal mining and reclamation operations including mountaintop removal operations, contour and auger mining operations, underground mine face ups, processing and loading facilities, preparation plants, roads, or any other facility that had to make use of a spoil or refuse disposal site in order to operate. No distinction was made between spoil or refuse fills. Impoundments were added whenever such information was made available. This was done in order to provide as complete an inventory as possible and to accurately reflect field conditions. The majority of the fills are permitted as part of surface mining operations. Of the 6697 fills counted in this inventory, 5688 (85 percent) are on surface mining operations, 719 (11 percent) are on underground mining operations, and the remaining 290 (4 percent) are on other types of operations such as preparation plants, tipples and load-outs, or other types of facilities. It is assumed that all the files on surface mining operations and most of the fills on underground operations are spoil fills. If is certain that a fair percentage of the fill structures on some underground mines and most of the other types of operations are refuse fills or impoundments.

The data for the inventory are fairly complete and allow for meaningful analysis of trends. Reliable information on the permitted fill volume is generally not available except in the individual permitting documents, and was not analyzed. Stream measurements were estimated from a stream network derived using a flow accumulation model over the National Elevation Data set (NHD), and based on draining a minimum watershed size of 30 acres. The digital "hydrography layer" of a USGS 7.5-minute topographic map consists of two line types--a solid blue line (representing perennial stream segments) and a broken blue line (representing intermittent stream segments). Delineation of the two stream types on USGS 7.5-minute topographic map was highly subjective, and followed no standard qualifying criteria. The synthetic stream net is objective and remains more consistent across State boundaries than the anecdotal evidence of a USGS 7.5-minute topographic map. Measurements for ephemeral stream segments were not available and are not included in this section. The inventory has been developed in GIS using ArcView as the base program for mapping and data analysis. OSM is looking into the feasibility of making the map coverages and data used for this analysis available on its web page located at http://www.osmre.gov.

The following figures show the extent of the entire study area and provide a visual indication as to the level of valley fill construction in the states within the study area.

Figure III.K-7: Overview of the Valley Fill Inventory Study Area

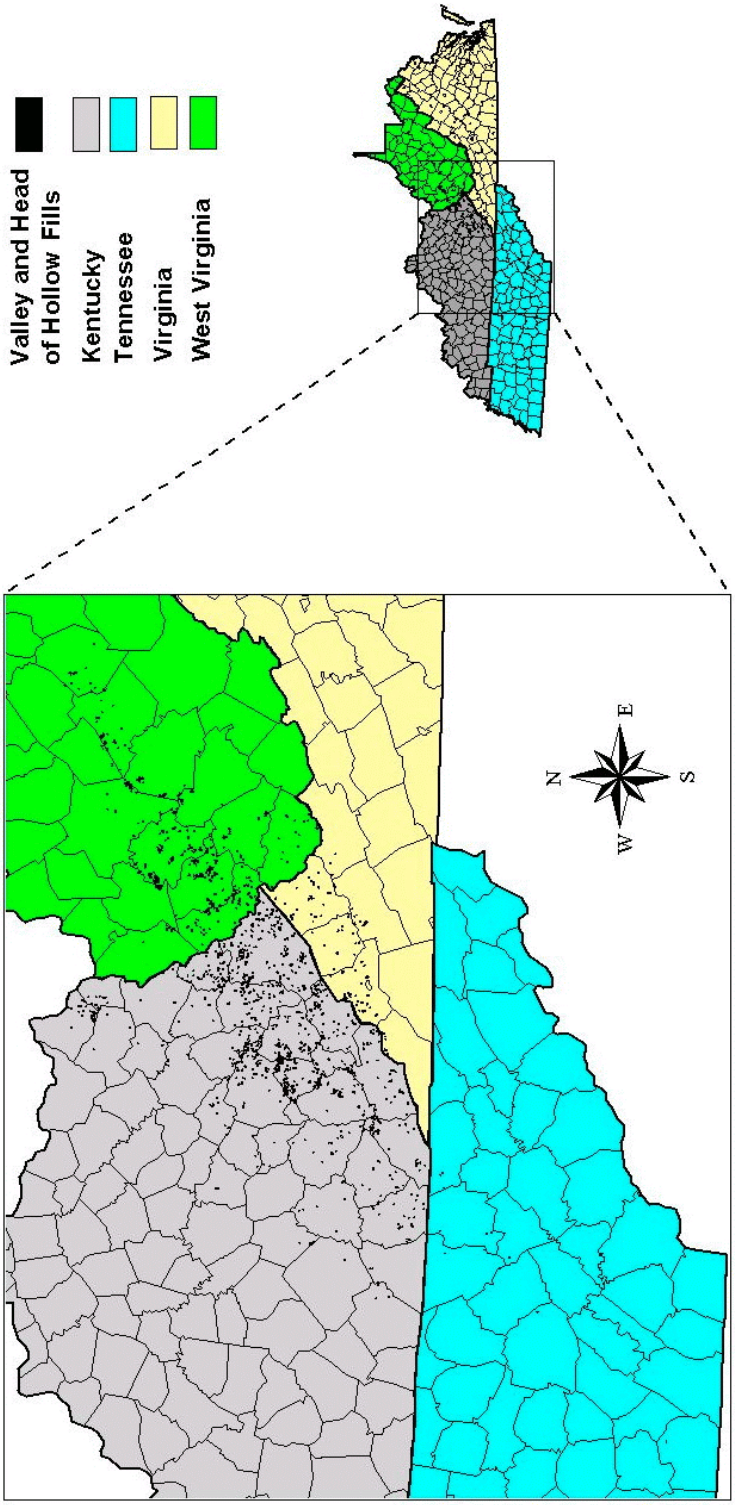


Figure III.K-8: Kentucky Fill Inventory Study Area

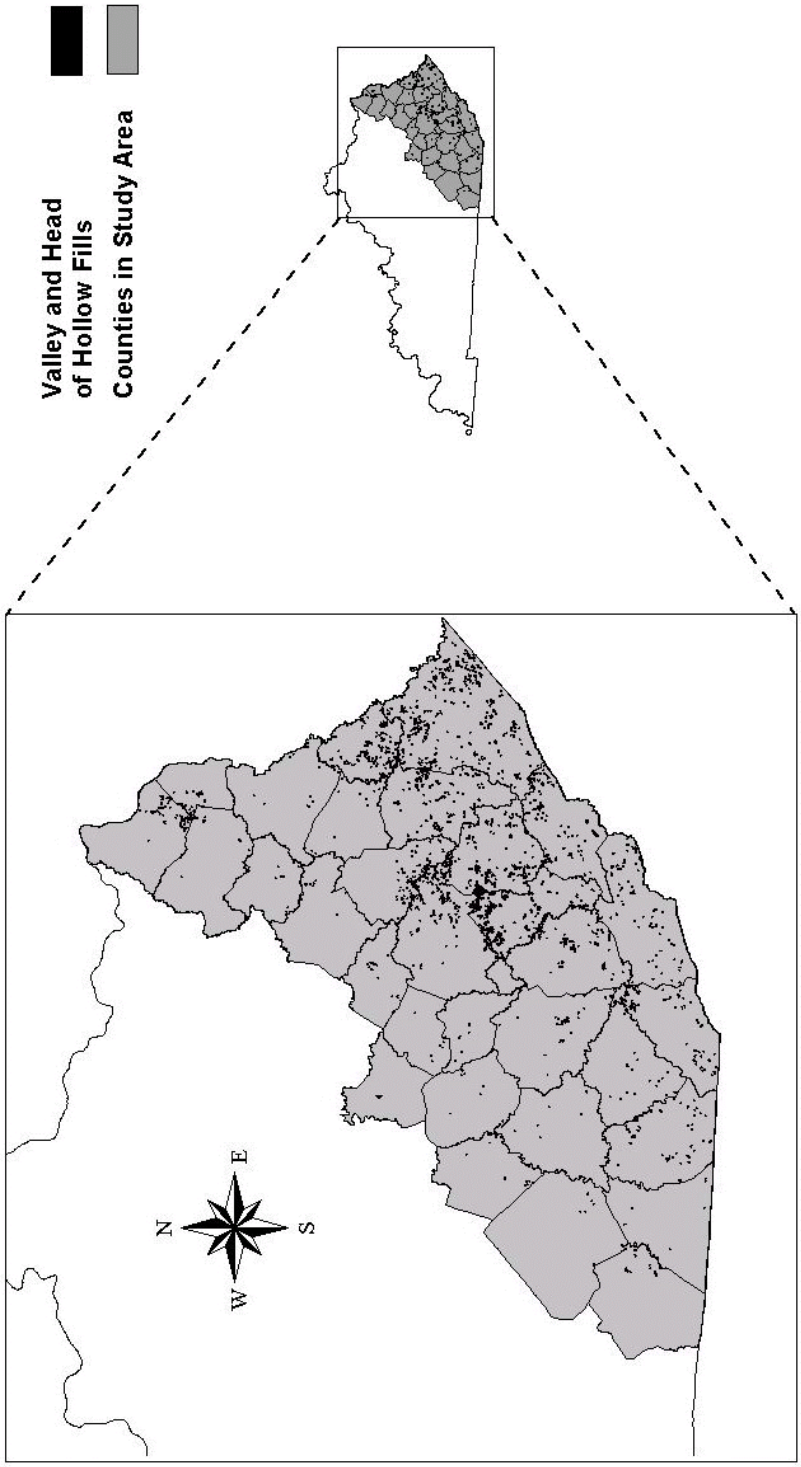


Figure III.K-9: Tennessee Fill Inventory Study Area

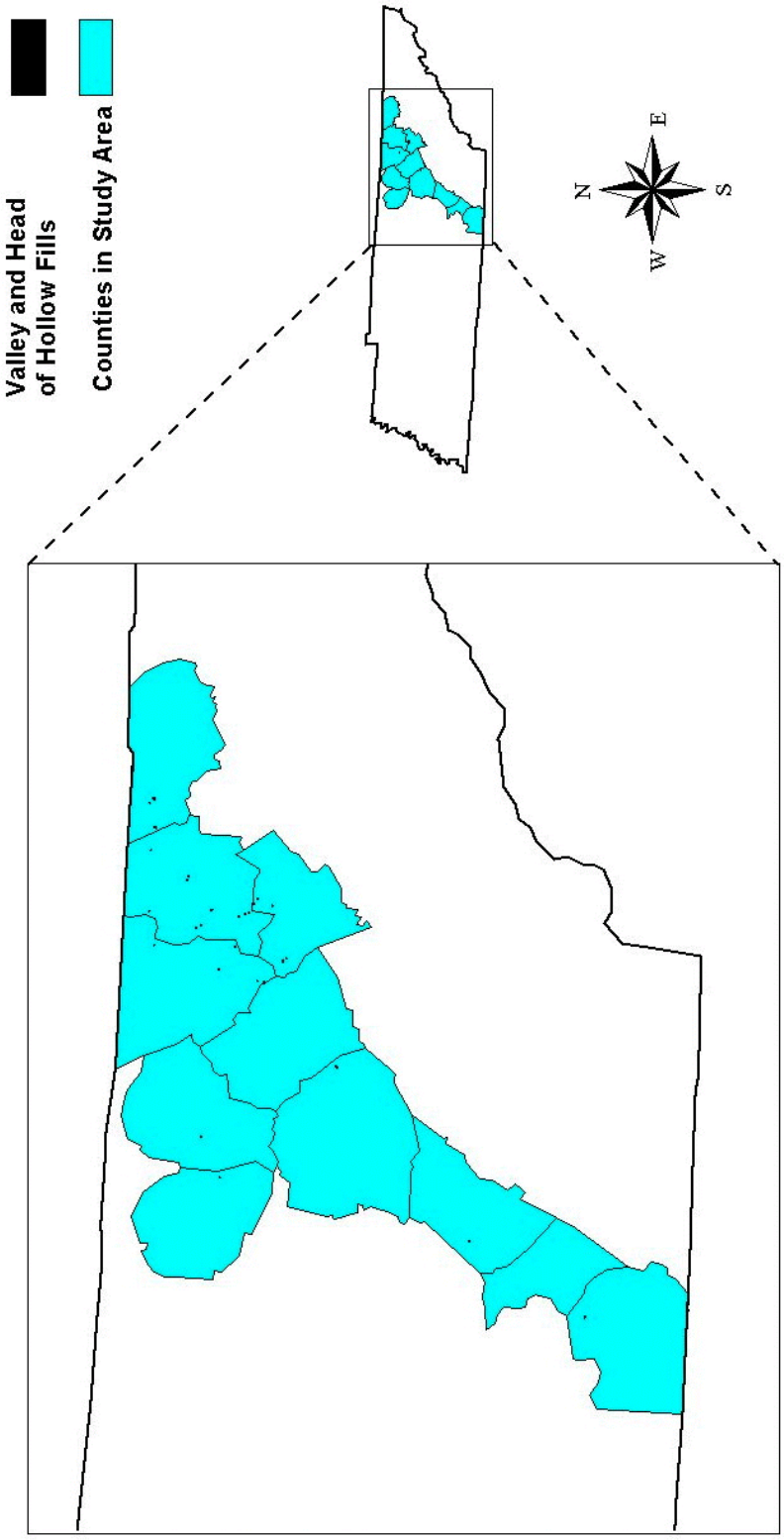


Figure III.K-10: Virginia Fill Inventory Study Area

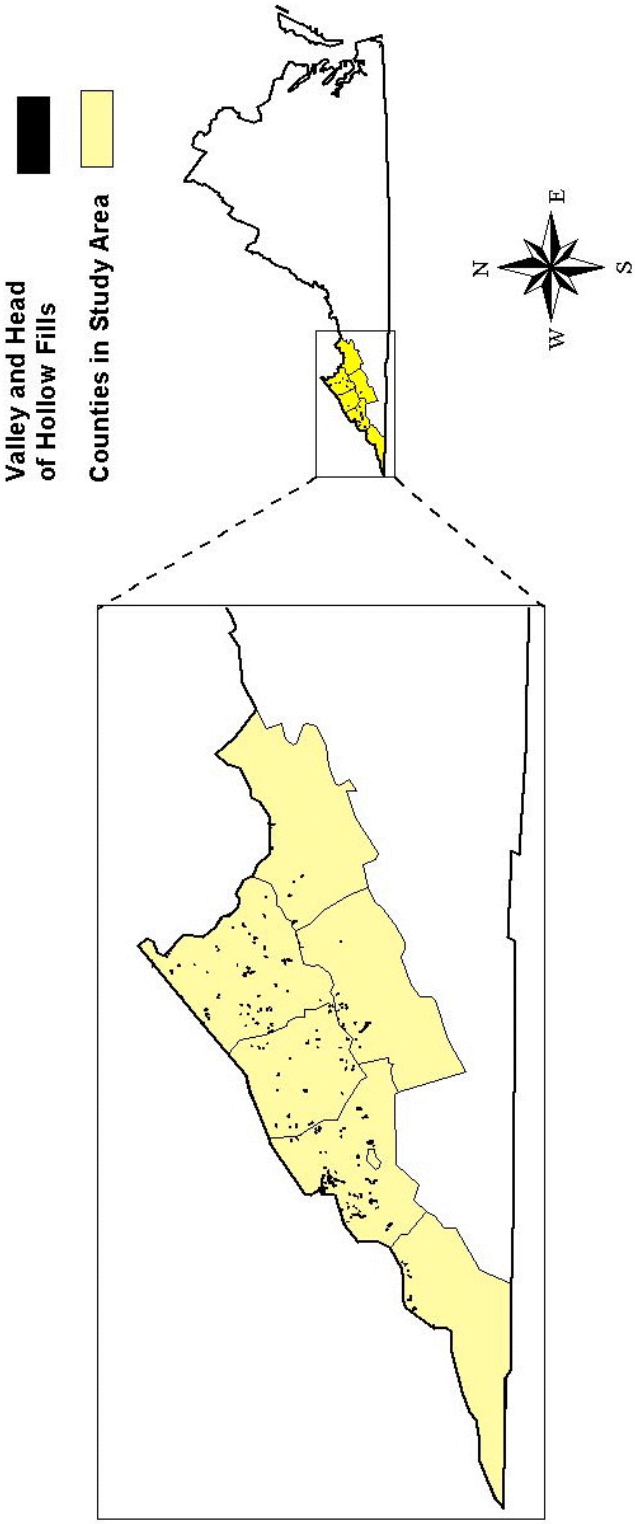
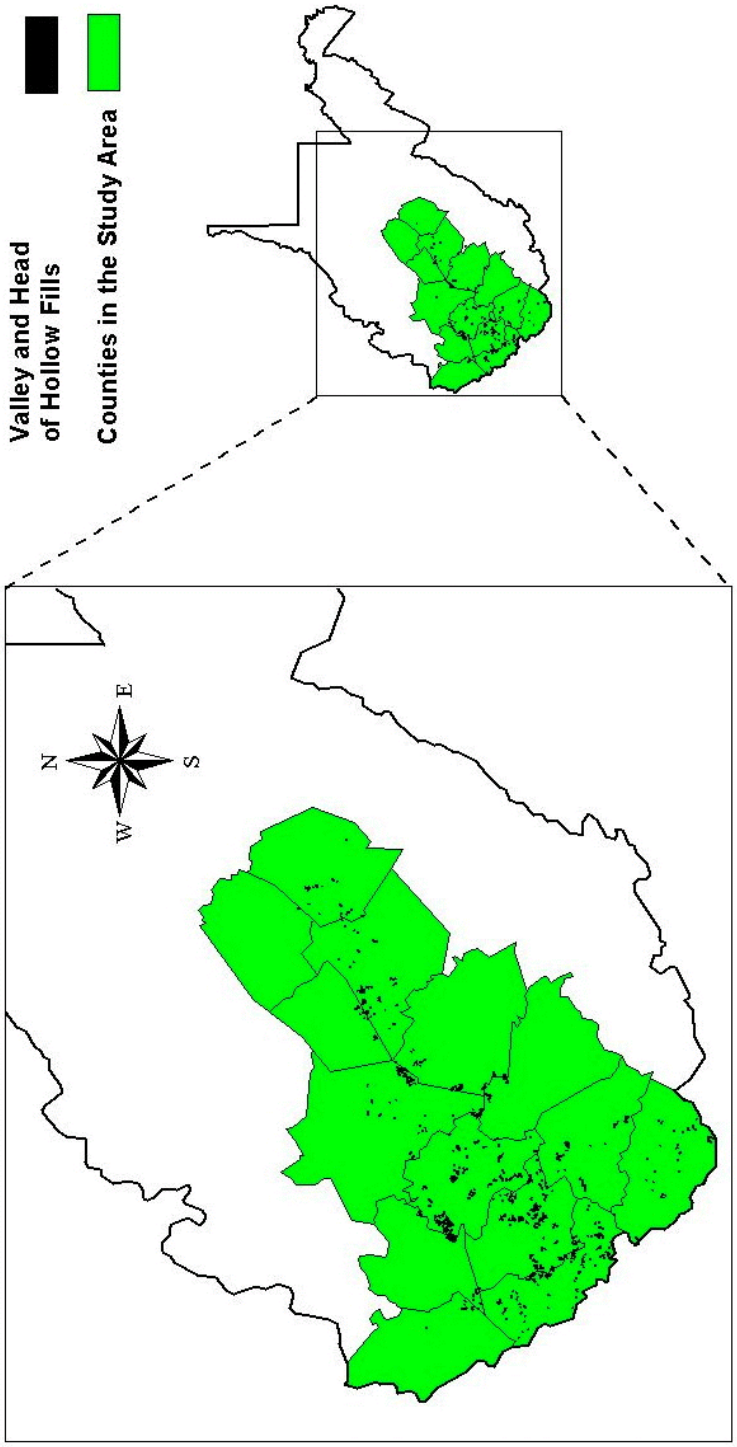


Figure III.K-11: West Virginia Fill Inventory Study Area



a. Regional Valley Fill Trends

Figure III.K-12 is the number of valley fills approved in each of the states contained in the study area for the period from 1985 through 2001. A total of 6697 valley fills were approved during this period.

Figure III.K-12 Total Number of Valley Fills Approved in States and Region

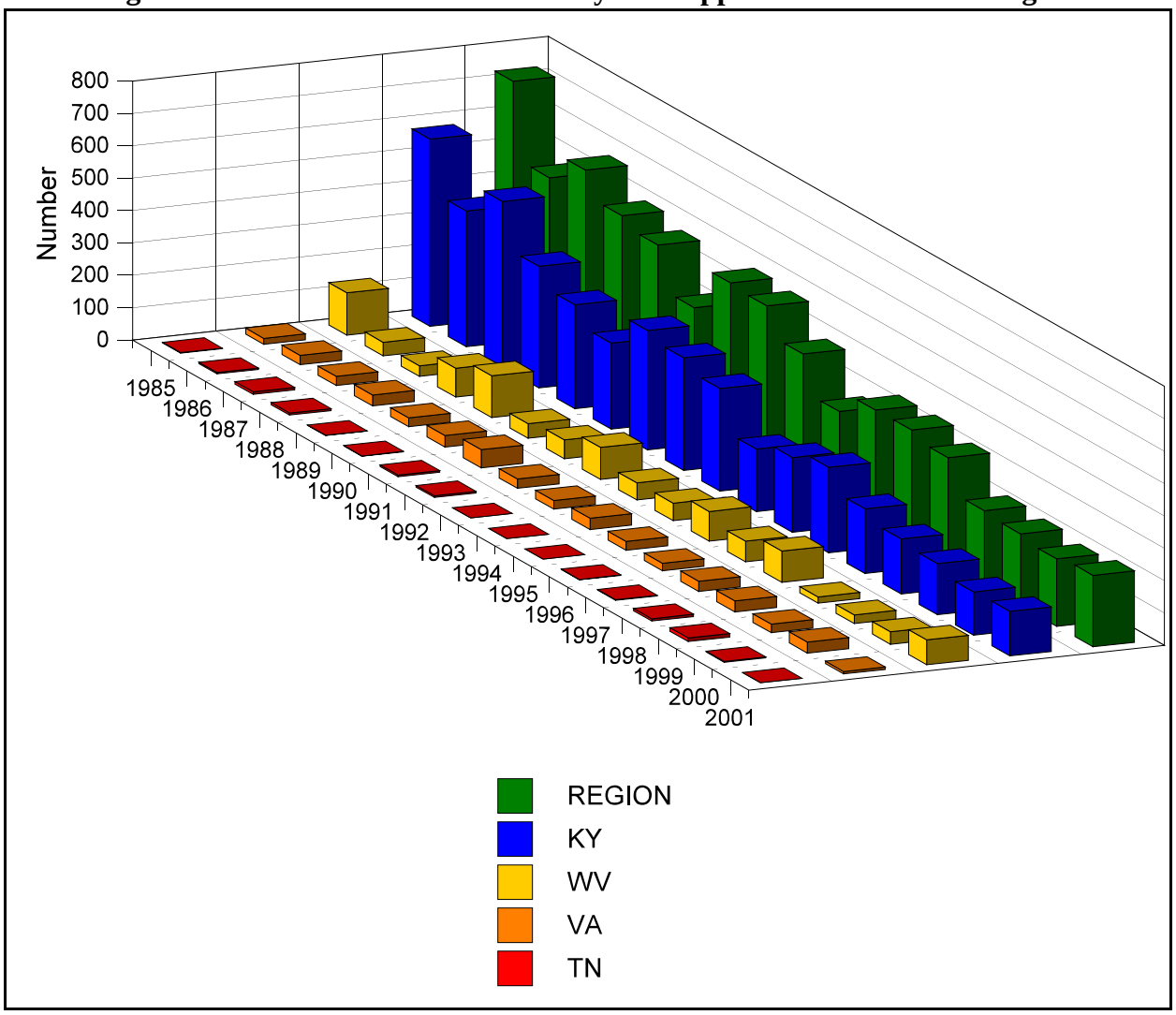


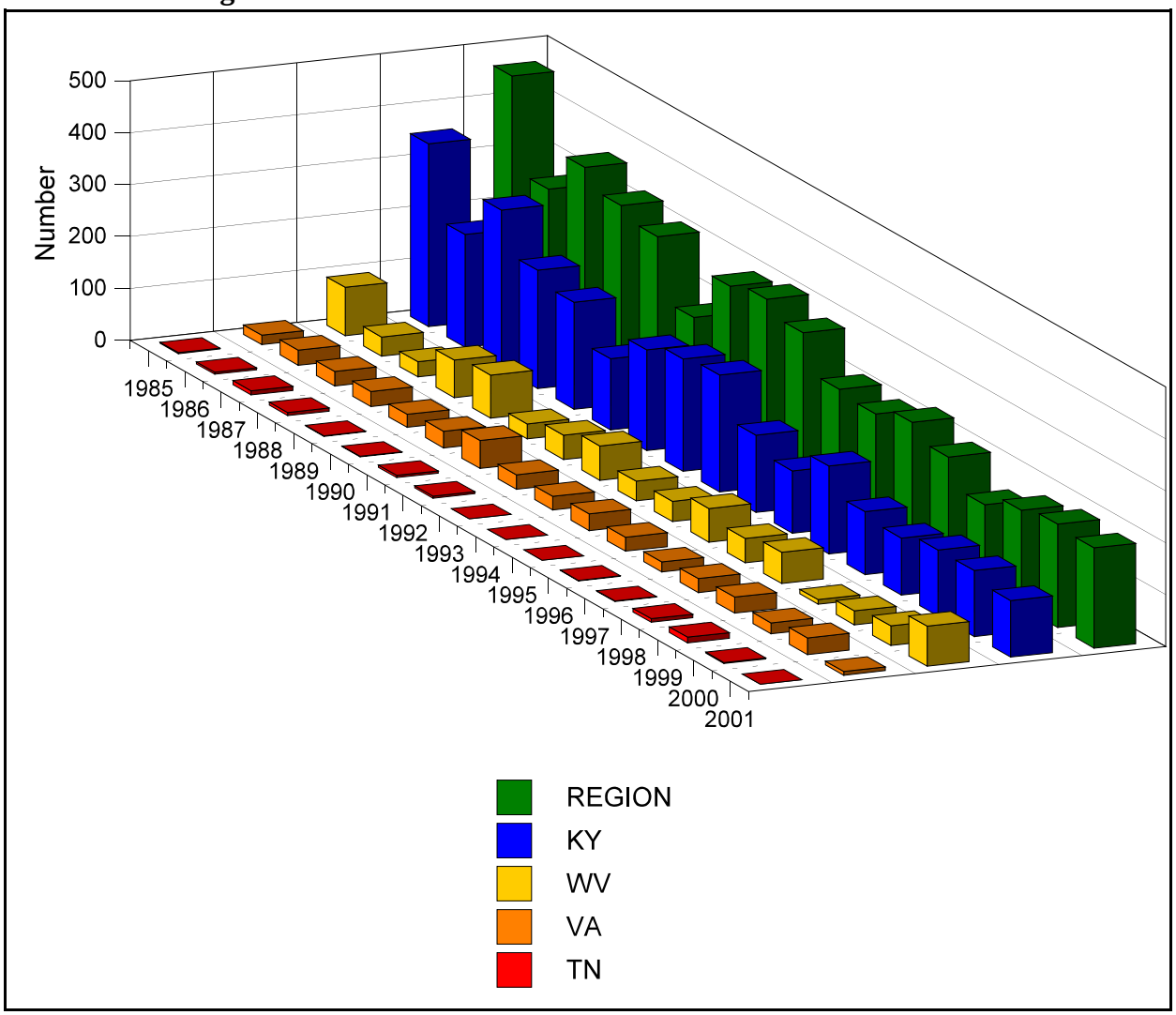
Table III.K-1 provides yearly data for the number of valley fills approved in states contained in the study area.

Table III.K-1
Valley Fills Approved in States and Region

Year	Kentucky	Tennessee	Virginia	West Virginia	Region
1985	578	2	18	131	729
1986	420	4	29	42	495
1987	513	8	28	33	582
1988	376	6	34	89	505
1989	321	1	27	129	478
1990	266	1	36	45	348
1991	369	5	56	58	488
1992	348	5	29	99	481
1993	317	0	26	53	396
1994	193	0	35	54	282
1995	231	0	27	92	350
1996	264	1	23	64	352
1997	200	2	31	97	330
1998	170	7	34	19	230
1999	158	11	26	27	222
2000	134	2	34	38	208
2001	137	0	7	77	221
Total	4995	55	500	1147	6697

Figure III.K-13 is the number of valley fills that were constructed or may be constructed in each of the study states for the period from 1985 through 2001. A total of 4484 (67 percent) valley fills out of the 6697 approved were constructed or may be constructed.

Figure III.K-13 Trends in Valley Fills Constructed or Proposed to be Constructed by States and Region



b. Kentucky Valley Fill Trends

During the period from 1985 through 2001, a total of 6,446 new permanent program permits were issued in Kentucky (OSM's Annual Reports from 1985-2001). Of these, 3,837 were new permits within the study area. The other 2,609 were in western Kentucky, were issued under the now repealed two-acre exemption, or were transfers or successions of existing operations. (SMCRA originally exempted any operation affecting 2 acres or less from requirements to comply with the standards of the Act. Most states still required permits on such sites and required reclamation to state standards. Due to widespread abuse of this provision, the 2-acre exemption was repealed in 1987.) Within the study area, 2,404 permits were issued without valley fills, and 1433 permits were issued with 4995 valley fills. Four thousand one hundred and thirty seven (4137) fills were approved on 961 surface mines, 738 were approved on 393 underground operations, and 120 were approved on 79 operations of other types (preparation plants, refuse fills, roads, tipples, etc. Figure III.K-14 shows that the number of permits issued, with or without valley fills, generally decreased through the period. During the period from 1990 through 2001, the number of permits (with or without valley fills) decreased 54 percent. Figure III.K-14 also shows that the number of fills decreased 48 percent during this same period. Including all permits issued, an average of 1.79 valley fills per permit was approved for the period 1990 through 2001. For permits containing approved valley fills, the average number of valley fills per permit was 3.6 for this same period. The range of valley fills issued per permit for the same period was zero to 31.

Figure III.K-14 Total Number of Fills Approved in Kentucky

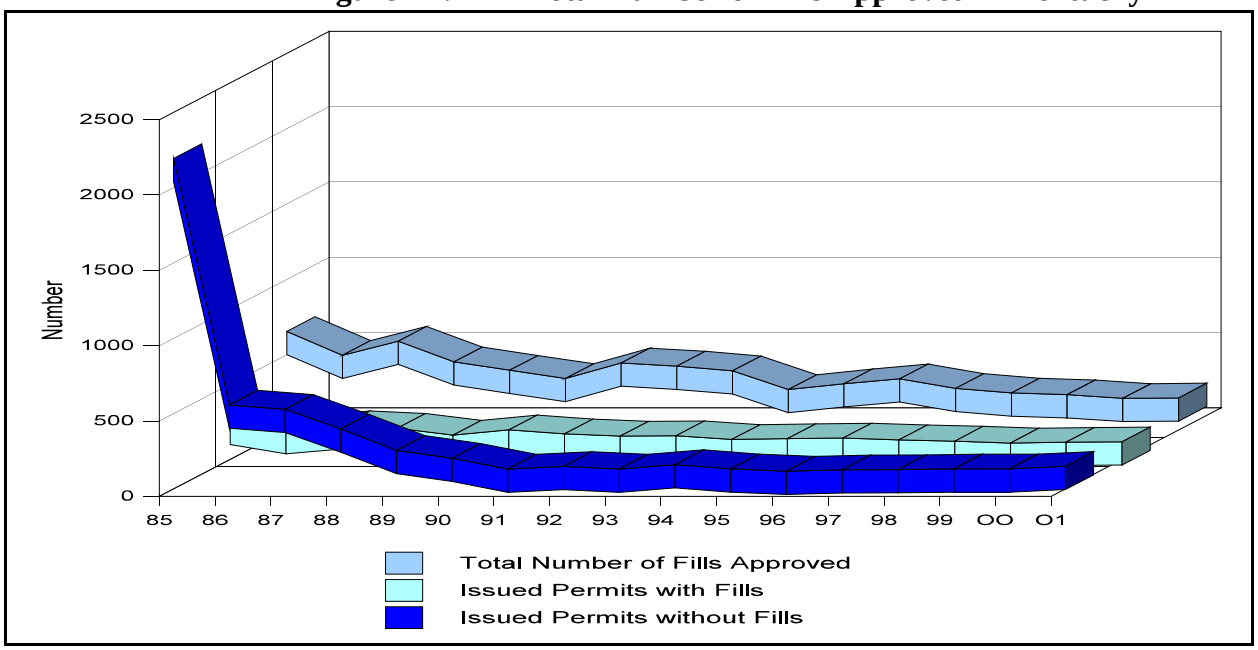
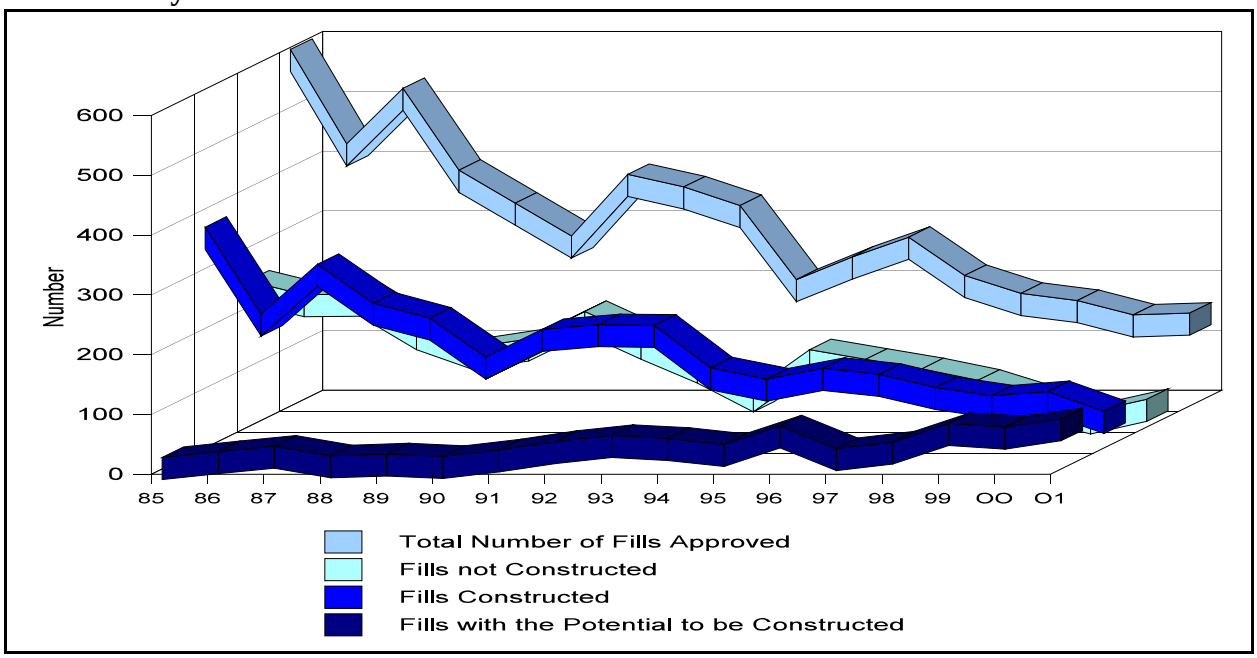


Figure III.K-15 shows trends in Kentucky valley fills constructed, or that having the potential to be constructed due to ongoing mining activity, during the period from 1985 through 2001. A total of 3117 (62 percent) of the 4996 approved valley fills are either constructed or may be constructed. The other 1879 valley fills will not be built because the bonds have either been released or forfeited for those permits.

Figure III.K-15 Trends in Valley Fills Constructed or Proposed to be Constructed in Kentucky



c. Tennessee Valley Fill Trends

Tennessee had a relatively small number of permits issued with valley fills. These limited data inhibit a trend analysis. Nonetheless, trends have been prepared for comparison to the other states. During the period from 1985 through 2001, a total of 236 new permanent program permits were issued in Tennessee (OSM's Annual Reports from 1985-1999). Thirty-five permits were issued with 55 valley fills. The other 201 permits were approved without valley fills. Figure III.K-16 shows that the number of permits issued with or without valley fills varied slightly during the period from 1985 through 2001, with one exception. An anomaly involving an increase in the number of valley fills was noted in 1999. This anomaly is related to one permit with nine valley fills that was issued in 1999. The average number of valley fills issued per permit is 0.62. The range of valley fills issued on permits is zero to nine.

Figure III.K-16 Total Number of Valley Fills Approved in Tennessee

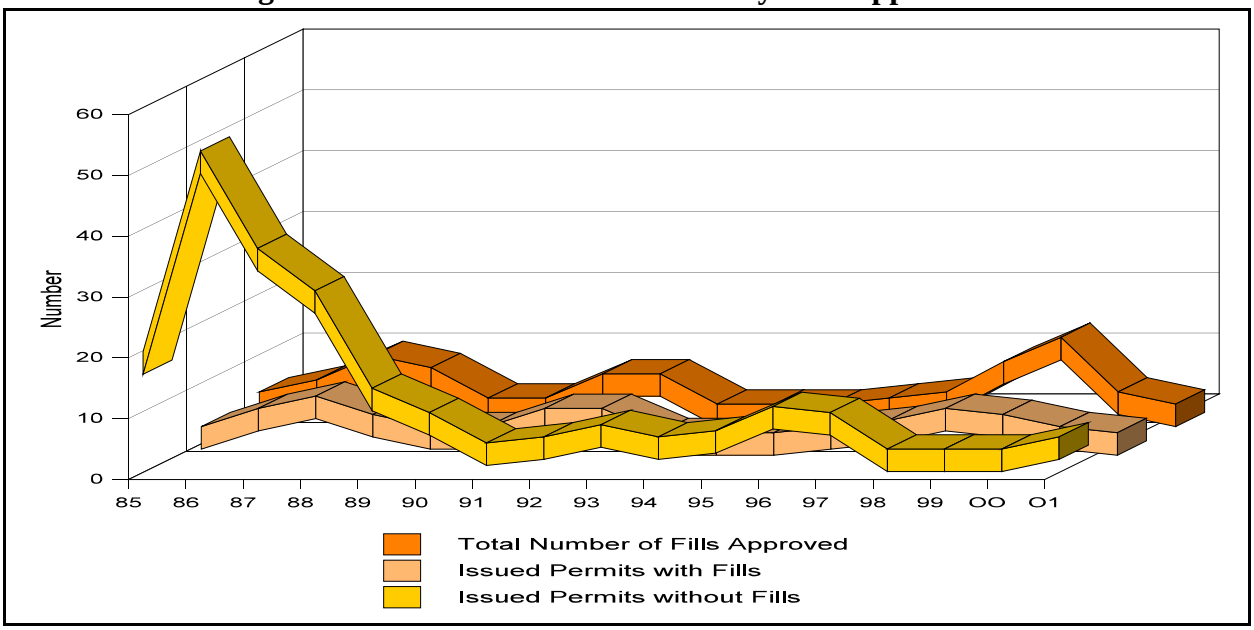
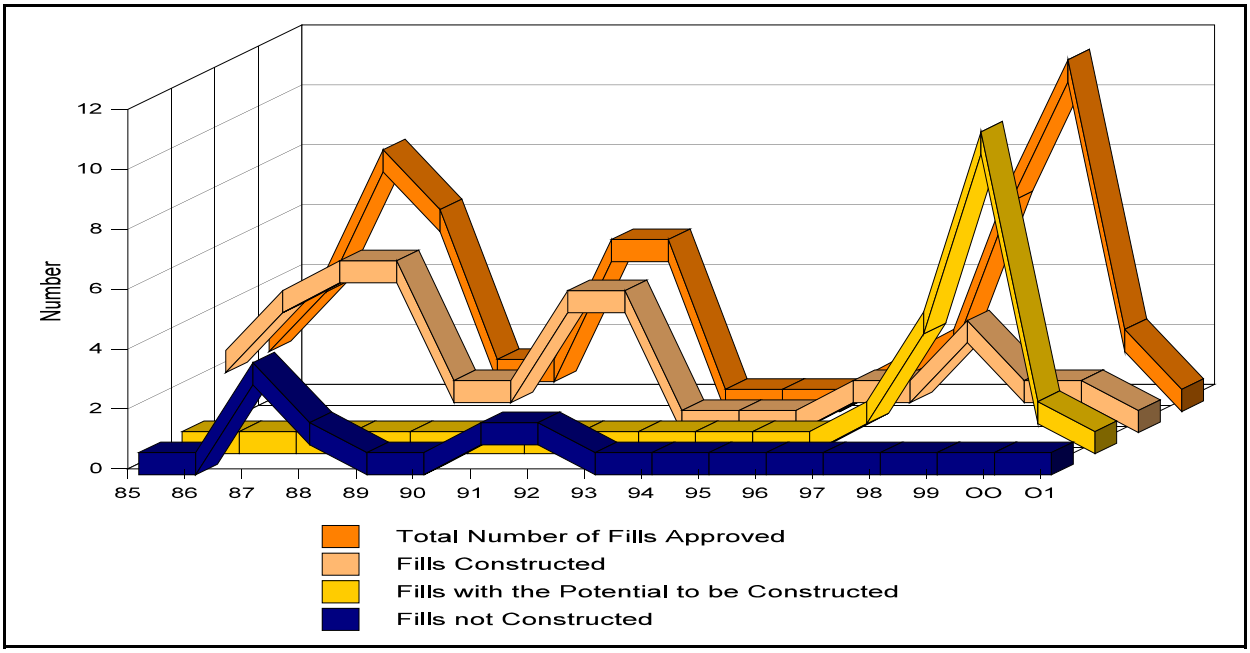


Figure III.K-17 shows trends in valley fills constructed or having the potential to be constructed in Tennessee during the period from 1985 through 2001. A total of 48 (87 percent) of the 55 approved valley fills are either constructed or have the potential to be constructed. The other seven valley fills will not be built.

Figure III.K-17 Trends in Valley Fills Constructed or Proposed to be Constructed in Tennessee



d. Virginia Valley Fill Trends

During the period of 1985 through 2001, a total of 916 new permanent program permits were issued in Virginia (OSM's Annual Reports from 1985-2001). Of these, 194 were issued under the now repealed two-acre exemption or were transfers or repermits of existing operations leaving 722 permits where permanent program standards would have applied to valley fills. Of these 722 permits, 493 were issued without valley fills, and 229 were issued with 500 valley fills. Three Hundred and thirty valley fills were approved on 123 surface mines, 45 were approved on 39 underground operations, and 125 were approved on 74 operations of other types (preparation plants, refuse fills, roads, tipples, etc.) Figure III-K-18 shows that, during the last ten years, the number of permits and valley fills issued each year have remained relatively consistent throughout the period with a few deviations. An average number of 2.7 valley fills per permit was approved for the period 1990 through 2001. The range of valley fills issued on permits for the same period is zero to 11.

Figure III-K-18 Total Number of Fills Approved in Virginia

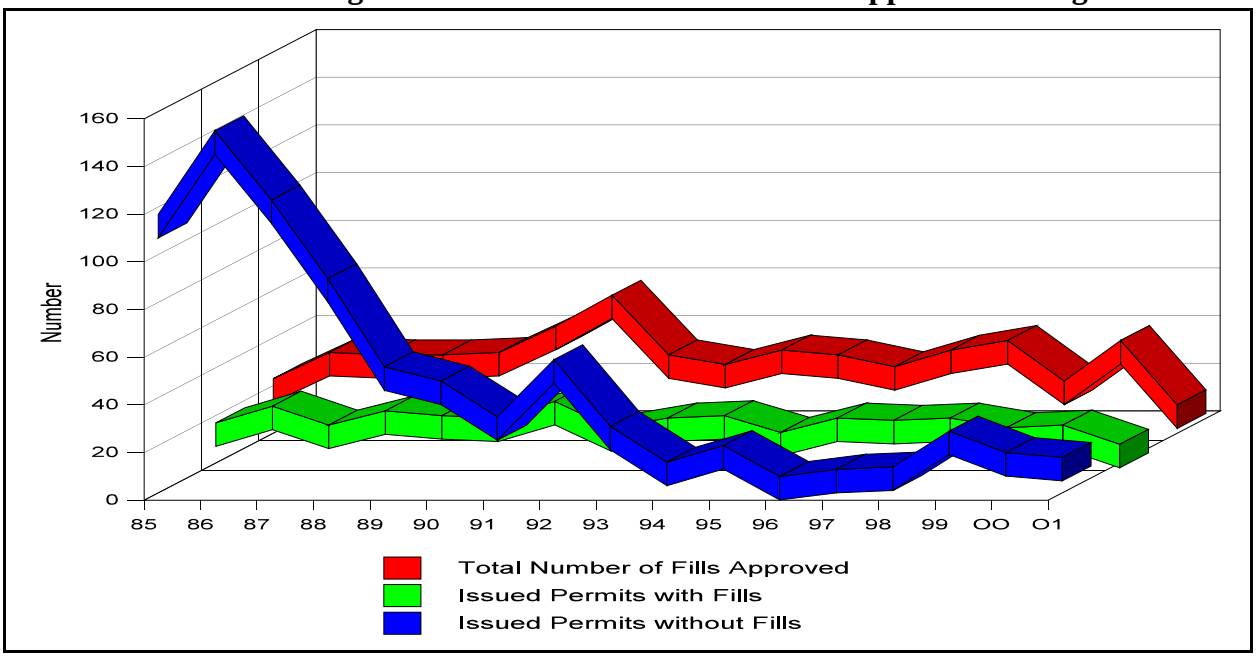
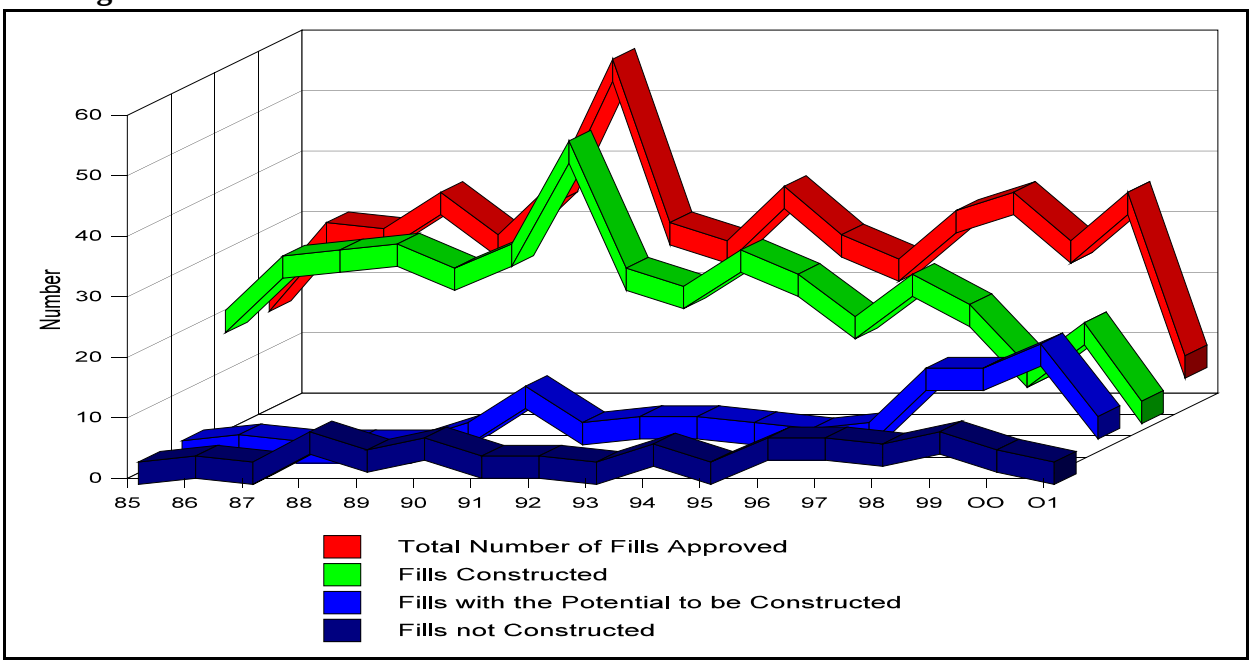


Figure III.K-19 shows trends in valley fills constructed, or that having the potential to be constructed due to ongoing mining activity, during the period from 1985 through 2001. A total of 465 (93 percent) of the 500 approved valley fills are either constructed or may be constructed. The other 35 valley fills will not be built because the bond has either been released or forfeited for those permits.

Figure III.K-19 Trends in Valley Fills Constructed or Proposed to be Constructed in Virginia



e. West Virginia Valley Fill Trends

During the period from 1985 through 2001, a total of 2,639 new permanent program permits were issued in West Virginia (OSM's Annual Reports from 1985-1999). Three hundred and forty two (342) permits were issued with 1147 valley fills. The other 2,297 permits were approved without valley fills. Figure III.K-20 shows marked variability during the period from 1985 through 2001. The figure suggests a decrease in the number of permits issued without valley fills, while the number of permits issued with valley fills has varied during the period. Figure III.K-20 also shows that the number of fills decreased during the period from 1990 through 2001 from a high of 91 fills in 1995 to a low of 19 fills in 1998. An average of 0.6 valley fills per permit was approved for the period 1990 through 2001. The range of valley fills issued on permits for the same period is zero to13.

Figure III.K-20 Total Number of Valley Fills Approved in West Virginia

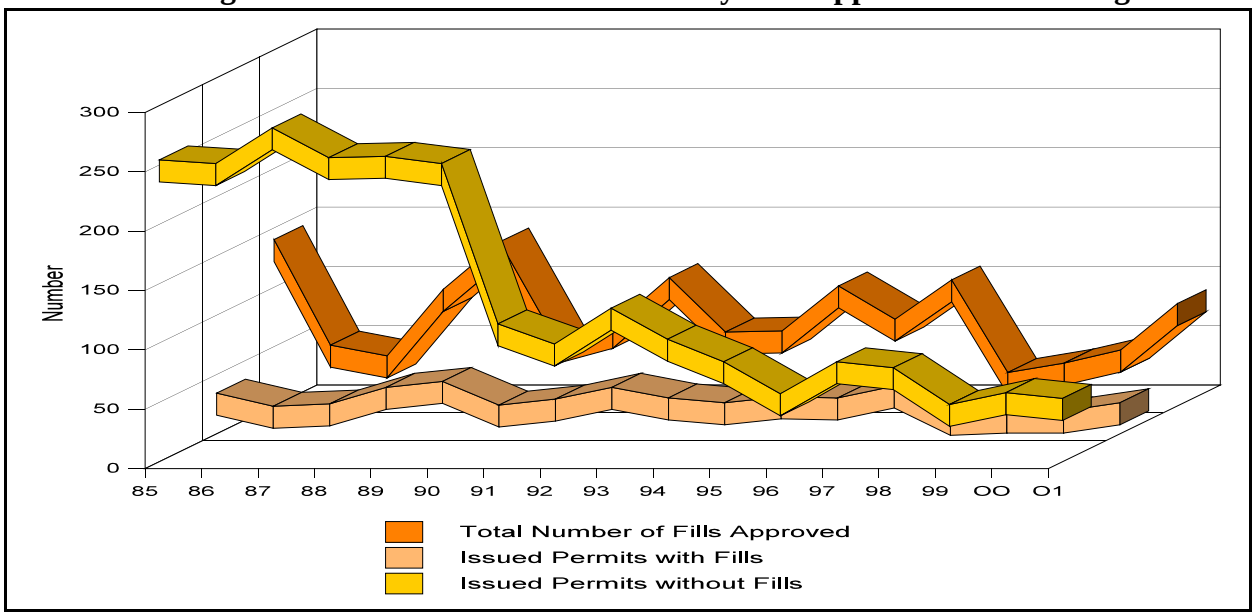
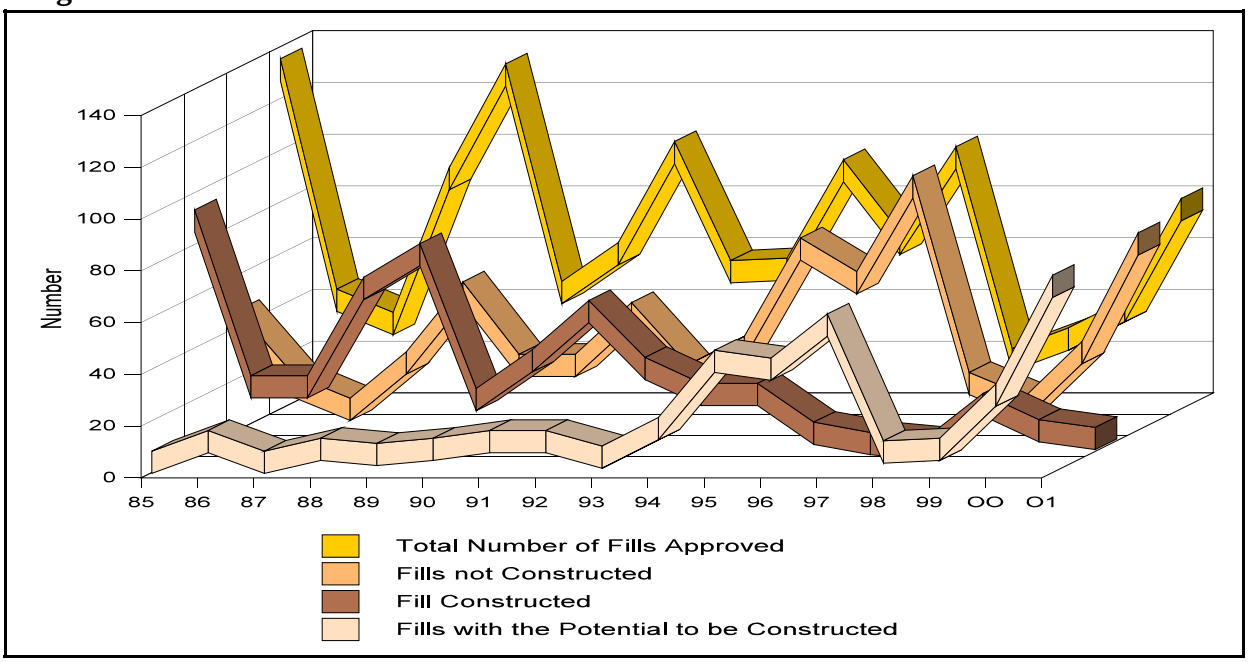


Figure III.K-21 shows trends in valley fills constructed or that having the potential to be constructed in West Virginia during the period from 1985 through 2001. A total of 856 (75 percent) of the 1147 of the approved valley fills are either constructed or may be constructed. The other 291 valley fills will not be built because the bonds have either been released or forfeited for those permits.

Figure III.K-21 Trends in Valley Fills Constructed or Proposed to be Constructed in West Virginia



3. Trends in Valley Fills Size

As with total excess spoil disposal, trends for individual valley fill sizes were developed for the Fill Inventory Study. For the EIS, available electronic databases were reviewed for the four states to provide an assessment of trends in valley fill size over time. These are similarly representative of valley fills that were proposed in permit applications, some of which may not have been or will not be constructed. The following summarizes the findings for the four states and the region.

a. Regional Valley Fill Size Trends

Figure III.K-22 is the total acreage of valley fills approved in each of the states contained in the study area for the period from 1985 through 2001. A total of 83,797 acres of land is covered by 6697 valley fills approved during the period.

Figure III.K-22 Trends in Valley Fill Acreage in States and Region

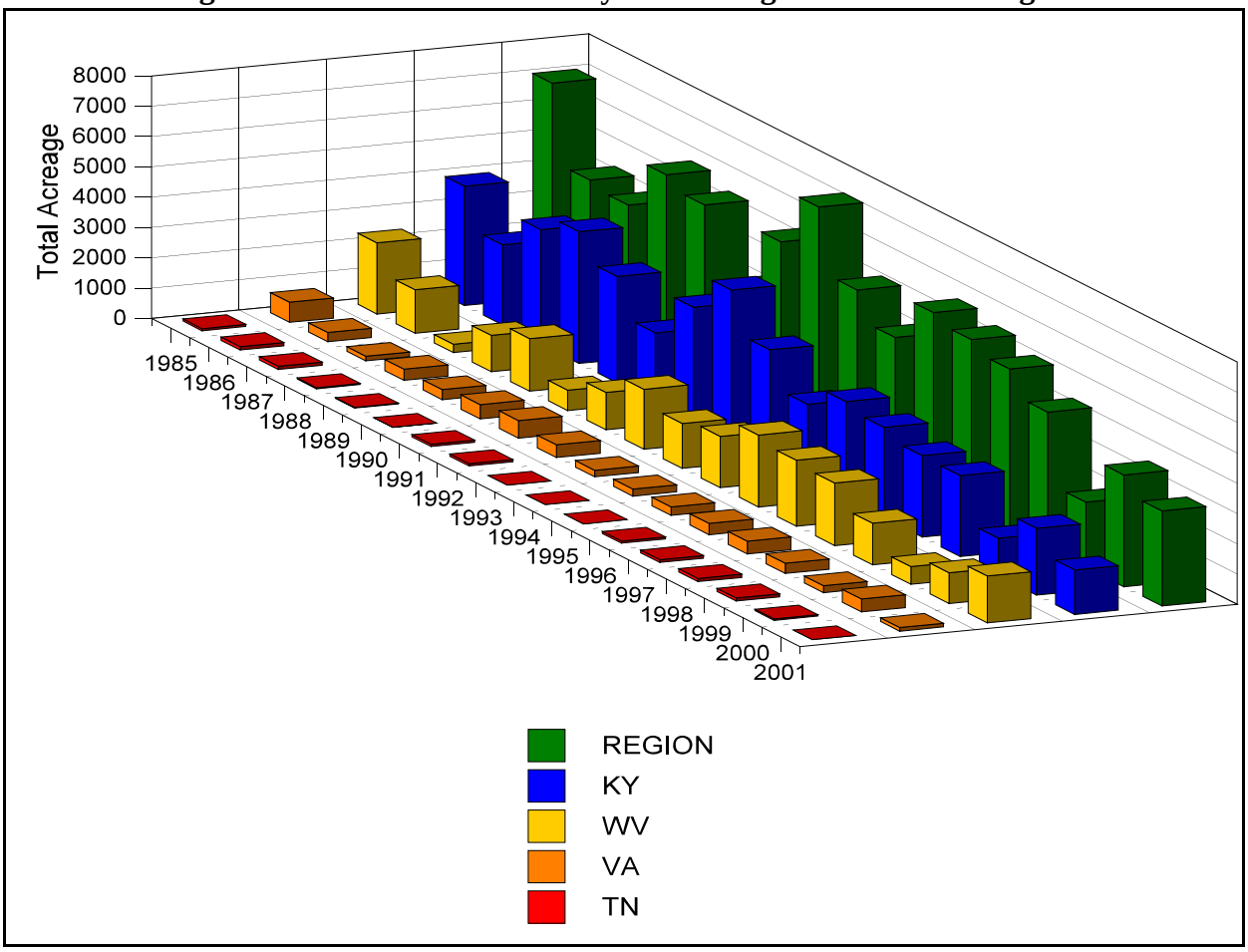


Table III.K-2 provides yearly data for total valley fill footprints approved, valley fill average sizes, and the range of valley fill sizes for the states within the study area.

Table III.K-2

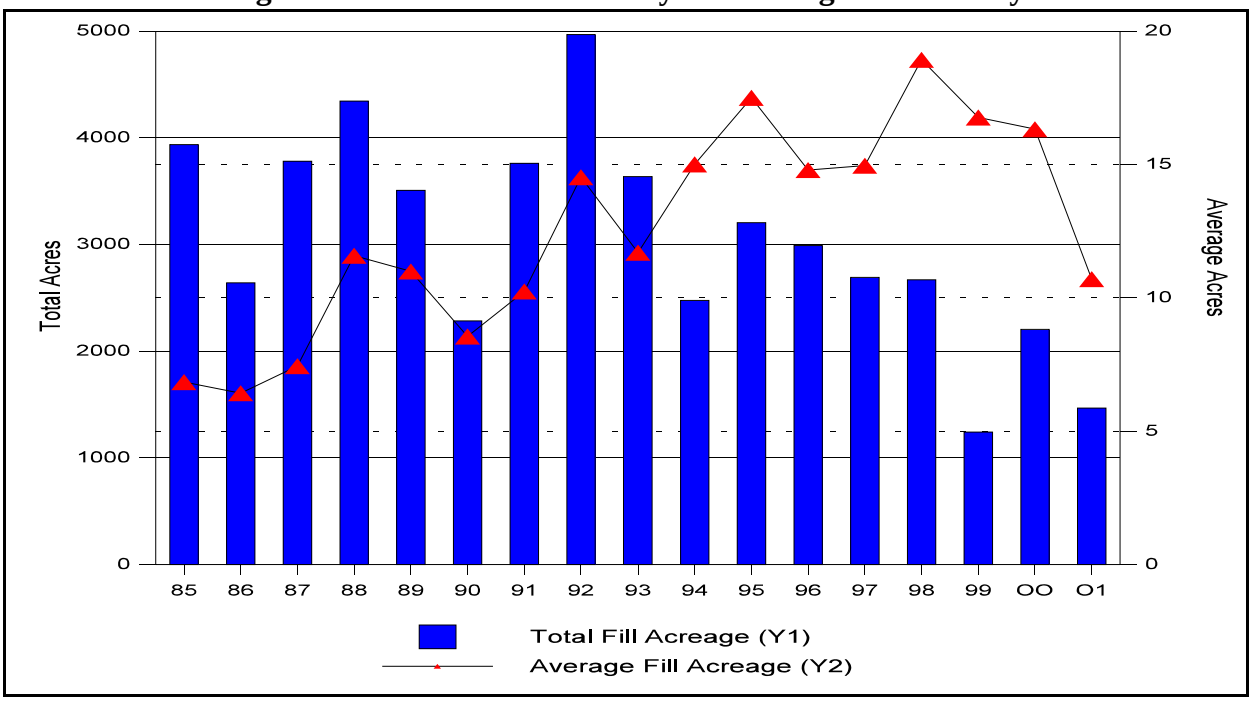
Year	Valley Fill Footprint Approved in Acres				Valley Fill Footprint Average Size in Acres				Range of Valley Fill Footprint Size in Acres			
	KY	TN	VA	WVA	KY	TN	VA	WVA	KY	TN	VA	WVA
1985	3,935	69	666	2,342	6.84	34.50	37.00	17.88	0.2-107	31-38	0.3-367	0.5-130
1986	2,640	115	306	1,437	6.42	28.75	10.56	34.24	0.2-77	2-81	0.5-55	0.3-272
1987	3,778	99	154	276	7.44	12.38	5.91	8.36	0.1-86	1-51	0.6-33	1.5-31
1988	4,342	34	367	1,205	11.58	5.67	10.80	13.54	0.5-188	1-26	0.6-147	0.6-68
1989	3,506	21	325	1,735	10.99	21.00	12.03	13.45	0.5-117	21	0.5-126	0.3-88
1990	2,282	3	473	673	8.55	3.00	13.15	14.98	0.4-62	3	0.2-160	0.7-58
1991	3,759	76	582	1,229	10.24	15.20	10.77	21.20	0.5-121	1-33	0.4-101	0.3-167
1992	4,966	73	419	1,974	14.52	14.60	14.97	19.95	0.5-174	2-59	0.6-99	0.6-153
1993	3,635	0	216	1,482	11.69	0	9.46	27.96	0.6-94	0	0.7-33	1.2-161
1994	2,475	0	235	1,692	15.00	0	7.58	31.30	0.6-99	0	0.6-69	0.5-256
1995	3,202	0	283	2,372	17.50	0	10.48	25.79	1.0-645	0	0.6-36	1.1-203
1996	2,988	69	374	2,179	14.79	69.0	16.24	38.05	0.2-134	69	0.3-56	0.2-216
1997	2,691	93	425	2,062	14.95	46.50	13.70	21.26	0.4-129	3-90	0.1-52	0.6-96
1998	2,668	109	333	1,379	18.92	15.57	9.78	72.60	0.5-173	2-65	0.8-55	1.2-473
1999	1,240	104	226	580	16.76	9.45	13.27	21.5	1.4-114	4-21	2.1-71	0.9-80
2000	2,203	44	425	1015	16.32	22.0	12.51	26.22	0.4-91		0.2-47	1.8-27
2001	1,465	0	126	1546	10.7	0	18.03	20.07	.14-92	0	8-30	0.8-99
Total	**51775**	**909**	**5935**	**25178**	**10.36**	**16.52**	**11.79**	**22.02**	**0.1-645**	**1-90**	**0.1-367**	**0.2-473**

b. Kentucky Valley Fill Size Trends

Figure III.K-23 shows that for the period from 1985 through 2001, the total approved valley fill acreage has generally decreased from a high of 4,966 acres in 1992 to a low of 1,240 acres in 1999. Although the total acreage of valley fills permitted increased again in 2000 to 2,203 acres, it decreased again in 2001 to 1,465 acres. The figure also shows that the average approved valley fill size has generally increased during the period, from a low of 6.42 acres in 1986 to a high of 18.92 acres in 1998.

Total valley fill acreage approved for the period is 51,775 acres. The average total valley fill acreage approved per year is 3,045 acres. The average approved valley fill size for the period is 10.36 acres. Individual approved valley fill acreage ranged from 0.1 acres in 1987 to 645 acres in 1995.

Figure III.K-23 Trends in Valley Fill Acreage in Kentucky

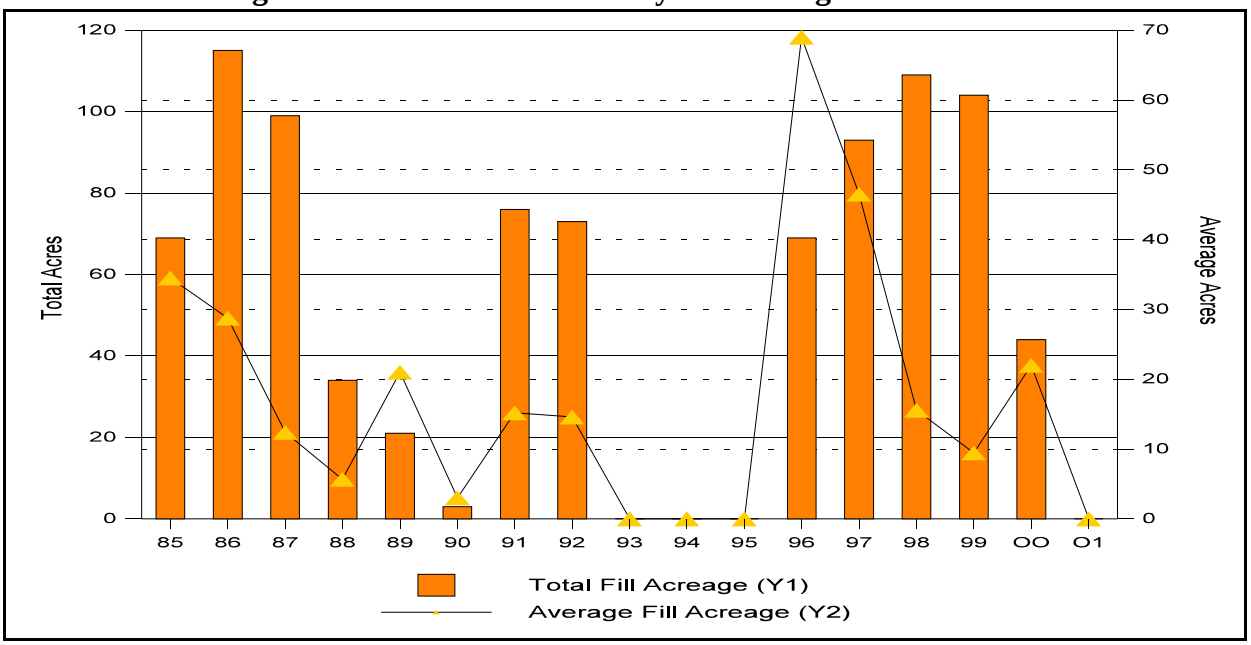


c. Tennessee Valley Fill Size Trends

As noted in Section III.K.2.c, Tennessee had a relatively small number of permits issued with valley fills. These limited data do not lend themselves well to a trend analysis, but Figure III.K-24 has been prepared for comparison to the other states. The high for total acreage approved was 115 acres in 1986. In some years, there were no permits issued with fills. The figure shows that the average approved valley fill size shows great variability, with a high of 69 acres in 1996, to a low of 3 acres in 1990.

Total valley fill acreage approved for the period is 909 acres. The average acreage approved per year is 52.88 acres. The average approved valley fill size for the period is 16.34 acres. Individual approved valley fill acreage ranged from 1 acre in a number of years to 90 acres in 1997.

Figure III.K-24 Trends in Valley Fill Acreage in Tennessee

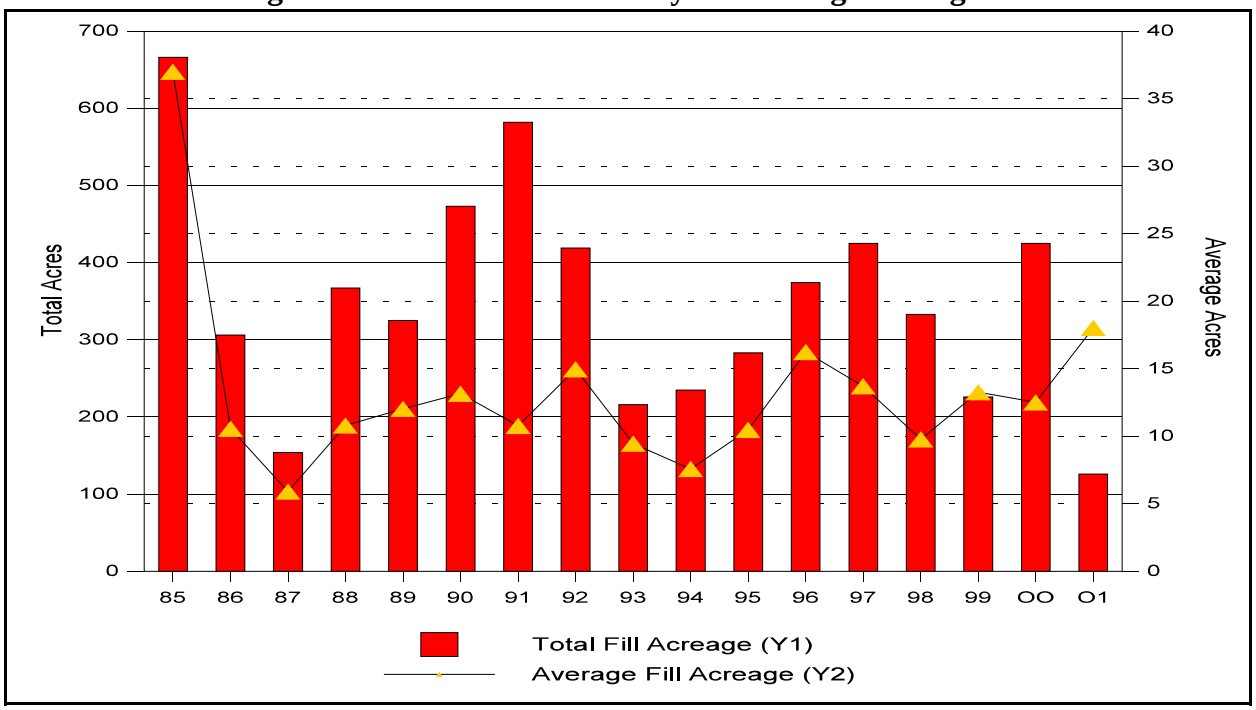


d. Virginia Valley Fill Size Trends

Figure III.K-25 shows great variability during the period from 1985 through 2001. Since 1990, the total approved valley fill acreage has generally declined with a few exceptions. In 1985, the approved total valley fill acreage was 666 acres and in 2001 it was 126 acres. The figure also shows that the average approved valley fill size varied from a high of 37 acres in 1985 to a low of 5.91 acres in 1987. Since 1990, the average approved valley fill size varied from a high of 16.24 acres in 1996 to a low of 7.58 acres in 1994.

The total valley fill acreage approved for the period is 5,935 acres. The average approved per year is 349 acres. The average approved valley fill size for the period is 11.79 acres. Individual approved valley fill acreage ranged from 0.1 acres in 1997 to 367 acres in 1985.

Figure III.K-25 Trends in Valley Fill Acreage in Virginia

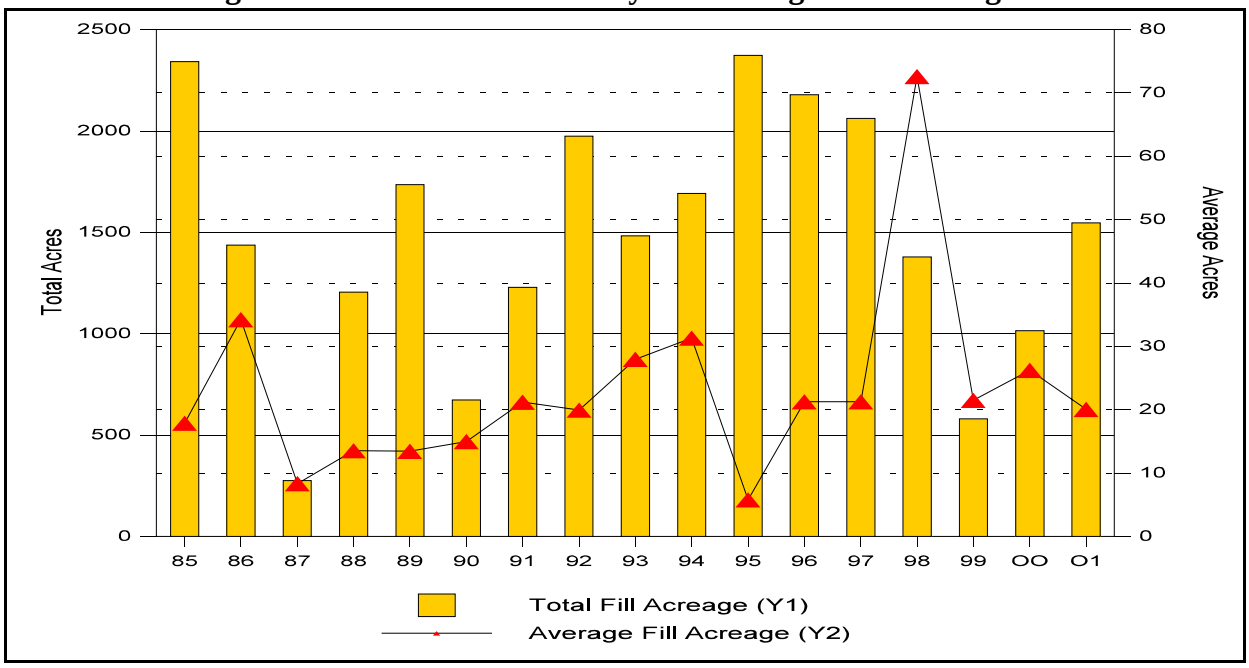


e. West Virginia Fill Size Trends

Figure III.K-26 shows a lot of variability during the period from1985 through 2001. The figure suggests that the total approved valley fill acreage has generally increased from a low of 276 acres in 1987 to a high of 2,372 acres in 1995. The figure also shows that the average approved valley fill size also has increased during the period with a high of 72.6 acres in 1998 to a low of 8.36 acres in 1987.

Total valley fill acreage approved for the period is 25,178 acres. The average acreage approved per year is 1,481 acres. The average approved valley fill size for the period is 22.02 acres. Individual approved valley fill acreage ranged from 0.2 acres in 1996 to 472.66 acres in 1998.

Figure III.K-26 Trends in Valley Fill Acreage in West Virginia



4. Trends in Watershed Size

As previously described, trends can be measured by the number of valley fills and their size. Another important aspect in evaluating valley fills and their impact on the environment is the impact to watersheds. This trend is very useful in evaluating and predicting overall impacts on the environment. The following provides a summary of trends in watershed sizes in each of the states within the study area.

a. Regional Watershed Trends

Valley fills are typically in headwater streams with varying sizes of watershed or drainage area above, or upstream, of the competed fill. Some valley fills may envelope the majority of the watershed, and others are farther downstream. The watershed acreage is determined by measuring the upland area above each fill toe. Figure III.K-27 is the total watershed acreage in which there are valley fills approved in each of the states contained in the study area for the period from 1985 through 2001. A total of 438,472 acres of watersheds are located above approved valley fills.

Figure III.K-27 Trends in Watershed Acreage in States and Region

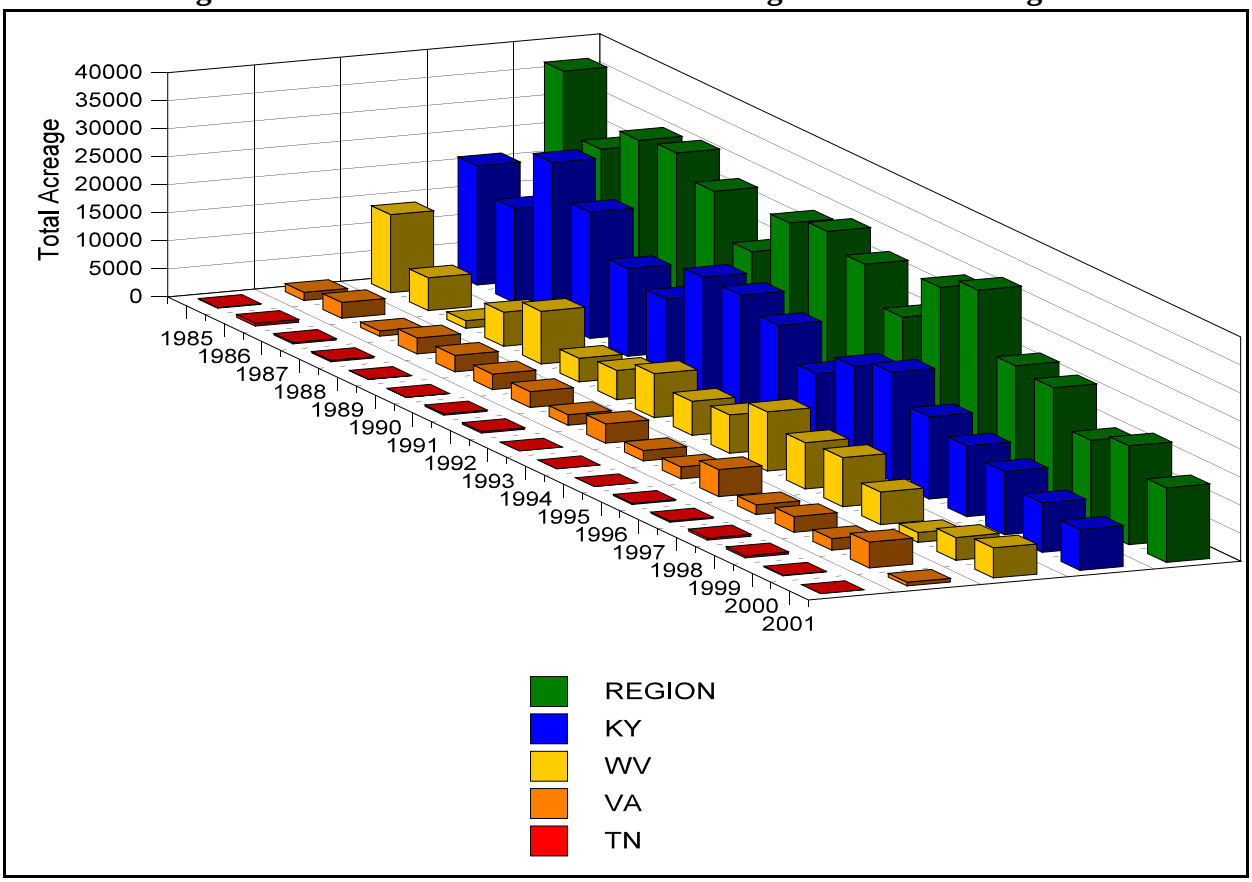


Table III.K-3 provides yearly data for watershed sizes for the states within the study area.

Table III.K-3
Watershed Impacts by States

Year	Total Watershed Impacted by Valley Fill Construction in Acres				Average Watershed Impacts by Valley Fill Construction in Acres			
	KY	TN	VA	WVA	KY	TN	VA	WVA
1985	21,262	150	1,430	13,938	36.8	75	79.5	106.40
1986	16,846	490	2,828	5,843	40.0	122.50	97.5	139.12
1987	28,234	269	915	1,379	55.0	33.63	33.9	41.79
1988	22,525	239	2,873	6,079	59.9	39.83	84.5	68.31
1989	15,646	45	2,944	9,429	48.6	45	109.0	73.09
1990	13,417	39	2,793	4,213	51.00	39	77.6	93.64
1991	20,464	255	2,823	5,228	55.3	51	50.4	90.14
1992	20,425	270	1,904	7,858	59.0	54	132.9	79.38
1993	18,237	0	3,454	6,085	58.1	0	132.9	114.82
1994	12,838	0	1,851	6,817	66.5	0	52.9	126.24
1995	17,305	0	2,112	10,575	74.3	0	78.2	114.95
1996	19,417	186	4,837	8,255	73.8	186	96.8	128.98
1997	14,662	234	1,741	8,773	73.3	117	54.4	90.45
1998	12,651	378	2,804	5,809	74.4	54	85.0	305.79
1999	11,259	364	2,071	1,744	71.7	33.09	79.7	64.60
2000	8,858	98	4,617	4,067	66.6	22	131.9	107.04
2001	7,301	0	632	5,387	50.7	0	90.3	70.88
Total	**281,347**	**3,017**	**42,629**	**111,479**	**51.78**	**54.85**	**78.41**	**97.28**

b. Kentucky Watershed Trends

Figure III.K-28 shows variability during the period from 1985 through 2001. Since 1990, the total watershed area impacted by valley fill construction has generally declined with a number of exceptions. In 1990, the total watershed area impacted by valley fill construction was 13,417 acres, and in 2001, it was 7,301 acres. The figure also shows that the average watershed acreage increased during the same period from a low of 51.00 acres in 1990 to 71.7 acres in 1999.

The total watershed acreage above valley fills constructed during the period is 281,355 acres. The average watershed size is 56.3 acres. Individual watershed acreage ranged from 0.8 acres in 1999 to 3,777 acres in 1987.

Figure III.K-28 Trends in Watershed Acreage in Kentucky

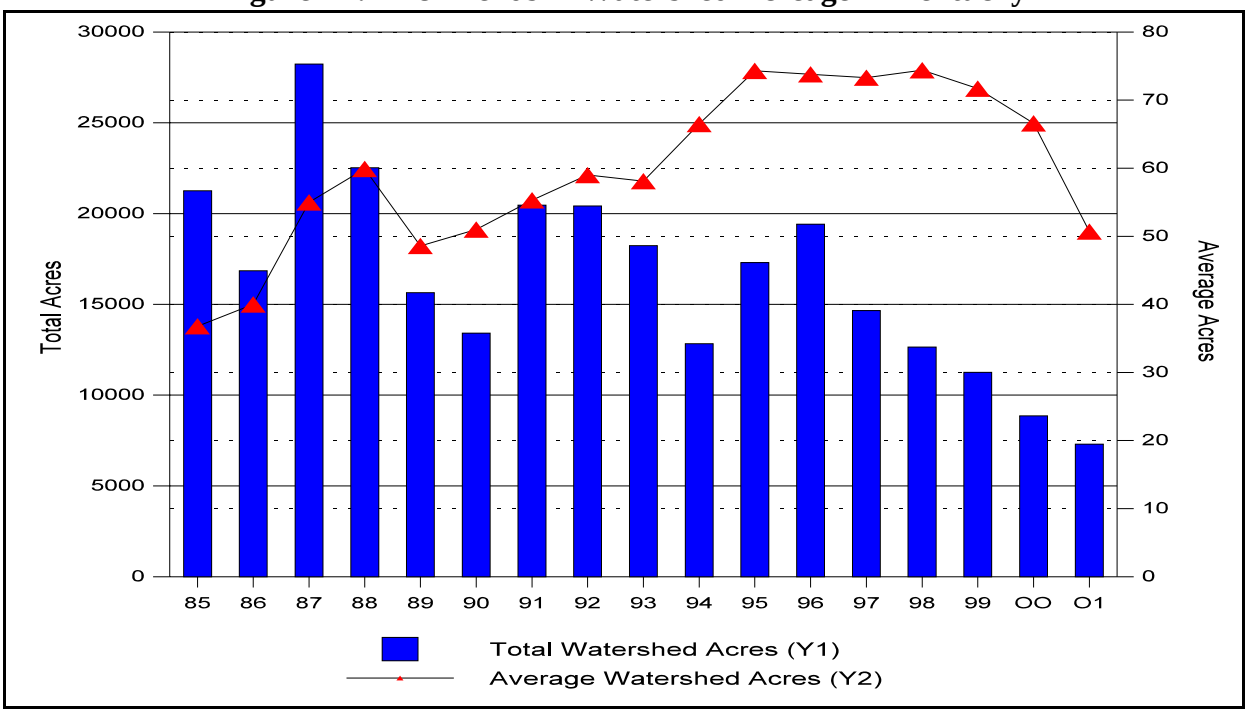


Table III.K-4 shows the distribution of watershed acres of valley fills approved in Kentucky for the period from 1985 through 2001. Eighty percent of the valley fills approved have watersheds less than 75 acres. As the table shows, 108 valley fills have a watershed greater than 250 acres in Kentucky.

Table III.K-4
Distribution of Watershed Sizes for Valley Fills in Kentucky

Watershed Acres	Year																	Total
	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	
Less than 75 Acres	519	378	432	289	275	216	308	262	253	138	165	193	136	116	104	972	121	4,002
75 Acres to less than 250 Acres	52	38	72	73	42	41	55	76	55	49	64	63	56	47	47	34	22	886
250 Acres and Greater	7	5	5	14	5	6	7	8	6	6	4	7	8	7	6	2	1	108

c. Tennessee Watershed Trends

As noted in Section III.K.2.c., Tennessee had a relatively small number of permits issued with valley fills. These limited data do not lend themselves well to a trend analysis, but Figure III.K-29 has been prepared for comparison to the other states. The high for total watershed acres with fills was 490 acres in 1986. In some years, there were no permits issued with fills. The figure shows variable average watershed acreage, with a high of 186 acres in 1996, and a low of 33.63 acres in 1987.

The total watershed acreage above valley fills constructed during the period is 3,017 acres. The average watershed size is 54.85 acres. Individual watershed acreage ranged from 2 acres in 1988 to 288 acres in 1998.

Figure III.K-29 Trends in Watershed Acreage in Tennessee

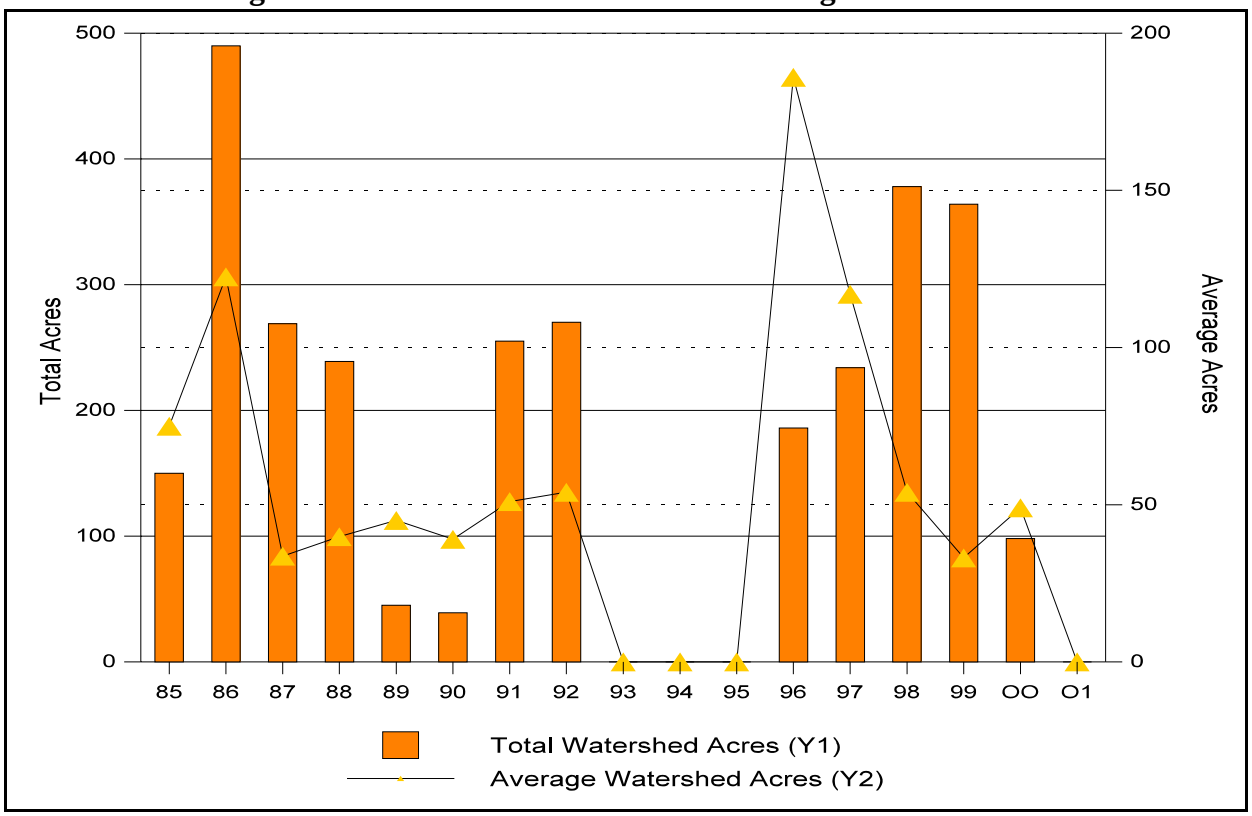


Table III.K-5 shows the distribution of watershed acres for valley fills approved in Tennessee for the period from 1985 through 1999. Seventy-nine percent of the valley fills approved have watersheds less than 75 acres. As the table shows, only one valley fill has a watershed greater than 250 acres in Tennessee.

Table III.K-5
Distribution of Watershed Sizes for Valley Fills in Tennessee

Watershed Acres	Year																	Total
	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	
Less than 75 Acres	1	2	8	4	1	1	4	4	0	0	0	0	1	6	10	2	0	44
75 Acres to less than 250 Acres	1	2	0	2	0	0	1	1	0	0	0	1	1	0	1	0	0	10
250 Acres and Greater	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1

d. Virginia Watershed Trends

Figure III.K-30 shows variability during the period from 1985 through 2001. Since 1990, the total watershed acreage has been irregular but does show an a slight trend toward smaller totals despite two notable exceptions in 1996 and 2000. In 1996, the total watershed area impacted by valley fill construction was 4,837 acres, and in 2001, it was 632 acres. Between 1990 and 2001, the average acreage of impacted watersheds was 2,636 acres per year. The figure also shows that the average watershed acreage varied from a high of 132.9 acres in 1993 to a low of 50.4 acres in 1991.

The total watershed acreage above valley fills constructed during the period is 40,526 acres. The average watershed size is 81.05 acres. Individual watershed acreage ranged from 1.5 acres in 1987 to 1,238 acres in 1989.

Figure III.K-30 Trends in Watershed Acreage in Virginia

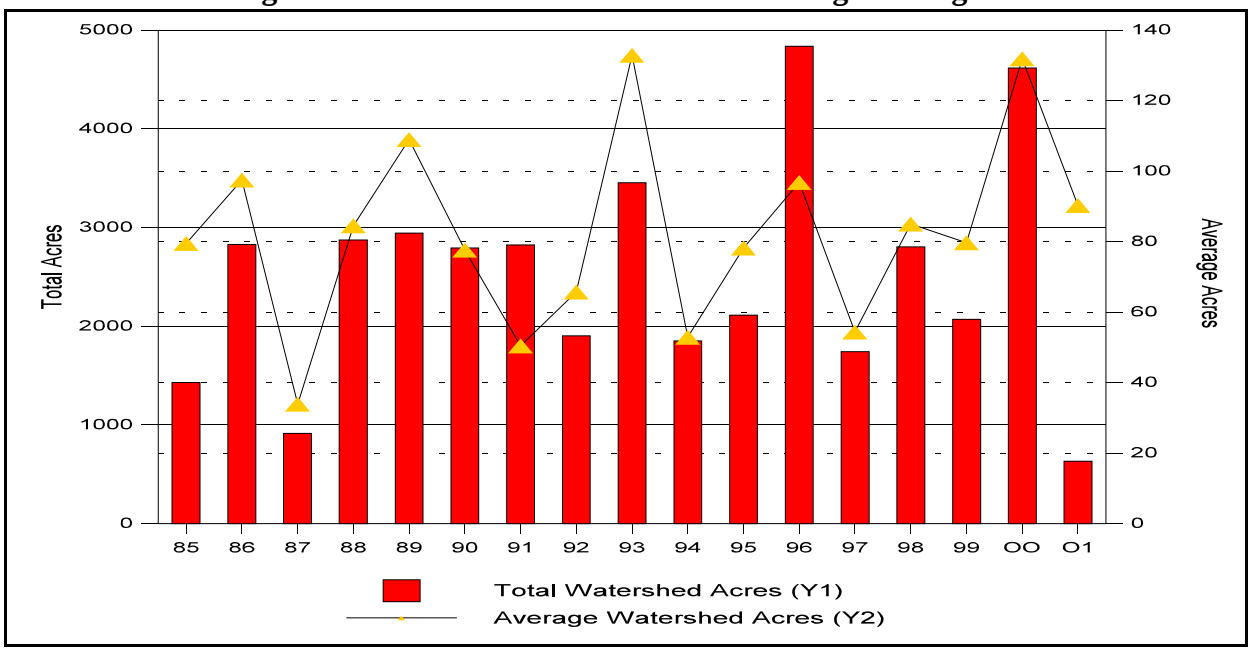


Table III.K-6 shows the distribution of watershed acres for valley fills approved in Virginia for the period from 1985 through 2001. Sixty eight percent of the valley fills approved have watersheds less than 75 acres. As the table shows, only 22 valley fills have a watershed greater than 250 acres.

Table III.K-6
Distribution of Watershed Sizes for Valley Fills in Virginia

Watershed Acres	Year																	Total
	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	
Less than 75 Acres	13	21	25	25	19	27	45	20	14	30	16	10	25	18	17	17	2	344
75 Acres to less than 250 Acres	4	6	2	8	6	8	9	8	7	4	11	12	7	15	8	14	5	134
250 Acres and Greater	1	2	0	1	2	1	2	1	5	1	0	1	0	0	1	4	0	22

e. West Virginia Watershed Trends

Figure III.K-31 shows variability during the period from 1985 through 2001. Between 1990 and 1997, the total watershed acreage impacted each year has generally increased. In 1998 and 1999 this acreage decreased significantly from a total of 8,773 acres in 1997 to only 1744 acres in 1999. In the last two years, there again appears to be an increase in the watershed sizes. The total watershed area impacted by valley fill construction has ranged from a high of 13,938 acres in 1985 to a low of 1,744 acres in 1999. The figure also shows that the average watershed acreage has gradually increased since 1987 from a low in 1987 of 41.79 acres to a high of 305.79 in 1998.

The total watershed acreage above valley fills constructed during the period is 111,479 acres. The average watershed size is 97.28 acres. Individual watershed acreage ranged from 0.2 acres in 1996 to 1,628 acres in 1985.

Figure III.K-31 Trends in Watershed Acreage in West Virginia

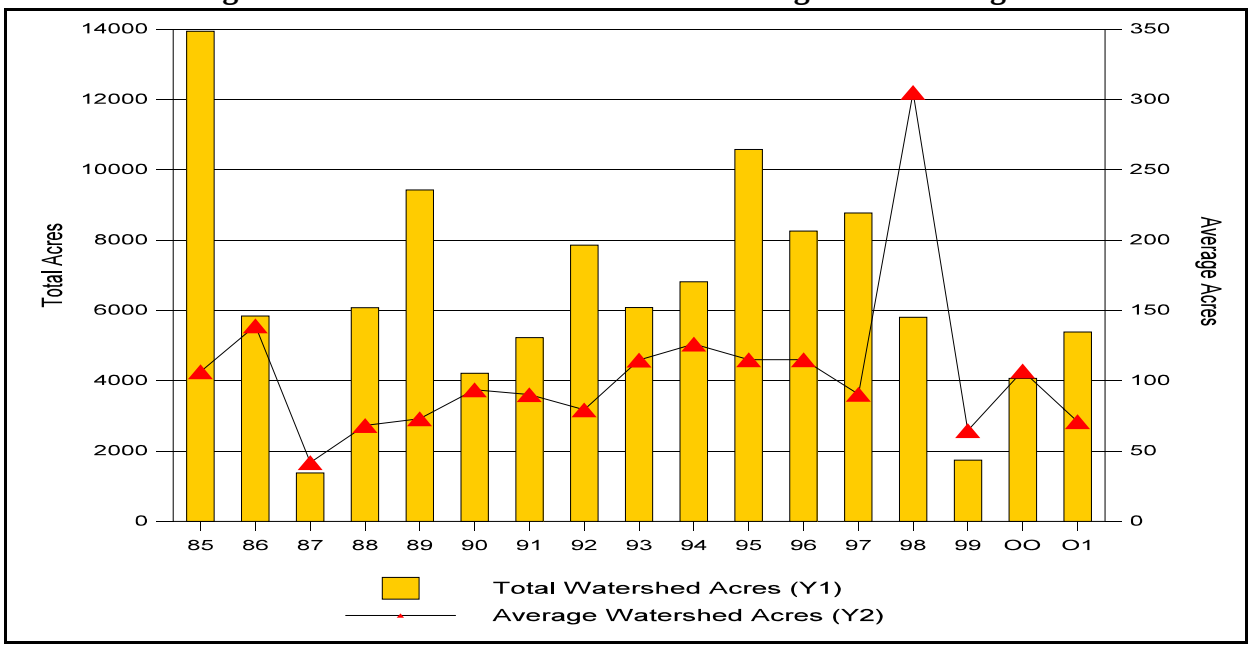


Table III.K-7 shows the distribution of watershed acres for valley fills approved in West Virginia for the period from 1985 through 2001. Fifty-nine percent of the valley fills approved have watersheds less than 75 acres. As the table shows, 73 valley fills have a watershed greater than 250 acres in West Virginia.

Table III.K-7
Distribution of Watershed Sizes for Valley Fills in West Virginia

Watershed Acres	Year																	Total
	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	
Less than 75 Acres	76	24	30	65	91	27	33	69	25	28	47	26	51	4	19	15	51	681
75 Acres to less than 250 Acres	44	14	3	22	33	15	20	25	24	20	35	32	42	8	7	23	26	393
250 Acres and Greater	11	4	0	2	5	3	5	5	4	6	10	6	4	7	1	0	0	73

5. Trends on Stream Impact Under Fill Footprints

The final measurement for evaluating impacts from valley fill construction and predicting their overall impact on the environment is stream loss. As discussed in III.K.2., the stream impact is based on a synthetic stream network defined on a 30-acre watershed accumulation threshold over the National Elevation Dataset (NED). The NED for each state was processed to enforce hydrologic integrity (filling of spurious sinks). A flow accumulation grid was prepared and queried to define a drainage network over the entire region. The stream network represents all drainage for watersheds greater than 30 acres. Table III.K.-8 provides a summary of trends on stream impacts by individual states within the study area.

Figure III.K-32 is the total length of stream impacts under the valley fill footprints approved in each of the states contained in the study area for the period from 1985 through 2001. The total of stream impact for states within the study area is 724 miles, or 1.23 percent of the 58,998 miles of streams within the study area.

Figure III.K-32 Trends in 30-Acre Synthetic Stream Impacts in States and Region

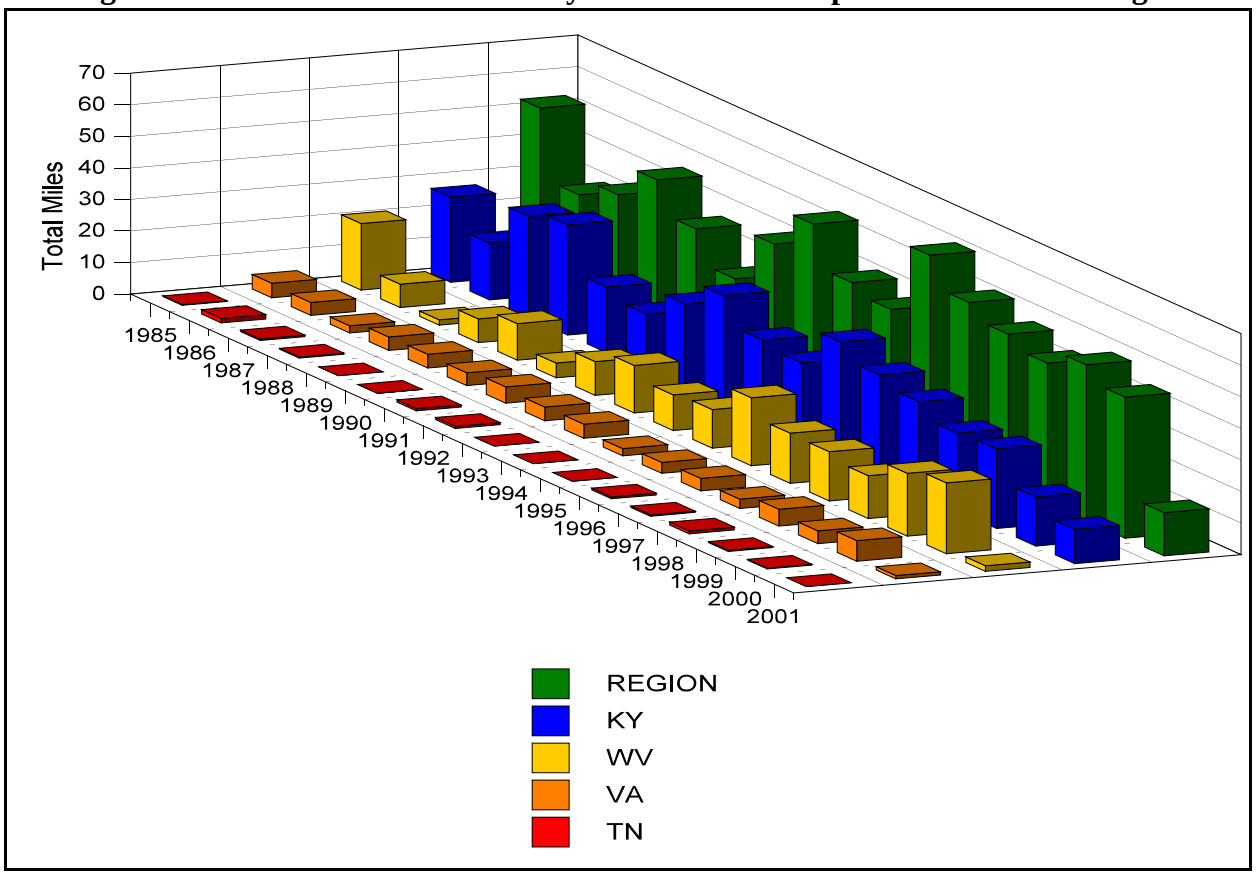


Table III.K-8
Yearly Totals by States for Impacts to Streams Under Valley Fill Footprints

Yr.	Stream Miles Under Valley Fill Footprints			
	KY	TN	VA	WVA
85	26.98	.22	4.6	21.02
86	18	1.42	4.04	7.39
87	32.07	.51	2.22	1.66
88	34.96	.33	4.27	7.55
89	20.81	0	4.32	11.66
90	17.85	.02	4.05	4.66
91	26.6	.65	5.16	10.73
92	34.9	.68	4.31	15.12
93	26.3	0	4.5	11.31
94	24.59	0	2.33	12.25
95	36.83	0	3.46	21.58
96	31.94	.58	4.01	15.91
97	28.99	.43	3	15.58
98	24.6	.92	5.36	13.55
99	25.19	.31	4.06	19.9
00	15.56	.24	6.58	22.41
01	10.19	0	1.09	1.73
Total	**436.36**	**6.31**	**67.36**	**214.01**

6. Relationship of Excess Spoil Generation to Mining Method

The gross volume of spoil generation on a given mine site is directly related to the total area of mining volume of overburden that is mined, and to the rock type of the overburden. Mining a given volume of sandstone would generate a larger volume of spoil than the same volume of shale regardless of mining method. Conceptually, mountaintop removal operations would generate the greatest volume of spoil on a given mine site, since that type of operation would remove all the overburden above the basal coal seam, typically at an overburden to coal or stripping ratio of approximately 15:1 (cubic yards overburden: ton of coal) in West Virginia. Total volume of excess spoil is related to the ability of the mine method and mine plan to return spoil to the bench. While mountaintop removal would normally be expected to generate the greatest volume of excess spoil on a given mine site, this is not always the case. An extensive (i.e., many linear feet or miles of contour cut) contour operation could generate more excess spoil (typical stripping ratio of 12:1 in southern WV) than a mountaintop removal operation on the same site because of bench spoil return restrictions imposed by maintaining sedimentation controls and haul roads along the croplines. The relationship of mining method to excess spoil disposal is therefore expected to be very site specific based on topography, overburden type, and extent of individual mining methods.

7. Relationship of Excess Spoil Generation to AOC Variance

To evaluate the possibility of a relationship between excess spoil generation and AOC variance status, several recent OSM Oversight Reports pertaining to AOC policies in the individual states were reviewed. In general, no definite relationship can be drawn from this information, largely due to differing policies regarding the need for AOC variances between the states and the lack of states achieving true AOC. However, it can be concluded that AOC variances would, inherently and by necessity, generally result in greater excess spoil volume in order to achieve a greater amount of flat land suited for alternative post-mining land uses. The following summarizes the findings for excess spoil disposal and AOC variance for each state.

a. Excess Spoil Generation and AOC Relationships in Kentucky

According to the 1999 OSM Oversight Report: “An Evaluation of Approximate Original Contour and Post-Mining Landuse in Kentucky,” AOC variances were required to be requested by permit applicants if more than 20 percent of the original bank volume of the mine site’s spoil was excess (i.e., to be placed in a fill). Under this policy, it would seem that permits with AOC variances would always have more excess spoil disposal than those that did not. However, Kentucky also required AOC variances for mine sites proposing to leave a permanent road, bench, terrace, or other feature exceeding 20 feet in width. Such circumstances could happen on any mine site whether fills were proposed or not, potentially skewing the results when included with sites that had variances for no reason other than excess spoil disposal. For this reason, no reliable relationship can be made between excess spoil disposal and AOC variance status in Kentucky.

b. Excess Spoil Generation and AOC Relationships in Tennessee

The limited number of permits that have been issued for excess spoil valley fills in Tennessee since 1988 (eight) allows a direct evaluation of the relationship for that state. Only one of the eight permits is reported to have had an AOC variance, and this permit proposed an excess spoil disposal of 24 percent. The remaining seven permits without AOC variance showed a proposed excess spoil disposal averaging 18 percent and ranging from 3 percent to 53 percent. Although the excess spoil disposal for the single variance permit was slightly higher than the average of the non-variance permits, it was still well within the range of the non-variance permits. This amount of data is too small for a definitive assessment of whether excess spoil disposal quantities are related to AOC variance in Tennessee.

c. Excess Spoil Generation and AOC Relationships in Virginia

The 1999 OSM Oversight Report "An evaluation of approximate original contour variances and post-mining land uses in Virginia" did not draw definite conclusions regarding a relationship between AOC variance and excess spoil generation. However, the report did state the following based on a sampling of Virginia mine permits: "Seventy percent of the permits in our sample proposed to place less material in fills than the predicted "swell" generated during mining. Due to the high percentage of remining sites in Virginia (80 percent of our sample), permittees' maintain most (83 percent) of the overburden generated during mining on the mine bench or on previously mined lands included within the permitted area. Because of the large amount of overburden retained on the mine benches and the overall configuration (including an average elevation change of -31' for AOC sites and -26' for variance sites) of the resulting land, one must question whether the majority of the sites in our study required a variance from approximate original contour restoration in the first place." From this it is inferred that most Virginia mines did not vary greatly in spoil disposal characteristics and reclamation practices between those with AOC variances and those without. Additional review of permit statistics would be required to verify that this is the case.

d. Excess Spoil Generation and AOC Relationships in West Virginia

The 1998 OSM Oversight Report: "Draft Report: An Evaluation of Approximate Original Contour and Post-mining Land Use in West Virginia"stated the following findings based on a sampling of West Virginia mine permit applications: "Where data was available, sites with AOC variances had a somewhat wider percentage range of excess spoil being placed in fills than did sites without AOC variances...the percentage of spoil being placed in fills ranged from 8 to 62 percent for sites with AOC variances and between 33 and 45 percent for sites without AOC variances. Both sites with and without AOC variances placed more material in the fill than could be accounted for by just the swell factor, which ranged from 20 to 40 percent, according to the permits...Current regulations do not place a numerical limit on the amount or percentage of material which may be placed in a fill..." An independent review of the OSM report data for this EIS did show the AOC variance sites to have a higher percentage of excess spoil disposal than those without variances, 45 percent compared to 40 percent. It is cautioned that this is a very limited sampling from which to draw any conclusions regarding a relationship between excess spoil disposal and AOC variance in West Virginia.

L. MINE FEASIBILITY EVALUATION AND PLANNING

The presence of coal reserves on a given site does not necessarily imply that the site can be economically mined. Evaluation of mining feasibility on any site requires a detailed investigation into the nature of the coal reserves and the physical, environmental, and regulatory constraints of the site. If a coal reserve is found to be conceptually feasible for mining, a mine plan must be developed to determine the actual economics and practical extent of the potential operation. Finally, the mine plan and attendant engineering and environmental controls must undergo regulatory scrutiny during the mine permitting process. This section provides an overview of the factors influencing mine feasibility and planning, and outlines the typical steps and considerations in developing a mine plan once a site has been determined to be feasible for mining. Figure III.L-1 provides a flowchart diagram of this overall process.

RETURN ON INVESTMENT AND PROFIT MAY NOT BE REALIZED UNTIL WELL INTO THE LIFE OF A MINE OR EVEN AFTER MINING IS COMPLETE WHEN RESIDUAL RECLAMATION BONDS HAVE BEEN RELEASED. THE DECISION TO PROCEED WITH A MINE SITE REPRESENTS A LONG-TERM COMMITMENT OF CAPITAL AND RESOURCES FOR A COAL COMPANY.

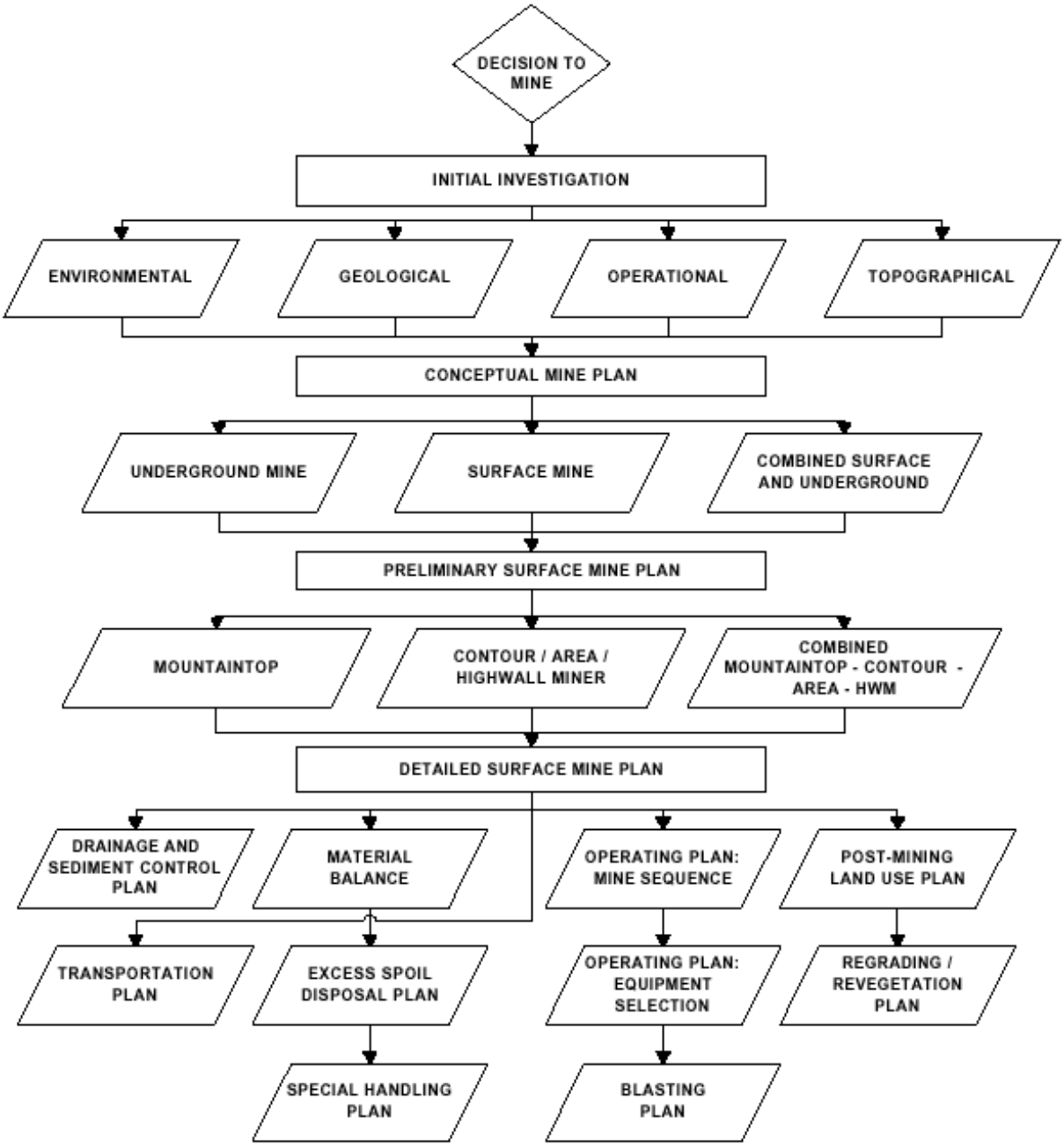
1. General Considerations

There are a number of economic and management factors that must be considered by a coal company before a decision is made to proceed with mine planning on a potential site. Mining in general requires a relatively high initial investment, with potential long-term delays in returns during the site planning, permitting, and development stages, and considerable risk due to fluctuations in market prices and production costs. Return on investment and profit may not be realized until well into the life of a mine or even after mining is complete, when residual reclamation bonds have been released and the mine site liquidated for other uses. The decision to proceed with a mine site, therefore, represents a long-term commitment of capital and resources for a coal company.

a. Property Ownership

To mine coal on a given piece of land, a coal company may already own the land, purchase the land outright, or lease the land from the landowner for mining purposes. Often, the mineral rights to the coal are owned separately from the surface property rights, and the coal company must negotiate with both parties for the right to mine. If a coal company does not own a property and/or attendant mineral rights, the typical arrangement is to pay the owners of these rights a royalty fee that can be based on the value or tonnage of coal mined. Royalty fees are established during the negotiation process for the mining rights. Other forms of mineral rights, such as oil and gas, may also conflict/compete with mining plans and need to be negotiated for protection or purchase. If a coal company owns or purchases a property for mining, it must consider the value that this land will represent after mining in determining the net cost of coal production. Coal mined from both owned

Figure III.L-1
Overall Mine Development Decision Process



Source: Miekle & Kitt, 1999

and leased land is also subject to a state (and sometimes local) severance tax--on top of royalties and production costs.

b. Capital Investment

Basic capital costs of mining include site development, equipment purchases, and on-site facilities. The costs to develop a site, such as haul road construction and utilities, may be partially offset by timber harvesting or recovered by postmining use of the land for residential, commercial, or industrial purposes. Some coal companies may lease mining equipment to avoid up-front capital expenditures, but most own their equipment. Large capital expenditure items, such as electric shovels and draglines, must normally be purchased outright. In general, investment in larger equipment reduces the cost per ton of production, but at the same time requires larger coal reserves and greater production rates (commensurate with the life of equipment) to justify the expenditure. Large mining operations may also invest in on-site coal processing plants and permanent structures for equipment maintenance and administration. These specialized facilities may be partially salvaged for use on other sites, but are otherwise not readily transferable for other postmining land uses.

c. Reclamation Bonding

Activation of a mine permit requires that reclamation bonds be posted on areas to be mined. The purpose of these bonds is to provide assurance that the coal operator will reclaim the mine site according to the approved reclamation plan, or to provide funds for the government to complete this work should a coal operator forfeit its responsibilities. SMCRA (30CFR 800.15) does not specify dollar amounts for bonding rates, other than requiring that no bond for a single permit be less than $10,000. Bond amounts, however, are based on a “worst-case” scenario based on the maximum amount of disturbed area open at any one time and may range from a few hundred thousand to many millions of dollars. The individual state regulatory authorities are responsible for establishing bonding rates that reflect the probable difficulty of reclamation, giving consideration to such factors as topography, geology, hydrology, structure and facility removal, and revegetation potential. The amount of the bond is intended to be sufficient to assure the completion of the reclamation plan if the work had to be performed by the regulatory authority in the event of forfeiture. Reclamation bonds are released in phases, with Phase 1 release occurring after backfilling and regrading have been completed on a given area, Phase 2 occurring after completion of revegetation activities, and the final Phase 3 release occurring after the mine site has been accepted as being satisfactorily reclaimed and the approved post-mining land use met (i.e., meets all performance standards and the approved permit plan). Complete release of reclamation bonds on a given area typically requires five years after completion of reclamation, and may be delayed further if satisfactory reclamation has not been achieved. Additional time may be required for attainment of certain post-mining land uses, such as commercial forest land. A coal company will usually post reclamation bonds through a bonding company, paying a percentage of the total bond as a fee, rather than making this outlay by itself. Larger companies post other types of sureties and collateral bonds with company assets at stake.

Virginia and West Virginia surface mining regulatory programs utilize approved alternative bonding systems.

In Virginia the reclamation bonding requirement may also be met by participation in the Virginia Coal Surface Mining Reclamation Fund (Pool Bond Fund). Participation in the Pool Bond Fund is optional for permittees. In order to qualify for participation in the Pool Bond Fund, a permittee must demonstrate to the VADMLR's satisfaction that they have at least a consecutive three-year history of compliance under the Act or any other comparable State or Federal Act. Participation in the Pool Bond Fund shall constitute an irrevocable commitment by the permittee to participate in regards to the applicable permit and for the duration of the coal surface mining operations covered by the permit.

An applicant filing a permit application which proposes to be pool bonded must pay an entrance fee prior to the issuance of the permit. The entrance fee is $5,000 when the total balance of the Fund is less than $1,750,000 and is $1,000 when the total Fund balance is greater than $2 million. A renewal fee of $1,000 is required of all permittees in the Fund at permit renewal.

Participants in the Virginia Pool Bond Fund must also post bond as follows:

(1) For those underground mining operations participating in the Fund prior to July 1, 1991, in the amount of $1,000 per acre covered by the permit. In no event shall the total bond be less than $40,000, except that on permits which have completed all mining and for which completion reports have been approved prior to July 1, 1991, the total bond shall not be less than $10,000.

(2) For underground mining operations entering the Fund on or after July 1, 1991, and for additional acreage bonded on or after July 1, 1991, the amount of $3,000 per acre. In no event shall the total bond for such underground operations entering the Fund on or after July 1, 1991, be less than $40,000.

(3) For all other coal surface mining operations participating in the Fund prior to July 1, 1991, the amount of $1,500 per acre covered by each permit. In no event shall such total bond be less than $100,000, except that on permits which have completed all mining and for which completion reports have been approved prior to July 1, 1991, the total bond shall not be less than $25,000.

(4) For other coal mining operations entering the Fund on or after July 1, 1991, and for additional acreage bonded on or after July 1, 1991, the amount of $3,000 per acre. In no event shall the total bond for such operations entering the Fund on or after July 1, 1991, be less than $100,000.

If a pool bond permit is placed into temporary cessation for more than six months, participants must post bond equal to the total estimated cost of reclamation for all portions of the permitted site which are in temporary cessation. The additional bond must remain in effect throughout the remainder of the period during which the site is in temporary cessation. At such time as the site returns to active status, the additional bond posted may be released.

Participants in the Pool Bond Fund must pay taxes according to the following schedule. At the end of any calendar quarter where the total balance of the Pool Bond Fund, including interest thereon, is less than $1,750,000, all permittees participating in the Pool Bond Fund shall pay within 30 days after the end of each taxable calendar quarter, an amount equal to the following.

(1) Four cents per clean ton of coal produced by the surface mining operation of the permit during the taxable calendar quarter.

(2) Three cents per clean ton of coal produced by the underground mining operation of the permit during the taxable calendar quarter.

(3) One and one-half cents per clean ton of coal processed or loaded by the preparation or loading facility operation of the permit during the taxable calendar quarter.

At the end of any calendar quarter where the total balance of the Pool Bond Fund, including interest thereon, exceeds $2 million, payments shall be deferred until the balance is less than $1,750,000 at the end of a quarter. No permittee is required to pay the reclamation tax on more than five million tons of coal produced per calendar year, regardless of the number of permits held by that permittee, except upon permit issuance the permittee must pay the applicable reclamation tax required on coal mined and removed under the permit during the one year period commencing with and running from the date of the commencement of coal production, processing or loading from that permit.

Permittees participating in the Pool Bond Fund and holding more than one type of permit are not required to pay a reclamation tax at a rate in excess of five and one-half cents per ton on coal originally surface mined by that permittee or in excess of four and one-half cents per ton on coal originally deep mined by that permittee. Permittees holding one permit upon which coal is both mined and processed or loaded are not required to pay more than the tax applicable to the surface mining operation or underground mining operation. However, the permittee must pay the one and one-half cents per clean ton for all coal processed and/or loaded at the permit which originated from other permits during the calendar quarter.

In West Virginia, the alternative bonding system requires a bond for each operation at the rate of $1,000 per acre (or fraction of an acre), with a minimum bond of $10,000. In order to supplement the amount of the bond provided by individual operators, the state established a special reclamation fund provided by taxes levied on the amount of coal produced by each operator. The amount of money in the fund can fluctuate between approximately one to two million dollars. The tax of one cent per ton is levied on each active mining operation. Monies contained in the fund are used for reclamation of areas where the bonds provided by individual operators are not sufficient to cover the actual costs of reclamation.

d. Coal Market Conditions

The market valuation of coal reserves is a critical factor in mine feasibility. The coal quality of reserves on a given property is also a significant determinant in a mine's ability to meet market needs. Many mines must recover particular seams of particular quality (often including blending of seams) to meet exacting contract specifications for coal with certain properties (e.g. heat value, as expressed in BTUs, or British Thermal Units, sulfur content, ash value, moisture content, etc.) for a specific use (i.e., steam coal for electrical generation, coking coal for steel making, etc.). Demand for coal and coal prices fluctuate due to a number of factors, including annual variations in weather patterns affecting heating and power generation, and costs of alternative fuels, such as petroleum. Coal companies will sometimes delay permitting of new mine sites or activation of existing permits if market conditions are not currently favorable for coal production. Production costs include labor, fuel and power, equipment maintenance, transportation, and administration and

engineering services. All of these costs are variable, depending on current economic conditions. Active mines are vulnerable to fluctuations in market prices and production costs because they cannot be simply idled for long periods of time. Capital payments on large pieces of mining equipment demand that they remain productive, and environmental regulations require that mine disturbances be reclaimed in a timely manner.

e. Permitting Requirements

Aside from the multitude of design and performance constraints stipulated by regulation, the most significant influence that permitting requirements have on mine planning is the time delay required between initiation of the permitting process and approval to mine. This may take a year or longer from the time of application submission, depending on the size and complexity of a mine site, and the nature and extent of its potential impacts on environmental resources. Mine planners must account for this delay in obtaining new reserves, such that production lags do not occur while waiting for a new permit to be approved. Since it is possible for a mine permit application to be denied during regulatory review, it is prudent to have approved permits in place prior to their need for activation. Mine permit applications are typically prepared for a coal company by an independent consultant, but some larger companies utilize in-house environmental and mining engineering staff.

Over time, the Corps has increased mitigation requirements on Section 404 CWA permits. The Corps strives for no net loss of aquatic functions. The requirement to avoid, minimize and then compensate for unavoidable impacts to waters of the United States has become a larger economic factor in the mining decision. Mine planners should account for the costs of mitigation associated with 404 permits. The use of stream assessment methods, which assess stream quality, can play a significant role in siting mining disturbances to avoid or minimize stream impacts. The methodology should be used early in mine planning to decide if higher quality streams can be avoided because the mitigation costs can be substantially higher than mitigation costs associated with highly degraded streams. Also, the potential for permit denial or a more lengthy permitting time-frame can result when impacts to high value aquatic resources are at stake. The reliance on compensatory mitigation to insure impacts are minimal on an individual and cumulative basis, will likely result in a greater need for financial assurances or bonding to guarantee mitigation is completed.

2. Site-Specific Considerations

Once a potential mine site has been identified and the general considerations for mining are found to be favorable, mine planners will begin to investigate the site in detail to determine whether mining is conceptually feasible. These background investigations provide the information necessary for most later planning stages. Figure III.L-1 summarizes the various avenues of investigation under four basic categories, as discussed in the following sections.

a. Geological

Of primary importance to mine planners are the numbers, extents, thicknesses, and qualities of coal seams present on a site. The process of determining these factors is called a *reserve evaluation*. Preliminary investigations can be conducted remotely using geological surveys and other records from previous mine operations. If the site warrants further investigation, an exploratory drilling

program is implemented to measure actual coal depths and thicknesses, record overburden types and properties, and secure samples for laboratory analysis. This information is not only necessary for a company to evaluate the economic feasibility of bringing a product to market or fulfill contract requirements, but is also required by SMCRA for permitting. The coal, overburden, surface and groundwater, and other features and properties must be sampled and analyzed at enough points throughout the proposed permit area to be representative of baseline conditions-and to allow prediction of mining impacts. Coal is analyzed for its quality factors, including sulfur, ash, moisture, and heat content, while overburden is analyzed for environmental and strength factors, including sulfur content, neutralization potential, geotechnical parameters, chemical and textural suitability as topsoil substitute, and slake durability. In general, the lower the ash and moisture content, and higher the heat content or BTU value, the higher the market value of the coal. Core samples are also recovered from coal seams to identify quality and quantity (thickness) changes and partings that may be present within individual seams and require special operational consideration.

A second important consideration during the reserve evaluation is the extent of previous mining. Aside from residual environmental consequences, such as acid mine drainage, former mine workings can render remaining coal reserves on a site uneconomical for recovery. Surface mining of former underground mines may be of marginal viability, as only a fraction of the original coal remains in place, as is the case with areas of previous highwall or auger mining. Former contour cuts from old surface operations may have also left remaining coal reserves under too great an overburden cover to be extracted by new surface methods. Alternately, the reclamation of abandoned previous mining may have a positive influence on the mine permitting process. Elimination of abandoned highwalls, daylighting of underground mines adversely impacting water quality, and extinguishing mine fires can all be viewed as environmental benefits of new operations on previously mined sites.

b. Topographical - Geographical

Topography and geography relate to the land forms of the mine site and its relationship to other environmental and cultural features in the vicinity. Most large mine sites now employ aerial photogrammetric mapping to develop accurate contour maps of potential mine sites. Results from reserve evaluation activities are then added to the site mapping to produce a three-dimensional database of site conditions. Areas surrounding the mine site are usually depicted using USGS topographic quadrangle maps-mechanically reproduced at a larger scale, typically 1 inch = 400 hundred feet. Geographic, environmental, demographic, and cultural features can then be added to the site map and spatially evaluated for their potential influence on mine planning. SMCRA requires that maps of this nature be submitted with permit applications. Maps, or cross-sections and profiles developed from these maps, must show such things as pre-mining slopes, geologic structure, surface and groundwater information, coal outcrops, access roads, diversions, mining cut sequences, location of toxic- and acid-forming overburden, well locations, nearby residents--just to name a few.

Primary topographic constraints within a mine site are slopes, degree of coal seam exposure, and availability of access, sediment control and excess spoil disposal sites. Geographic constraints include distance to public roads, coal processing facilities, coal shipping points, and electric utility service. Demographic factors include proximity to occupied buildings, property lines, workforce availability, municipal regulations, and taxes. Cultural resources, such as historical structures, cemeteries, Native American artifacts, and other sites of unique heritage may be present within a mine site and require special protection. Proximity to parks and other protected public lands also comes into consideration when evaluating the potential difficulties in permitting a given site.

c. Operational

Operational considerations relate to the mining methods and support requirements that may be practical for a prospective site. Foremost for steep-slope surface mining is the availability of excess spoil disposal areas in a practical geometry. Access routes for haul roads of an acceptable grade must also be present. Existing underground mines and gas wells may have to be avoided, particularly in the case of active operations.

Other important operational considerations are transportation distances for coal haulage and support materials. Transportation of coal is a significant percentage of its total production cost, and mine sites must be located within a reasonable distance of high-volume shipping points, such as railroads or barge loading facilities. Both large- and small-scale mining operations require access to petroleum fuel for equipment, although this is now largely satisfied by overland truck haulage and on-site storage. Large-scale mines may also require access to high-voltage electrical service to operate draglines, electric shovels, and other equipment. Running new high-voltage service to remote sites can represent a considerable expense, and such sites may be relegated to petroleum-fueled operations only.

3. MTM/VF Mine Economic Analysis

To provide a conceptual understanding of the economic factors associated with MTM/VF mine operations, this section summarizes an economic analysis for a typical large MTM/VF mine operation. This example is based on a case study of an actual mine operation in West Virginia, as presented by Meikle & Fincham (1999), and is an approximation of the typical MTM/VF mine characteristics outlined in the previous section. Operational statistics for the example mine site are presented in Table III.L-1. The following summarizes the mine site economics in terms of capital investment, employment, costs and earnings, taxes, and a comparison to the underground mining alternative. The ultimate return on investment for this mine was 9.6%.

a. Capital Investment

Capital investments are related to physical investment in a mine site and do not include the costs of day-to-day mine operation and maintenance. These investments are usually categorized for surface mine operations by heavy equipment, support equipment, and development costs. Individual investments required for the example mine under these categories are summarized in Tables III.L-2, III.L-3, and III.L-4, respectively. As these tables show, the majority of capital investment (about 70 percent) occurs during the first year of mine operation as the site is developed and equipment is purchased. Later capital investments are generally related to replacement of equipment over time. The total capital investment for the project is $58,345,000.

Table III.L-1
Example MTM/VF Mine Operational Statistics

Mine Statistic	Value	Units
Projected Mine Life	10	years
Total Coal Production	16,395,984	CT
Annual Coal Production	1,680,000	CT
Average Selling Price of Coal	$24.75	
Coal Tons per Man Hour	7.25	CT/MH
Mine Recovery Rate	80.36	%
Direct Shipping Percentage	80.00	%
Total Depth of Cut	436	feet
Number of Seams Mined	8	
Stripping Ratio	15.02	BCY/CT
Total Overburden Moved	246,283,400	BCY
Overburden Moved per Year	25,200,000	BCY
Total Overburden Haulage (70%)	172,398,380	BCY
Total Cast Blast and Dozing (30%)	73,885,020	BCY
Swell Factor	30	%
Total Spoil Generated	320,168,420	LCY
Spoil Returned to Mine Bench	192,101,051	LCY
Spoil Placed in Valley Fills	128,067,368	LCY
Spoil Return Percentage	60	%
Yards Overburden per Man Hour	108.90	BCY/MH
Total Man Hours Worked	2,261,507	MH

CT - clean tons BCY - bank cubic yards
MH - man hours LCY - loose cubic yards

Source: Meikle & Fincham, 1999

Table III.L-2
Example MTM/VF Mine Economic Analysis
Capital Budget - Life of Mine

HEAVY EQUIPMENT

Item Description	Year 0	Year 1	Years 2 thru 10	Total
25 Yard Shovel	$0	$3,500,000	$0	$3,500,000
18 ½ Yard Backhoe	$0	$2,650,000	$0	$2,650,000
16 Yard Endloader	$0	$1,200,000	$1,200,000	$2,400,000
210 Ton Rock Trucks	$0	$4,500,000	$0	$4,500,000
150 ton Rock Trucks	$0	$7,320,000	$0	$7,320,000
Fill Dozers	$0	$2,160,000	$1,050,000	$3,210,000
Development Dozers	$0	$1,440,000	$1,440,000	$2,880,000
Reclamation Dozers	$0	$720,000	$720,000	$1,440,000
45 Yard Dozers	$0	$4,800,000	$4,800,000	$9,600,000
16 Yard Coal Loader	$0	$2,400,000	$700,000	$3,100,000
9 Yard Coal Loader	$0	$1,100,000	$500,000	$1,600,000
Drills	$0	$2,400,000	$4,800,000	$7,200,000
Total	$0	$34,190,000	$15,210,000	$49,400,000

Source: Meikle & Fincham, 1999

Table III.L-3
Example MTM/VF Mine Economic Analysis
Capital Budget - Life of Mine

SUPPORT EQUIPMENT

Item Description	Year 0	Year 1	Years 2 thru 10	Total
Motor Grader	$0	$400,000	$0	$450,000
Water Truck	$0	$600,000	$0	$600,000
5 Yard Backhoe	$0	$300,000	$0	$300,000
Light Plants	$0	$150,000	$0	$150,000
Mechanics Trucks	$0	$520,000	$0	$520,000
Fuel Truck	$0	$130,000	$0	$130,000
Service Truck	$0	$260,000	$0	$260,000
Portal Trucks	$0	$75,000	$0	$75,000
Pick-Up Trucks	$0	$150,000	$300,000	$450,000
Total	$0	$2,635,000	$300,000	$2,935,000

Source: Meikle & Fincham, 1999

Table III.L-4
Example MTM/VF Mine Economic Analysis
Capital Budget - Life of Mine

CAPITAL DEVELOPMENT

Item Description	Year 0	Year 1	Years 2 thru 10	Total
Haul Road	$1,000,000	$0	$0	$1,000,000
Pond Construction	$500,000	$0	$1,000,000	$1,500,000
Stream Mitigation	$500,000	$0	$0	$500,000
Permitting Related	$500,000	$0	$0	$500,000
Exploration	$350,000	$0	$0	$350,000
Clearing & Grubbing	$460,000	$230,000	$920,000	$1,610,000
Office/Warehouse	$200,000	$0	$0	$200,000
Radio System	$50,000	$0	$0	$50,000
Pump System	$150,000	$0	$0	$150,000
Power & Phones	$150,000	$0	$0	$150,000
Total	$3,860,000	$230,000	$1,920,000	$6,010,000

Source: Meikle & Fincham, 1999

b. Employment

Table III.L-5 provides a detailed breakdown of the manpower allocation required for operation of the example MTM/VF mine site. The example site runs two 10-hour shifts per day, 5 days per week, for a total of 260 working days per year. A day shift with 47 employees and night shift with 42 employees combine for a total labor force of 89 employees working 231,400 man hours per year. Equipment operators are the majority of the labor force at 70 percent, with support technicians comprising about 20 percent, and supervisory staff making up the remaining 10 percent of the employees.

c. Costs and Earnings

The costs of mining coal at the example MTM/VF mine site are shown in relationship to the gross earnings for the sale of coal in Table III.L-6. Sale of coal at $24.75 per ton generates a gross revenue of $405,800,604. From this, the costs of marketing and transportation, overhead and reclamation, and production mining are subtracted, leaving a cash margin of $78,204,696. This equates to a production cost per ton of $19.98 and cash margin of $4.77 per ton. Deduction of capital depreciation and amortization leaves a net earning before interest and taxes of $26,513,450. Labor and supplies are the largest single cost category for coal production, about 60 percent of the total. Supplies and trucking costs together are about 44 percent of the total production cost. These two categories are largely dependent on fuel costs and are thus the most vulnerable to fluctuation over the life of the mine. The total direct wages and benefits earned by employees during the life of the mine are $83,796,596, and total service and supply expenditures for this period are $145,722,663.

Table III.L-7 provides a breakdown of the example mine's cash flow statistics over its operational life. Initial capital outlays and production costs result in a net operating loss of about $34,000,000 through the first year of mining. The return on this investment is not realized until the 8th year of mine operation. The rate of return on the investment is estimated at 9.60 percent.

d. Taxes

Coal mining is subject to a number of taxes on the federal, state, and sometimes local levels. For the example MTM/VF mine site, these add up to $58,073,684 over the life of the mine, equating to $3.54 per ton and representing 14 percent of its total market value. The coal severance tax is the largest component of the total tax burden at $1.24 per ton, or 35 percent of the total. Table III.L-8 lists the individual taxes to which the mine operation is subject by total mine life cost and cost per ton of coal.

Table III.L-5
Example MTM/VF Mine Economic Analysis
MANPOWER TABLE

Period: Full Year

Production Days = 260 days

C.T. Per M.H.		7.25
BCY Per M.H.		108.90

Manpower				Job Description	O.B. Production	# Prod. Days	Hrs. Per Day	Total Manhours
Position	Day	Evening	Total					
25 yd. Front Shovel	1	1	2	O.B. Loading	7,500,000	260	10	5,200
210 Ton Rock Truck	3	3	6	O.B. Haulage		260	10	15,600
Fill Dozer	1	1	2	Run Fill		260	10	5,200
18 ½ yd. Backhoe	1	1	2	O.B. Loading	5,800,000	260	10	5,200
150 Ton Rock Truck	3	3	6	O.B. Haulage		260	10	15,600
Fill Dozer	1	1	2	Run Fill		260	10	5,200
16 yd. Endloader	1	1	2	O.B. Loading	4,100.,000	260	10	5,200
150 Ton Rock Truck	2	2	4	O.B. Haulage		260	10	10,400
Fill Dozer	1	1	2	Run Fill		260	10	5,200
45 yd. Bull Dozer	4	4	8	Prod. Dozing	7,800,000	260	10	20,800
Development Dozer	2	2	4	Development		260	10	10,400
Reclamation Dozer	1	1	2	Reclamation		260	10	5,200
16 yd. Coal Loader	2	2	4	Coal Prep. Ldg.		260	10	10,400
9 yd. Coal Loader	2	2	4	Coal Prep. & Ldg.		260	10	10,400
Drillers	4	3	7	O.B. Drilling		260	10	18,200
Motor Grader	1	1	2	Road Maint.		260	10	5,200
Water Truck	1	1	2	Dust Control		260	10	5,200
Mechanics/Welders	2	6	8	Maintenance		260	10	20,800
P.M. Technicians	1	2	3	Maintenance		260	10	7,800
Fueler/Greaser	1	1	2	Maintenance		260	10	5,200
Blasters	6	0	6	Blasting		260	10	15,600
Blasting foreman	1	0	1	D & B Superv.		260	10	2,600
Prod. Foreman	1	1	2	Shift Superv.		260	10	5,200
Maint. Foreman	1	1	2	Maint. Superv.		260	10	5,200
Maint. Planner	1	1	2	Maint. Scheduling		260	10	5,200
Prod. Engineer	1	0	1	Engineering		260	10	2,600
Superintendant	1	0	1	General Superv.		260	10	2,600
Total	47	42	89		25,200,000			231,400

Source: Meikle & Fincham, 1999

Table III.L-6
Example MTM/VF Mine Economic Analysis of Earnings Before Interest and Taxes

	Total Project		
Parameter	**$$**	**$$ Per BCY**	**$$ Per C.T.**
Revenues	$405,800,604	$1.65	$24.75
Revenues Per ton	$24.75		
Non-Mining Costs:			
Sales Related Costs	$59,771,560	$0.24	$3.65
Intercompany Royalties	$0	$0.00	$0.00
Intercompany Commissions	$4,098,996	$0.02	$0.25
Trucking	$33,666,422	$0.14	$2.05
Other Transportation Costs	$9,837,593	$0.04	$0.60
Preparation Costs	$12,752,441	$0.05	$0.78
Subtotal	$120,127,012	$0.49	$7.33
Net Realization	$285,673,592	$1.16	$17.42
Indirect Costs:			
Overhead	$8,996,465	$0.04	$0.55
Reclamation	$2,459,394	$0.01	$0.15
Subtotal	$11,455,859	$0.05	$0.70
Mining Costs:			
Labor	$83,956,796	$0.34	$5.12
Supplies	$112,056,241	$0.45	$6.83
Subtotal	$196,013,037	$0.80	$11.95
Cash Margin	$78,204,696	$0.32	$4.77
Cash Margin Per Ton	$4.77		
Cash Cost Per Ton	$19.98		
Direct D.D. & A.	$51,691,246	$0.21	$3.15
Indirect D.D. & A.	$0	$0.00	$0.00
Subtotal	$51,691,246	$0.21	$3.15
Earnings Before Interest & Taxes (E.B.I.T.)	$26,513,450	$0.11	$1.62

Source: Meikle & Fincham, 1999

Table III.L-7
Example MTM/VF Mine Economic Analysis
CAPITAL INVESTMENT STATISTICS ($millions)

Parameter	Initial Inv. Year 0	Year #1	Year #2	Year #3	Year #4	Year #5	Year #6	Year #7	Year #8	Year #9	Year #10	Year #11
E.B.I.T.	$0.00	$2.43	$2.57	$2.64	$2.79	$2.82	$1.45	$1.55	$1.70	$5.22	$3.33	$0.00
Taxes @ 30%	$0.00	$0.73	$0.77	$0.79	$0.84	$0.85	$0.44	$0.47	$0.51	$1.57	$1.00	$0.00
Commissions	$0.00	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.32	$0.00
Taxes on Comm.	$0.00	$0.13	$0.13	$0.13	$0.13	$0.13	$0.13	$0.13	$0.13	$0.13	$0.10	$0.00
Intercompany Royalty	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Taxes on Intercompany	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Tax Savings Depl.	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Net Income	$0.00	$2.09	$2.14	$2.14	$2.25	$2.27	$1.31	$1.38	$1.49	$3.95	$2.56	$0.00
(Add) DD&P	$0.00	$5.29	$5.29	$5.29	$5.22	$5.23	$6.53	$6.53	$6.48	$2.97	$2.85	$0.00
(Less) CapEx	$3.86	$37.06	$0.48	$0.23	$0.48	$2.78	$10.66	$1.70	$0.00	$2.55	$0.00	($6.65)
Net Cash Flow	($3.86)	($29.77)	$6.90	$7.21	$6.99	$4.72	($2.82)	$6.21	$7.97	$4.37	$5.41	$6.65

N.P.V. @ 5%	$7.45
N.P.V. @ 8%	$2.26
N.P.V. @ 10%	($0.52)
I.R.R.	9.60%
Payback Period	7.56 yrs

Cash Flows 1 - 11	
E.B.I.T.	$26.51
Net Inc.	$21.43
Net Cash	$19.98

Source: Meikle & Fincham, 1999

Table III.L-8
Individual Taxes
By Total Mine Life Cost and Cost Per Ton of Coal

Taxes	Total Mine Life Cost	Cost Per Ton of Coal
Personal Property Tax	$3,132,574	$0.19 per ton
Worker's Compensation	$5,559,085	$0.34 per ton
Matching FICA	$3,097,378	$0.19 per ton
Unmined Mineral Tax	$1,173,000	$0.07 per ton
Franchise Tax	$504,390	$0.03 per ton
Severance Tax	$20,290,033	$1.24 per ton
Black Lung Tax	$8,747,264	$0.53 per ton
Federal Reclamation Tax	$5,566,431	$0.34 per ton
WV Special Assessment	$819,798	$0.05 per ton
Federal & State Income Tax	$9,183,734	$0.56 per ton
TOTAL	**$58,073,684**	**$3.54 per ton**

Individual taxes and tax rates vary between states in the study area. It is predicted that total taxes would be $4,189,994 less if this same operation where conducted in Kentucky, and $12,187,134 less if it were conducted in Virginia.

4. Mining Method Considerations

Selection of the appropriate mining method(s) for a given site is a complicated, iterative process during the mine feasibility evaluation and planning stages. Choices are typically driven by the desire to maximize coal recovery with the least expensive mining method that is practical for a given coal seam. This section summarizes the basic considerations for mine method selection.

a. Mine Method Selection Factors

The two basic options in mine method selection are surface and underground mining, or a combination of the two. For surface operations, contour, area, and mountaintop removal methods are available individually or in combination, and room and pillar and/or longwall mining are available for underground operations. The primary factors used for deciding between the individual methods are summarized in Table III.L-9.

Table III.L-9
Summary of Mine Method Selection Factors

Selection Factor	Surface Methods			Underground Methods	
	Contour	Area	Mountaintop Removal	Room & Pillar	Longwall
Coal Seam Thickness	≈ 1 ft	≈ 1 ft	≈ 1 ft	>= 28 in	>= 6 ft
Stripping Ratio	≈ 10 - 12	≈ 12 - 15	≈ 15 - 20	NA	NA
Maximum Cover	varies - 100	varies -	varies -	≈ 1,500 ft	> 1,500 ft
Minimum Cover	NA	NA	NA	100 ft	> 100 ft
Reserve Size	L - M	M - H	H	L - M	H
Recovery Rate	varies	< 100%	up to 100%	40 to 80 %	up to 85%
Excess Spoil Generation	L - M	M - H	M - H	NA	NA
Capital Investment	L	M - H	H	L - M	H
Equipment Size	L	M - H	H	L - M	H
Mine Plan Flexibility	M - H	L - M	L	M - H	L
Orphan Reserves	M	L	NA	M - H	L - M

Relative value for comparison: L - Low, M - Moderate, H - High, NA - Not Applicable
Source: Gannett Fleming, Inc.

When dividing a reserve between surface and underground mining methods, stripping ratios may be first applied to determine which seams are impractically deep for surface mining. Lower seams meeting the thickness and cover criteria for either of the two underground methods may then be considered for underground operations. The upper seams are examined more closely to refine their applicable surface mining methods. The maximum practical extent of contour mining may first be delineated for each seam by its stripping ratio. Remaining interior cores of ridges or mountaintops are then evaluated to determine how far mining can progress using stripping ratios generated by multiple-seam area or mountaintop removal approaches. Thus, more than one mining method may be applied on a given site.

Application extent for individual mining methods may be further constrained by site factors not related to stripping ratio alone, such as a reserve size being too small to justify heavy-equipment mining methods. Extent of mining can be limited by availability of excess spoil disposal volume, favoring contour mining over area or mountaintop removal methods. Site geometry of topography and coal seams may be incompatible with the capabilities of equipment spreads, leading operations to become “spoil bound,” or not having sufficient space to maneuver and place spoil. The equipment or capital investment capabilities of an operator may also dictate a lesser extent of mining than conceptually feasible. Mine plan flexibility becomes a consideration for marginal operations under unstable market conditions. A final important consideration is generation of orphan reserves, or those that will be left permanently unmineable due to high stripping ratios after completion of mining. Evaluation of feasibility of highwall mining to partially recover these reserves requires consideration of lengths of time that pits must remain open and their extent as this relates to backfilling of spoil from other working areas of the mine.

M. COAL DISTRIBUTION AND MARKETS

1. Coal Uses and Distribution

The Energy Information Administration (EIA) develops and publishes energy market projections. The projections are "business-as-usual trend forecasts, given known technology, technological and demographic trends, and current laws and regulations" (USDOE EIA, 2000). Selected EIA coal related projections from the *Annual Energy Outlook, 1999* (USDOE EIA, 2000) are presented in this sub section and the ones that follow.

Nationally, the predominant use of coal is for electricity generation. Coal use in electricity generation has grown and is projected to continue growing. The combined other uses of coal have fallen since at least 1970 and are projected to increase only very slightly. [Figure III.M-1 Electricity and Other Coal Consumption, 1970-2020]

Figure III.M-1

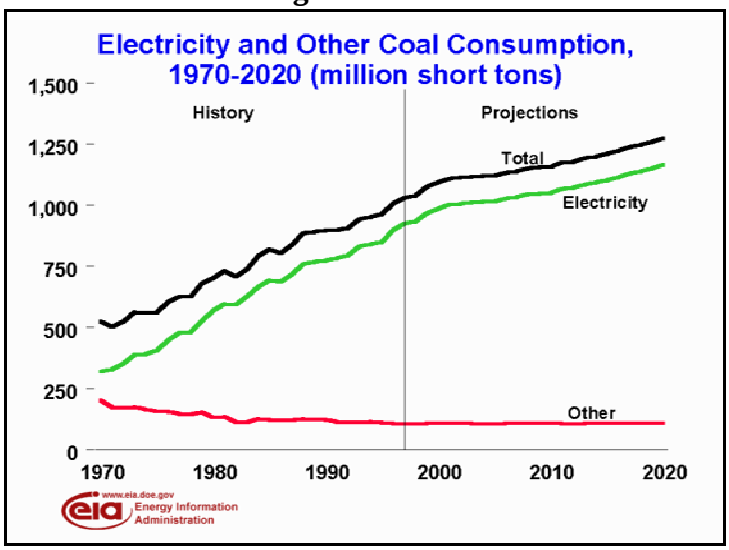


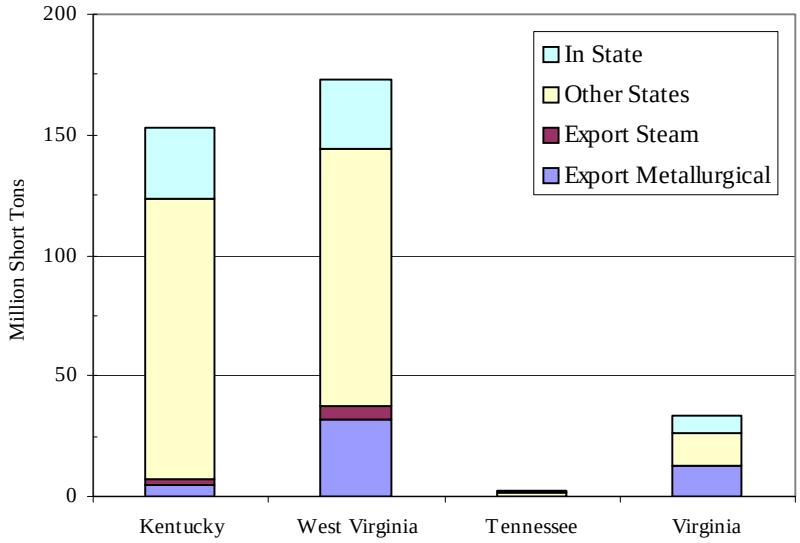
Table III.M-1 and Figure III.M-2 display the distribution of coal produced in the study area states in 1998. West Virginia is the leading exporter of U.S. coal. Its exports of 37.5 million short tons represent 47 percent of total foreign distributions in 1998. Twenty-two percent of West Virginia's 1998 coal production was exported. Metallurgical coal is the state's dominant export, comprising 86 percent of West Virginia's coal exports.

Table III.M-1
Coal Distribution, 1998
(million short tons)

Destination	Producing State				Percent of Total Production			
	KY	WV	TN	VA	KY	WV	TN	VA
Export Metallurgical	5.0	32.2	—	12.6	3%	19%	0%	37%
Export Steam	1.9	5.3	—	0.2	1%	3%	0%	.5%
Other States	116.5	106.6	1.3	13.1	78%	62%	48%	39%
In State	29.7	28.5	1.4	7.6	20%	17%	52%	23%

Source: U.S. Department of Energy, Energy Information Administration., 2000. *Coal Industry Annual, 1998.*

Figure III.M-2
Coal Distribution, 1998



Source: U.S. Department of Energy, Energy Information Administration, 2000. Coal Industry Annual, 1998.

While Virginia's output is much smaller than that of West Virginia, exports figure even more prominently in its coal distribution patterns. Nearly 38 percent of its 1998 production was exported; the great majority of this being metallurgical coal. Tennessee recorded no coal exports in 1998. Kentucky exported four percent of its 1998 production, about three-quarters of it as metallurgical coal. Kentucky's steam coal exports have fallen considerably from their five year high at 6,055

thousand short tons in 1995 to 1,889 thousand short tons in 1998. Kentucky metallurgical coal exports in 1998 are roughly unchanged from 1993 levels.

2. Productivity and Price Trends

One of the most noteworthy trends of the past decade of coal mining is the increase in labor productivity. Gains in coal mine labor productivity result from technology improvements, economies of scale, and better mine design. Improvements in labor productivity have been, and are expected to remain, the key to lower coal mining costs. Labor productivity, measured as short tons of coal, per miner, per hour, has improved as shown in Table III.M-2 below:

Table III.M-2
Coal Mining Productivity (short tons per miner per hour)

Region	1998		1989		Avg. Annual % Change	
	Under-ground	Surface Mines	Under-ground	Surface Mines	Under-ground	Surface Mines
Eastern Kentucky	3.28	4.27	2.40	2.92	3.5	4.3
So. West Virginia	3.89	5.74	2.57	3.71	4.7	5.0
Tennessee	2.25	2.90	1.58	2.20	4.0	3.1
Virginia	2.56	3.54	2.15	2.59	2.0	3.6
Wyoming	10.09	39.79	3.21	21.38	13.6	7.1

Source: U.S. Department of Energy, Energy Information Administration, 2000. Coal Industry Annual, 1998.

The table illustrates impressive gains in productivity in the study area and also illustrates Wyoming as an example of western coal productivity. The gains in Wyoming (the largest coal-producing state in the U.S.) and the vastly higher productivity in that state relative to the Appalachian coalfields are noteworthy because of increasing competitive pressure from western coal. Wyoming coal miners enjoy extraordinarily thick seams that lie close to the earth's surface. The higher labor productivity in surface mining compared to underground mining reflects the inherently greater labor intensity of underground mining.

On a national average, the share of wages in minemouth prices was 31 percent in 1970 and has fallen to 17 percent in 1998. The EIA projects that continued improvements in mine productivity (averaging 6.2 percent a year since 1977) will cause falling real mine prices throughout the forecast.

Figure III.M-3 Coal Mining Labor Productivity by Region 1990-2020 (short tons per miner per hour), displays the increasing labor productivity in the recent past and over the forecast period and contrasts the high productivity western coalfields with those of the eastern U.S.
Table III.M-3 illustrates the relative minemouth prices among regions and the fall in prices over the period 1989-1998. The table illustrates the higher price of underground mined coal versus surface mined coal. It also illustrates the considerably lower minemouth price of western coal (that pulls down the national average price) and the greater declines in western coal prices compared to that

of the study area. Figure III.M-4 Average Minemouth Price of Coal by Region, 1990-2020 (1997 dollars per ton), depicts the historic and projected trends for falling minemouth prices in both eastern and western coalfields. It should be noted here that coal consumers are considering other factors besides mine month price, including coal quality and transportation costs.

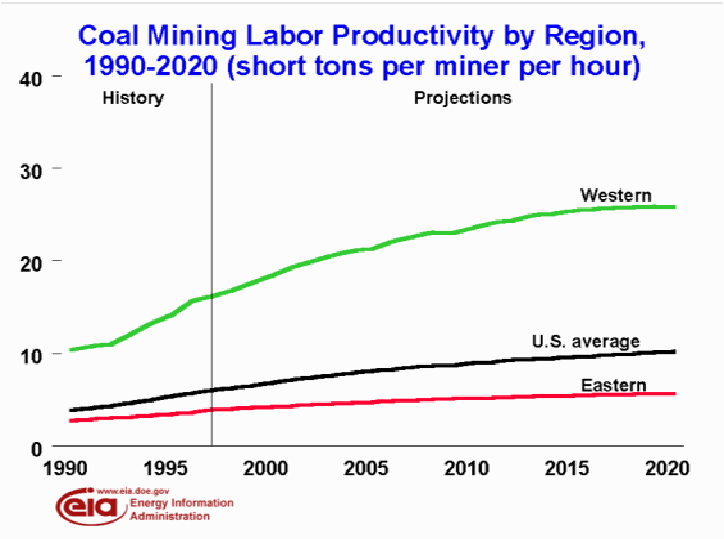
Table III.M-3
Average Mine Price ($ per short ton)

Region	Price in 1998			1989-1998
	Underground	Surface	Average	Avg. Annual % Change
Eastern Kentucky	$25.36	$23.57	$24.59	-0.5
Southern West Virginia	$29.28	$24.79	$27.57	-0.6
Tennessee	w	w	$28.69	0.7
Virginia	$29.55	$26.21	$28.69	0.4
Western U.S.	$17.58	$7.77	$8.76	-3.5
United States	$25.64	$12.92	$17.67	-2.3

Source: U.S. Department of Energy, Energy Information Administration, 2000. *Coal Industry Annual, 1998.*

In addition to falling minemouth prices, coal transportation costs are projected to fall, resulting in lower utility prices for coal. Falling coal prices are projected to continue contributing to decreased costs at coal fired power plants. Since 1980, the per-kilowatt-hour fuel costs for coal fired power plants have fallen significantly. Fuel prices have been declining since the early 1980s. Generating costs for coal fired plants decreased by 49 percent from 1980 to 1996. In addition, non-fuel operations and maintenance costs are also expected to fall. Efforts to cut staff and reduce operating costs were prompted by the combination of technology improvements and competitive pressure. The amount by which utilities can continue to cut costs is uncertain, but many analysts agree that further reductions are possible (USDOE EIA, 2000).

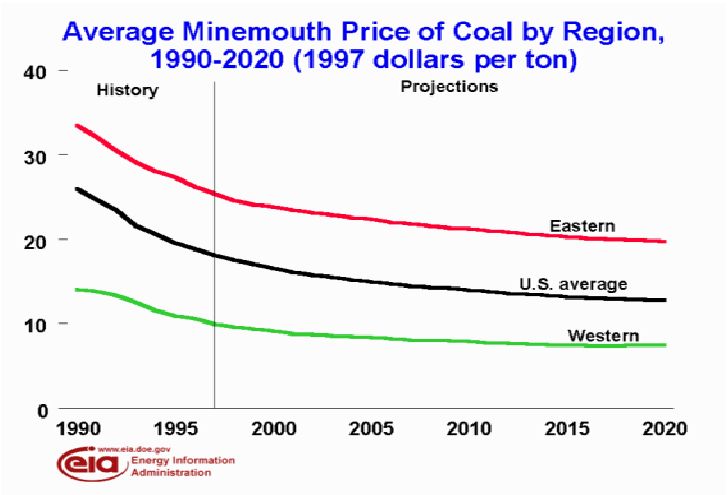
Figure III.M-3



3. Coal Demand and Production Projections

The lower projected coal prices, combined with projected increases in electricity demand, would create increasing demand for coal. This coal demand is subject to a fixed sulfur emissions cap from the Clean Air Act Amendments of 1990, which mandate progressively greater reliance on the lowest sulfur coals (from Wyoming, Montana, Colorado, and Utah). As coal demand grows, however, new coal fired generating capacity is required to use the best available control technology: scrubbers or advanced coal technologies that can reduce sulfur emissions by 90 percent or more. Thus, even as the demand for low sulfur coal grows, EIA predicts that there will still be a market for low cost higher sulfur coal throughout the forecast. From 1997 to 2020, EIA projects high and medium sulfur coal production to increase from 654 to 662 million tons annually (0.1 percent a year), and low sulfur

Figure III.M-4



coal production to increase from 445 to 696 million tons annually (2.0 percent a year). As a result of the competition between low sulfur coal and post-combustion sulfur removal, western coal production is projected to continue its historic growth, reaching 772 million tons in 2020. Its growth rate, however, is projected to fall from the 9.4 percent average annual growth achieved between 1970 and 1997 to 1.8 percent average annual growth in the forecast period (USDOE EIA, 1998)

THE EIA PROJECTS COMPETITION FROM VERY LOW SULFUR, LOW COST WESTERN AND IMPORTED COALS TO LIMIT THE GROWTH OF EASTERN LOW SULFUR COAL MINING.

The EIA projects competition from very low sulfur, low cost western and imported coals to limit the growth of eastern low sulfur coal mining. Western low sulfur coal has been successfully tested in all U.S. Census divisions, except New England and the Mid-Atlantic, and its penetration of eastern markets is projected to increase (USDOE EIA, 1998). Projected falling transportation costs are expected to reinforce this trend. The recent history and projected production from eastern and western coal sources is depicted in Figure III.M-5 Coal Production by Region, 1970-2020 (million short tons). The EIA projects that the western production will increase considerably while eastern production remains essentially flat. As for coal exports, EIA projects slow growth for total U.S. coal exports and a slight decline in metallurgical coal exports.

4. Structure of the Coal Industry [1]

During the past decade, the coal industry, often in response to market forces, has undergone major structural changes. The depressed coal market since 1984 and the Clean Air Act Amendments of 1990 (CAAA) induced changes in coal demand patterns that have resulted in (1) the coal industry being increasingly concentrated in ownership and (2) the transformation of coal companies from local and regional companies into nationally based companies.

THE DEPRESSED COAL MARKET SINCE 1984 AND THE CLEAN AIR ACT AMENDMENTS OF 1990 INDUCED CHANGES IN COAL DEMAND PATTERNS THAT HAVE RESULTED IN (1) THE COAL INDUSTRY BEING INCREASINGLY CONCENTRATED IN OWNERSHIP AND (2) THE TRANSFORMATION OF COAL COMPANIES FROM LOCAL AND REGIONAL COMPANIES INTO NATIONALLY BASED COMPANIES.

A lower than expected level of demand for coal has contributed to chronic excess production problems for the coal industry. According to the EIA, the average price for coal at minemouth (in constant dollars) has declined since 1975 and is at a level similar to that in 1970—the pre-oil embargo era (USDOE EIA, 1998). In recent years, some coal producers were reportedly forced to price their products at or below variable costs in order to sell them (DRI/McGraw-Hill). Many marginal coal operations were forced to shut down.

Previously, companies that sold most of their coal under long term contracts could use the profits on these contracts to subsidize spot market sales at prices below average total costs. Most coal contracts include a market reopener clause to allow coal buyers or sellers to renegotiate if the contract price proves to be higher than the market price for similar coals by a predetermined amount. This price mechanism is used to prevent the contract price of coal from escalating too rapidly. However, in a sustained downward market, the market reopener clause in coal contracts has enabled the price of coal to approach the cost of *incremental* production (i.e., the marginal cost) and not the fully loaded cost that includes capital recovery. In such an environment coal producers must become much more efficient so that the cost of production could be lowered.

Another aspect of the changing landscape of the coal industry has been the entry and subsequent exit of oil producers. Many oil companies diversified into the coal business in the 1970's with the expectation of a high return on their investments. The depressed coal price levels and the changing investment environment contributed to the exit of major oil companies from the coal business during the past 5 years. Consequently, many coal properties have changed hands.

Falling coal prices, tight profit margins, and a changing business environment have resulted in a surge of coal industry consolidation and merger activities. The vast majority of the acquisitions during the past 5 years have involved low sulfur or compliance coal properties. While oil companies exited from the coal business, traditional mining companies expanded their coal holdings. Company buyouts and mergers such as Amax and Cypress, Consolidation Coal and Island Creek, and Kennecott's buyout of NERCO and Sun's coal properties have transformed local and regional coal companies into nationwide companies. Since 1982, the coal industry has become much more

[1] The discussion in this section is from the "*Final Economic Analysis of Valid Existing Rights*", U.S. Department of Interior, 1999.

concentrated. In 1982, the top 10 companies accounted for 34 percent of the total U.S. coal production. By 1993, production from the top 10 companies accounted for approximately 45 percent of the total. The continuing coal industry concentration will result in fewer and larger coal suppliers.

The changing business environment brought about by the CAAA and, subsequently, by the deregulation of the electric utility industry mandated by the Energy Policy Act of 1992 has caused the coal companies to reevaluate their long term business strategies. The quality of coal demanded at electric utilities, the largest customers of coal, has changed as electric utilities move from Phase I CAAA compliance in 1995 to Phase II compliance by 2000. In order to survive or to expand their market shares, coal companies will have to be flexible in offering a wide range of products with coal quality varying from high sulfur to low sulfur. Major coal companies are expanding or acquiring coal properties in areas where they did not previously have a presence. As a result, the coal business has become much more national and in some cases even global.

With the exception of only a few short periods in history, the coal industry has otherwise been characterized by overcapacity. The chronic supply/demand imbalance, the dynamics of the coal market, and the relative ease of entry into the coal business have contributed to the competitiveness of the industry. Since the passage of the CAAA, coal market competition intensified. In addition to competition among coal operators in terms of mining methods, geographic locations, and coal qualities, coal must compete with natural gas, foreign coals, and SO_2 emissions allowances. The intensity of competition in today's coal market is unprecedented.

Another trend in coal mining is one towards larger mines. Increasingly complex permitting requirements and the large machinery investments required of modern high productivity mining methods make for high fixed costs. These high fixed costs require high volume production to achieve profitable unit costs.

THE HIGH FIXED COSTS OF MODERN COAL MINING REQUIRE HIGH PRODUCTION VOLUMES TO ACHIEVE PROFITABLE UNIT COSTS.

In West Virginia for example, the largest 22 mines (of 35 total), all produced more than 500,000 tons/yr and jointly accounted for 96 percent of state coal production. Virginia has 52 coal mines, but the largest five produce more than 300,000 tons/yr (Directory of Mines 1998) and account for 92 percent of state coal production (VA DMME 1998). In Kentucky, the largest 49 of 195 total mines produce more than 300,000 tons/yr and account for 68 percent of state coal production (VA DMME 1998).

N. PAST AND CURRENT MINING IN THE STUDY AREA

Coal production within the steep slope areas of West Virginia, Kentucky and Virginia closely follows the historical trend of the overall United States coal mining industry. In general, coal production in the United States increased annually due to increased mechanization of the industry from 1890 to the great depression of the 1930s, when production dropped off significantly. Coal production began to increase again with the onset of World War II and continued increasing until after the Korean conflict. In 1954, the railroad industry's conversion from coal to diesel fuel brought a modern low point in coal production. Since then, annual coal production has generally increased or remained stable.

Tables III.N-1, III.N-2 and Figure III.N-1 present data on coal production for the study area, using data from the Energy Information Administration (EIA). The discussion below highlights some of the notable statistics contained in these tables. The EIA data do not distinguish among the different types of surface mining methods. Based on research conducted by Hill and Associates (2000) and by Resource Technologies Corporation (2000), roughly 95 percent of the surface mining in southern West Virginia would be classified as the MTM/VF mining that is the subject of this EIS. The proportions for eastern Kentucky, Virginia, and Tennessee are not known.

Table III.N-1
Coal Production Trends by State, Region, and U.S. (Thousand Short Tons)

Coal-Producing State and Region	1989	1994	1998	Avg. Annual Percent Change	
				1994-1998	1989-1998
Kentucky Total	167,389	161,642	150,295	-1.8	-1.2
Eastern	125,739	124,447	116,654	-1.6	-.8
Western	41,649	37,195	33,641	-2.5	-2.3
Tennessee	6,480	2,987	2,696	-2.5	-9.3
Virginia	43,006	37,129	33,747	-2.3	-2.6
West Virginia Total	153,580	161,776	171,145	1.4	1.2
Northern	56,018	49,316	44,618	-2.5	-2.5
Southern	97,562	112,460	126,527	3.0	2.9
Study Area Total	272,787	277,023	279,624	0.2	0.3
State Totals	370,455	363,534	357,883	-0.4	-0.4
U.S. Total	980,729	1,033,504	1,117,535	2.0	1.5

Source: Energy Information Administration. 2000 - http://www.eia.doe-gov/cneaf/coal/cia/special/t1p01p1.html

Southern West Virginia is the only portion of the study area to have experienced higher coal production in 1994 and 1998 than in 1989.

Figure III.N-1
Coal Production, 1998

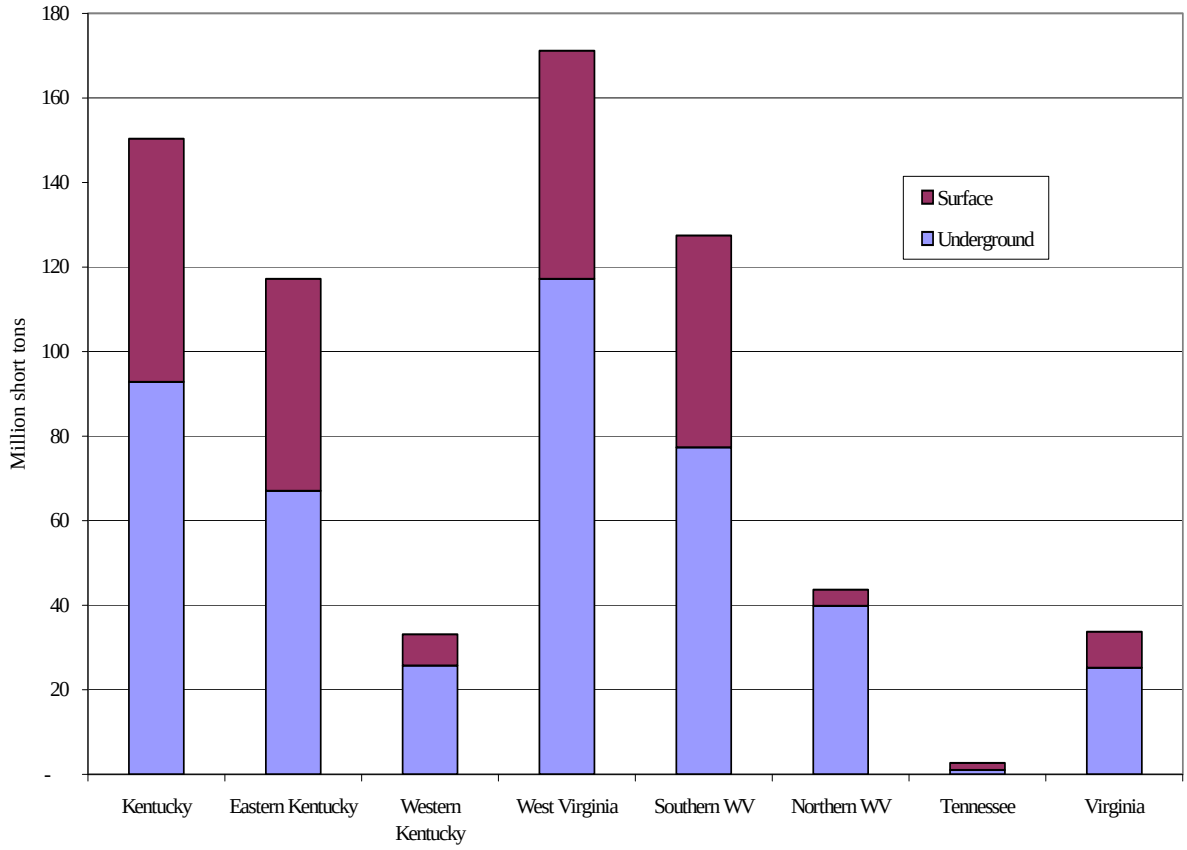


Table III.N-2
Coal Production and Number of Mines by State, County, and Mine Type, 1998 (thousand short tons)

Location	Underground		Surface		Total	
	Mines	Production	Mines	Production	Mines	Production
Kentucky	277	92,832	205	57,462	482	150,295
Eastern Tier	**259**	**67,066**	**186**	**49,589**	**445**	**116,654**
Bell	12	3,390	10	2,130	22	5,520
Breathitt	–	–	5	4,302	5	4,302
Clay	1	25	5	348	6	373
Floyd	31	2,426	8	3,258	39	5,684
Harlan	29	6,629	10	1,502	39	8,131
Jackson*	–	–	1	3	1	3
Johnson	3	1,100	3	37	6	1,137
Knott	25	5,119	19	3,943	44	9,061
Knox	11	399	6	188	17	587
Lawrence	1	145	4	130	5	275
Leslie	8	7,470	7	2,167	15	9,637
Letcher	15	6,519	23	3,342	38	9,860
Magoffin	–	–	2	819	2	819
Martin	24	6,530	11	5,048	35	11,578
Owsley	–	–	3	50	3	50
Perry	14	5,755	17	8,729	31	14,484
Pike	82	21,420	49	13,470	131	34,890
Whitley	3	139	3	125	6	264
Tennessee	**13**	**1,047**	**14**	**1,649**	**27**	**2,696**
Anderson	2	16	–	–	2	16
Campbell	2	470	5	382	10	852
Claiborne	4	503	4	435	8	937
Cumberland	–	–	1	86	1	86
Fentress	–	–	2	211	2	211
Morgan	1	11	–	–	1	11
Scott	1	47	–	–	1	47
Sequatchie	–	–	2	537	2	537

Table III.N-2

Coal Production and Number of Mines by State, County, and Mine Type, 1998 (thousand short tons)

(Continued)

Location	Underground		Surface		Total	
	Mines	Production	Mines	Production	Mines	Production
Virginia	**127**	**25,212**	**46**	**8,535**	**173**	**33,747**
Allegheny	–	–	1	109	1	109
Buchanan	55	10,941	9	1,537	64	12,477
Dickenson	14	2,271	8	971	22	3,242
Lee	5	1,057	2	169	7	1,225
Russell	6	809	2	415	8	1,224
Tazewell	12	1,807	–	–	12	1,807
Wise	35	8,327	24	5,335	59	13,662
West Virginia	**246**	**117,191**	**100**	**53,955**	**346**	**171,145**
Southern Tier	**213**	**77,954**	**73**	**48,572**	**286**	**126,527**
Boone	30	21,066	8	8,420	38	29,486
Braxton	1	588	–	–	1	588
Clay	–	–	4	6,636	4	6,636
Fayette	3	1,358	4	1,993	7	3,351
Greenbrier	2	496	3	30	5	526
Kanawha	10	4,647	6	9,478	16	14,126
Lewis	–	–	1	1	1	1
Lincoln	1	24	–	–	1	24
Logan	21	3,814	8	10,305	29	14,119
McDowell	63	4,4343	10	1,901	73	6,244
Mingo	27	16,160	14	6,249	41	22,409
Nicholas	6	2,015	4	749	10	2,764
Raleigh	20	12,376	2	109	22	12,486
Wayne	4	3,366	2	1,024	6	4,390
Webster	5	2,147	2	2,586	7	4,733
Wyoming	20	8,289	5	1,679	25	9,967

*Surface Production rounded to zero

Source: Energy Information Administration, 2000. htp:www.eia.doe.gov/cneaf/coal/cia/special/tb104p01.txt

1. Kentucky

Kentucky had the third highest state coal production rate in 1998. The 150.3 million short tons produced in Kentucky comprised over 13 percent of the domestic coal production (Table III.N.-1). Eastern Kentucky is the dominant of the state's two coal mining regions, producing 117.2 million short tons in 1998, or 78 percent of the total state production. Production in eastern Kentucky has decreased at an average annual rate of -0.8 percent from 1989 to 1998. Production in western Kentucky has also decreased, resulting in a slight net decrease (-1.2 percent) for the state overall over the period. The four eastern Kentucky counties of Pike, Martin, Letcher, and Perry account for 47 percent of the total state production (Table III.N.-2). In 1998, the top producing mine in the state was Lodestar Energy's No. 13 Baker underground mine, with 4.39 million short tons of coal.

SURFACE MINING ACCOUNTS FOR 42.5 PERCENT OF THE COAL PRODUCTION IN EASTERN KENTUCY IN 1998. THE TOP SURFACE MINING COUNTIES IN 1998 WERE PIKE, PERRY, AND MARTIN

In 1998, eastern Kentucky surface coal mines produced 49.6 million short tons from 186 mines (Table III.N.-2), that accounted for 33 percent of the total state coal production and 42.5 percent of eastern Kentucky production. Eastern Kentucky had 259 operating underground mines in 1998, producing 67 million short tons of coal. Coal production from Kentucky underground mines has increased less than 1 percent annually from 1988 to 1997. The continuous mining method produces the majority (74.9 million short tons) of coal mined by underground methods (USDOE EIA, 1998).

The eastern Kentucky coalfields are located in 30 counties consisting of 7.2 million acres. There are 2,295 permanent program permits with 1,361,145 permitted acres in these counties. Of these, 936 permits are surface mining operations with 386,945 acres permitted. These surface mining operations use a variety of mining techniques (i.e. contour, remine, auger, area, mountaintop removal, and any combination of these mine types).

Mountaintop removal and steep slope variance mines are a subset of all surface mines. There are 395 such mines with permanent program permits, amounting to 88,653 permitted acres with permanent program permits. From this total, 219 permits are in an active status, 149 permits have had either a Phase I or a Phase II bond release, and the status of the remaining 27 permits varies. This acreage represents approximately 1.2 percent of the land area in the 30 counties of the eastern Kentucky coal field. These active mountaintop removal/steep slope variance permits account for 6.5 percent of permitted acreage and approximately 17.2 percent of all permanent program permits in the eastern Kentucky coal field.

2. Tennessee

Tennessee is a minor coal producing state, contributing less than one percent of the total U.S. coal production in 1998 (USDOE EIA, 1998). From 1989 to 1994, coal production fell to less than one-half its 1989 level and has decreased slightly since then. The EIA reported production of 1.65 million short tons from 14 surface mines in 1998, accounting for 61 percent of total state coal production. The two largest surface mined coal producing counties in 1998 were Sequatchie, with 537 thousand short tons, and Claiborne, with 435 thousand short tons.

3. Virginia

In 1998, Virginia had the ninth highest coal production of all states at 33.7 million short tons, or 3 percent of the domestic coal production (see Table III.N-1). Virginia coal production has been on a downward trend, having decreased almost 3 percent annually since 1989 (Table III.N-1). The counties of Buchanan and Wise account for over 77 percent of the state's coal production. In 1998, the top producing mine in the State was CONSOL's Buchanan No. 1 underground coal mine, with 4.3 million short tons of coal.

Virginia had 46 operating surface mines in 1998, producing 8.5 million short tons of coal (Table III.N-2) that accounts for 25 percent of the total state production. While overall coal production has decreased, coal produced by surface mining methods increased by 1.1 percent from 1988 to 1997.

Virginia had 127 underground coal mines producing 25.2 million short tons in 1998 (Table III.N-2). This figure accounts for 75 percent of Virginia's coal production. Coal produced from underground mining methods decreased 3.7 percent annually from 1988 to 1997. The continuous mining method was used in the production of 55 percent of the coal produced from underground mines in 1998 (USDOE EIA, 1998).

4. West Virginia

In 1998, West Virginia had the second highest coal production rate of all states at 171.1 million short tons, or over 15 percent of the total nation's output (Table III.N-2). Mineable coal seams occur in 43 of the state's 55 counties. There are 117 identified coal seams in the state; of these, 62 seams are mineable using current technology.

Coal production in southern West Virginia was 126.5 million short tons in 1998, accounting for 74 percent of the state total. While production in northern West Virginia has decreased, production in southern West Virginia has increased at an average annual rate of 2.9 percent from 1989 to 1998, resulting in a net increase in production for the state overall. The four southern West Virginia counties of Boone, Logan, Mingo, and Kanawha account for 47 percent of the total state coal production. West Virginia's highest producing mine is Mingo-Logan Coal's Mountaineer Mine, an underground mine that produced 7.5 million short tons, placing it as the 20th most productive mine in the nation in 1998. The state's top producing surface mine is Samples' Caternary Coal Mine, which produced 4.95 million short tons and ranked 42nd in the nation in 1998 (USDOE EIA, 1999).

Surface mining in southern West Virginia typically occurs at a much larger scale than in neighboring states, with an average production of 684 thousand tons per mine in 1998, compared to 267 thousand tons per mine in eastern Kentucky, 118 thousand tons per mine in Tennessee, and 186 thousand tons per mine in Virginia.

SURFACE MINING ACCOUNTED FOR 40 PERCENT OF SOUTHERN WEST VIRGINIA COAL PRODUCTION IN 1998. THE TOP SURFACE MINING COUNTIES IN 1998 WERE LOGAN, KANAWHA, BOONE, CLAY, AND MINGO.

Coal production by surface mining methods in West Virginia has increased by 6 percent

from 1983 to 1997. The most common surface mining methods in the state are contour, mountaintop removal, and multiple seam operations. Southern West Virginia had 71 operating surface mines in 1998, producing 48.6 million short tons of coal (Table III.N-2). This production accounted for 30 percent of the state's total and 40 percent of all southern West Virginia coal production in 1998. The top surface mining counties in 1998 were Logan, Kanawha, Boone, and Clay and Mingo.

Underground mines in southern West Virginia produced 77.9 million short tons of coal from 209 mines [Table III.N-2]. Coal production from southern West Virginia underground mines accounts for 46 percent of the state's coal production and approximately 60 percent of all southern West Virginia coal production. Underground mining in southern West Virginia, using the continuous mining method, produced 52.0 million short tons in 1998 accounting for nearly two-thirds of all underground mining in that region of the state and 30 percent of the state's total coal output.

O. THE SCOPE OF REMAINING SURFACE-MINABLE COAL IN THE STUDY AREA

1. Demonstrated Coal Reserves

The Energy Information Administration provides an estimate of the demonstrated reserve base of coal in each state, by most likely type of mining method. This EIS deals only with the Appalachian region and bituminous coal seams, where the "demonstrated reserve base" consists of the portion of coal seams that are at least 28 inches thick and no greater than 1,000 feet deep. The demonstrated coal reserve information, as of 1996, is displayed in Table III.O-1. The data in this table includes demonstrated reserves outside of the EIS study area in portions of northern West Virginia and western Kentucky.

Table III.O-1
Coal Reserves and Remaining Production Life

Region	Demonstrated Reserve Base (million short tons)			Remaining Years of Production	
	Underground	Surface	Total	Underground	Surface
Kentucky	1,400	5,600	7,000	19	108
West Virginia	16,800	2,800	19,600	144	49
Tennessee	300	200	500	215	105
Virginia	900	500	1,400	33	49
Four-state Total	19,400	9,100	28,500	na	na
U.S. Total	122,900	151,900	273,900	na	na

Source: U.S. Dept. of Energy, Energy Information Administration, 1998. Coal Industry Annual, 1997.

2. Remaining Extent of Major Surface Minable Coal Seams

a. Introduction

The EIS Steering Committee commissioned several studies to determine the extent of remaining surface mineable coal seams. The seams analyzed account for the majority of current surface mining production as well as the potential future production in eastern Kentucky, central/southern West Virginia, and southwestern Virginia. Defining the location of these seams allows a spatial representation where likely future surface coal mining will result in the types of aquatic, community and terrestrial impacts described and analyzed in other sections of this EIS. One of the principle impacts evaluated by this EIS is excess spoil disposal in valley fills. Portraying the location of remaining surface mineable coal also generally identifies the potential areas where valley fills could occur.

b. Methodology

Information on surface mineable coal zones in Kentucky was provided to OSM under contract with Dr. Jerry Weissenfluh of the Kentucky Geologic Survey (KGS). Nick Fedorko of the West Virginia Geologic and Economic Survey (WVGES) prepared the data for West Virginia coal seams at the direction of the West Virginia Legislature. Dr. Eric C. Westman, Department of Mining and Mineral Engineering, Virginia Polytechnic Institute and State University (VPI), prepared the information for Virginia under contract to OSM. The following reports were provided to OSM , and, as described below, used to prepare the map in this section. The individual reports and GIS coverages are available from OSM or the authors.

b.1. West Virginia

WVGES prepared "Projecting Future Coal Mining in Steep Terrain of Appalachia, " May 2000. The report identifies three surface mineable coal zones in central/southern West Virginia. The coal zones selected by WVGES were based on a review of past and current mining trends, coupled with the general knowledge of the remaining extent of surface mineable seams. WVGES concluded that future surface mining activity will involve the Coalburg coal zone (Coalburg, Stockton and associated riders) and/or the overlying 5 Block coal zone (includes 5 Block, 6 Block and 7 Block). Using standard geologic techniques and a geographic information system (GIS), the contour or outcrop of the Coalburg and 5-Block coals were mapped as a GIS layer for each of the USGS topographic quadrangles in the West Virginia portion of the EIS study area.

Information on areas of existing permitted surface or underground mines and previously mined out areas for each of the coal zones were obtained by WVGES from the West Virginia Division of Environmental Protection and the mining industry. The past and current mining extent was also stored as a GIS cover. OSM developed the areas of remaining coal, using the GIS, by subtracting the mined out and permitted areas from the coal zone extent GIS coverage [see Figure III.O-1].

b.2. Kentucky

KGS submitted "Estimation of Future Mountain-Top Removal Areas in the eastern Kentucky," July 2000. The report covers three surface mineable coal zones in Eastern Kentucky. The outcrop of the Richardson, Broas, and Peach Orchard coal seams were mapped in a GIS coverage. KGS selected this interval because of the historical importance and likely remaining extent of these coals.

Information on areas of existing permitted surface or underground mines and previously mined out areas for each of the coal zones were obtained by KGS from the Kentucky Department of Mines, Department for Surface Mining Reclamation and Enforcement, and the mining industry. The past and current mining extent was also stored as a GIS cover. OSM developed the areas of remaining coal, using the GIS, by subtracting the mined out and permitted areas from the coal zone extent GIS coverage [see Figure III.O-1].

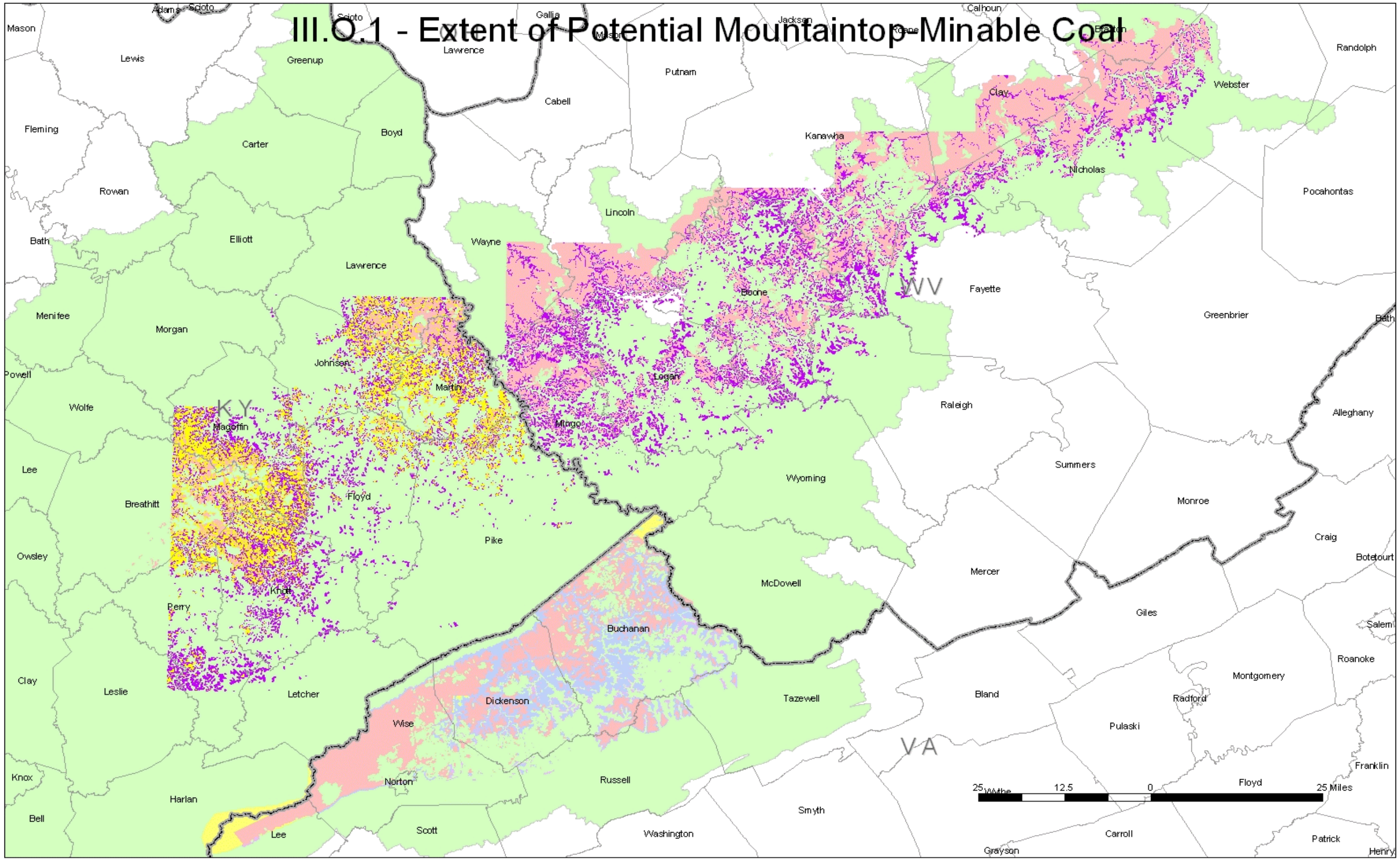
b.3. Virginia

VPI provided the report, "Estimation of South Western Virginia Reserve Base of Surface Mineable Coal," July, 2000. Five coal seams with potential for surface mining were identified based on information obtained from the mining industry and the Virginia Department of Mines, Minerals, and Energy and its Division of Mined Land Reclamation (VADMLR). The seams assessed were the Blair, Dorchester, Norton, Upper Banner, and Lower Banner. The outcrop and extent of these seams were mapped in a GIS coverage.

Information on areas of existing permitted surface or underground mines and previously mined out areas for each of the coal seams were obtained by VPI from the VADMLR and the mining industry. The past and current mining extent was also stored as a GIS cover. OSM developed the areas of remaining coal, using the GIS, by subtracting the mined out and permitted areas from the coal seam extent GIS coverage [see Figure III.O-1].

3. Geologic Extent of Remaining Mountaintop-Minable Coal in the EIS Study Area

It is very important to note that the extent of coal shown on map III.O-1 is <u>not</u> necessarily the extent of future surface mining [see Figure III.O-1]. The maps merely show the extent of coal seams that <u>could</u> be surface mined. The actual mining areas are dependent on the consistency of the coal bed, thickness, stripping ratio, coal quality, size of coal reserve block, and other factors used in site specific mining feasibility analysis. Thus, the areas that will actually be mined will likely be much smaller than the extent of the seam shown.


III.O.1 - Extent of Potential Mountaintop Minable Coal
Mason
Lewis
Adams
Scioto
Greenup
Lawrence
Gallia
Putnam
Jackson
Calhoun
Randolph
Webster
Clay
Cabell
Fleming
Carter
Boyd
Kanawha
Nicholas
Pocahontas
Rowan
Lincoln
Bath
Elliott
Wayne
Lawrence
Boone
WV
Fayette
Greenbrier
Menifee
Morgan
Johnson
Logan
Powell
Martin
Wolfe
KY
Magoffin
Mingo
Raleigh
Alleghany
Lee
Summers
Wyoming
Breathitt
Floyd
Monroe
Pike
Craig
Owsley
Botetourt
Mercer
McDowell
Knott
Perry
Giles
Buchanan
Salem
Roanoke
Clay
Leslie
Letcher
Montgomery
Dickenson
Tazewell
Bland
Radford
Wise
Pulaski
VA
Franklin
Knox
Norton
Russell
Floyd
25 Wythe
12.5
0
25 Miles
Harlan
Smyth
Bell
Lee
Scott
Washington
Carroll
Patrick
Grayson
Henry

P. DEMOGRAPHIC CONDITIONS

1. Population

From 1980 to 1990, the total population of the study area counties fell by over 140,000, from 2.11 million to 1.97 million–a 6.7 percent decrease. In contrast, the population of each of the states—with the exception of West Virginia—grew over this period. Regarding West Virginia, the study area counties lost population at a substantially greater rate than the state overall—1.4 percent per year compared to 0.7 percent per year for the state. Census estimates for 1998 indicate that the study area's population levels have slightly rebounded to total 2,014,466. Tennessee is the only state in which the study area counties have regained their 1980 population. Total population in the West Virginia study area has declined from 1990-1998, although at a slower rate than the previous decade.
With the exception of West Virginia, the study area population density of each state portion is below that of the state overall. West Virginia's study area counties show similar population densities to the state overall, which are lower than those of the other states encompassing the study area.

The population within the study area may be characterized as predominantly white and non-Hispanic. From 1980 to 1990, the majority of the counties within the study area experienced slight increases in minority levels. Statewide, West Virginia has the lowest proportion of population as minorities. On the other hand, the study area portion of West Virginia shows some of the highest percentage of minorities of all study area counties; five of the study area counties in West Virginia had more than five percent of their population as minority in 1990.

2. Education Levels

For purposes of this EIS, educational attainment was measured as the percentage of the population over age 25 that have not earned a high school diploma. Census data for 1990 indicate that the study area counties lag behind their states in educational attainment as measured by this statistic. On the positive side, educational attainment had increased from 1980 to 1990. However, only some of the study area counties were narrowing the educational gap with their state average; the counties did not show a consistently greater decrease than the state average in the percent of the population without a high school diploma.

3. Income and Poverty Levels

Income Statistics from the 1980 and 1990 Censuses indicate that the study area, as a whole, has a starkly lower income than the individual states. Just four of the sixty-nine study area counties had a per capita income exceeding its state average per capita income in 1990. Moreover, in most study area counties, per capita income grew more slowly from 1980 to 1990 than in the state. Among the states, West Virginia had the lowest per capita income in 1990 and the slowest growth from 1980 to 1990.

Another measure of economic well-being is the estimated percentage of the population with an income below the poverty level. Census statistics for 1980 and 1990 starkly depict a poverty problem throughout most of the study area. The statewide percentage of the population living below

the poverty level increased in West Virginia between 1980 and 1990. The poverty rate in all study area counties in West Virginia grew between 1980 and 1990 and in 1990 all but one of these counties had a higher poverty rate than the statewide rate of 19.7 percent. Over the entire study area, only four of the counties had a lower poverty rate than their respective state and only ten had a poverty rate below twenty percent in 1990. In twenty-four of the study area counties, over one in every three residents was estimated to live below the poverty level.

4. Analysis of Census Statistics for Select Communities

a. Introduction

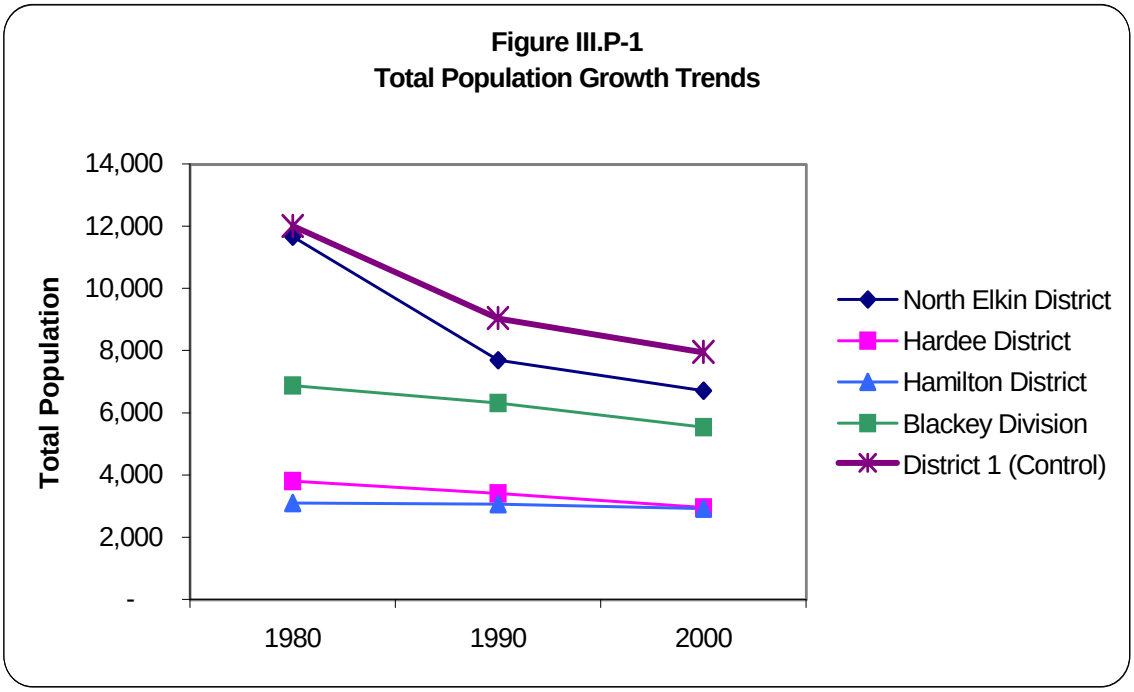
This section summarizes some of the key socioeconomic data presented in the "Case Studies Report on Demographic Changes Related to Mountaintop Mining". The purpose of this report was to evaluate what, if any, demographic changes can be observed in communities located adjacent to large-scale surface mining operations. The demographic evaluations presented for these communities were based on three decades of census data (i.e., the 1980, 1990, and 2000 decennial censuses) in order to assess the demographic trends that have occurred over time: prior to the introduction of large-scale surface mining operations adjacent to the case study community (i.e., 1980), during large-scale surface mining (i.e., 1990), and after large-scale surface mining (i.e., 2000).

The case study areas include one control area which was selected as similar to others in demographic , geographic conditions and economic resources but within which very little or no significant surface mining had taken place within the time period identified in the study. The case study communities were as follows:

- Hamilton District, community of Werth, Nicholas County, WV
- North Elkin District, community of Kyle, McDowell County, WV
- Hardee District, community of Naugatuck, Mingo County, WV
- Hardee District, community of Scarlet, Mingo County, WV
- Blackey Division, community of Carcassonne, Letcher County, KY
- District One, Wyoming County, WV as the Control Area.

b. Total Population Growth Trends

As illustrated in Figure III.P-1, the study area districts, including the control district, experienced decreases in their total populations over three mountaintop mining periods. The sharpest decrease for the North Elkin and District 1 (control community) districts occurred between the 1980 (prior) and 1990 (during) periods. The population decreases experienced by these census districts are similar to the trends enumerated for their respective counties; that is, the rate of population decline was greater over the 1980 to 1990 period than the 1990 to 2000 period. These trends may, in part, be attributed to an increase in net out-migration patterns, which is most likely associated with the downturn in the local economy that caused local residents to migrate elsewhere to seek employment opportunities.



c. Age Group Composition

Figures III.P-2 and III.P-3 illustrate that the case study communities' populations are aging. Figure III.P-2 illustrates that the proportion of school age group populations steadily decreased over the three census periods for each case study community. Combined with the overall population decline, this proportional decline indicates that the school age population as experienced an absolute increase over the two periods. While the school-age proportion of the populations has declined, the proportion that is of senior age has increased. The increase in the median age level (Figure III.P-4) for the case study communities is further evidence of this aging trend. Therefore, it is highly probable that the local communities will have a population base that is less in need of public school facilities but more dependent on transfer payments, such as social security and public assistance funds; thereby, creating a population having a decreased level of purchasing power and a greater dependence on specialized and public assistance services.

Figure III.P-2
Population Composition Trends - School Age Groups

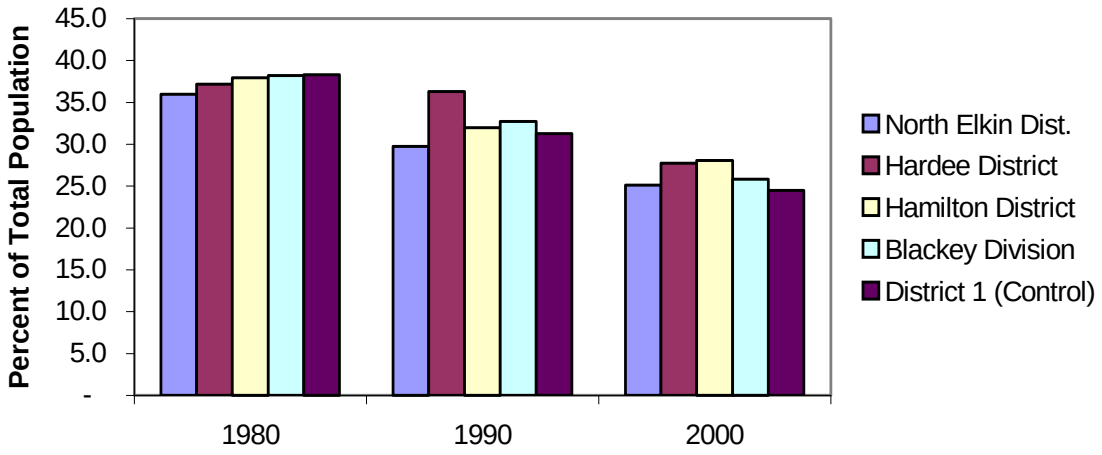
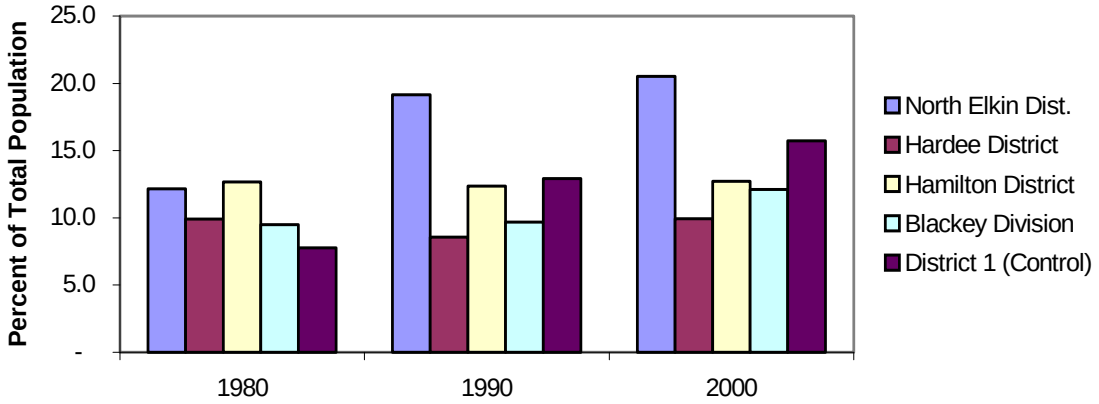
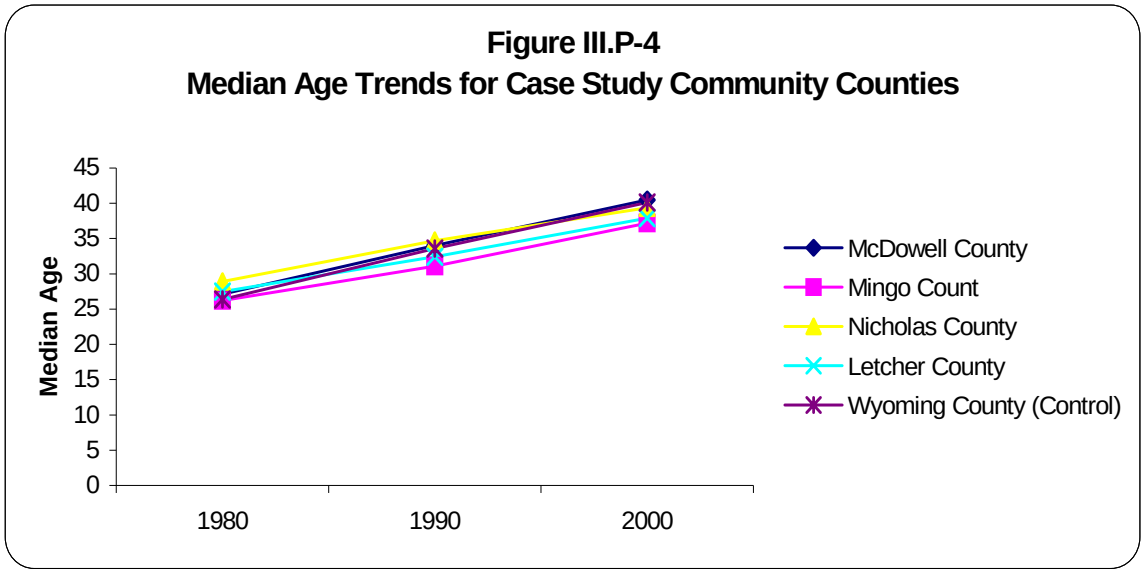


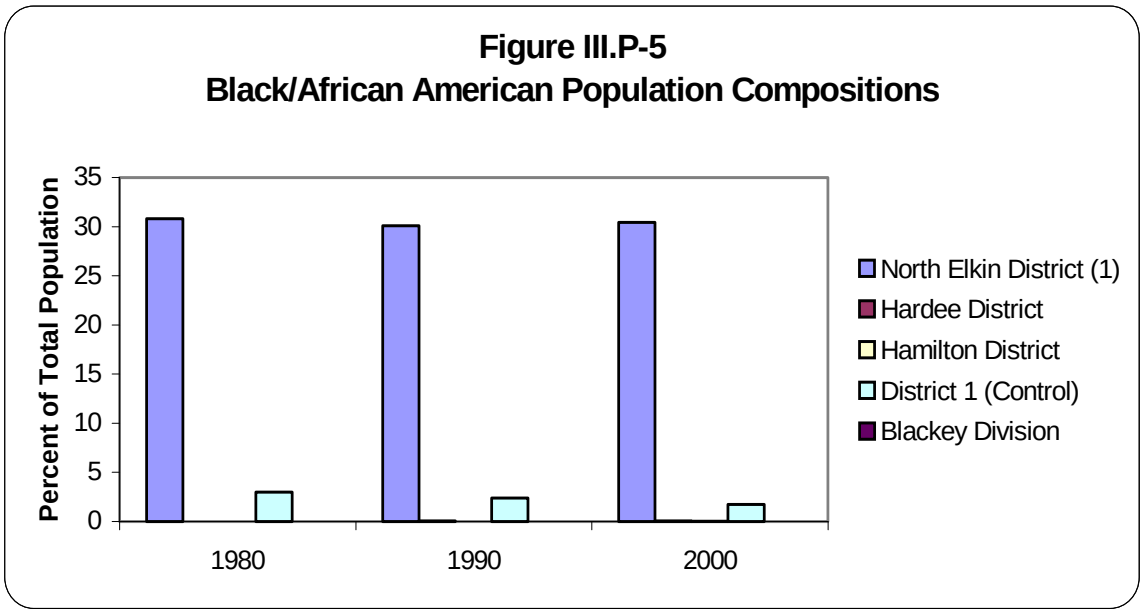
Figure III.P-3
Population Composition Trends - Senior Age Groups





d. Racial Composition

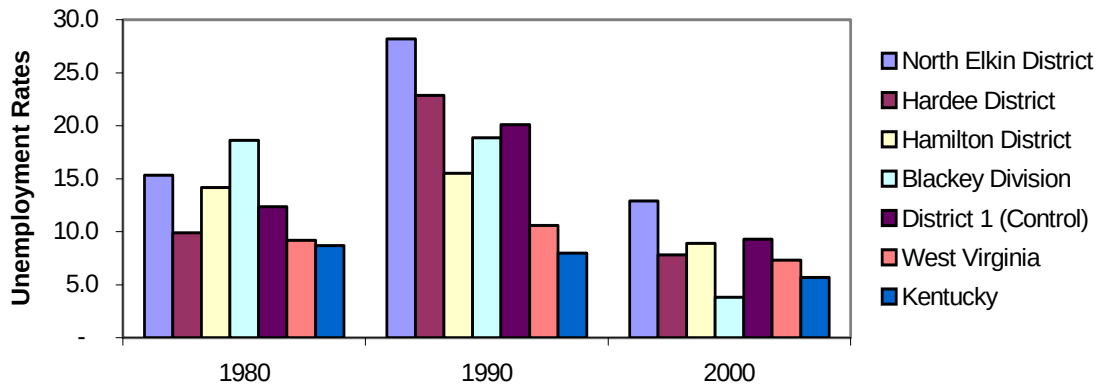
According to the 1980, 1990, and 2000 Censuses, the two largest racial groups comprising the case study communities are whites and Black/African Americans. As illustrated in Figure III.P-5, however, whites comprised a significantly larger share of the case study community populations than blacks/African Americans over the three mountaintop mining periods. The exception to this trend is noted for the North Elkin District (Kyle case study). Black/African American populations are more likely to be impacted by mountaintop mining operations in the North Elkin District compared to the remaining case study communities.



e. Poverty Levels and Unemployment Rates

Figure III.P-6 illustrates unemployment rate comparisons and trends for the case study communities and the states. With one exception (Blackey Division, KY, in 2000), unemployment rates in the communities exceed the state average unemployment rates, with the divergence being the most pronounced in 1990. Unemployment rates have decreased substantially for all studied geographic units over the 1990-2000 time period.

Figure III.P-6
Unemployment Rate Trends



Consistent with the unemployment data, poverty rates in the communities exceed the rates in their respective states for all time periods. Poverty rates increased from 1980 to 1990, but decreased for all but one community for the period 1990-2000. The movements in unemployment and poverty rates for the control community paralleled the movements for the case studies communities; thus, these data offer no evidence that the large-scale surface mining had an effect on these measures of economic well-being.

5. Environmental Justice Populations

a. Regulatory Background

Executive Order (EO) 12898 addresses how executive agencies are to consider environmental justice in their decision-making. The executive order specifies federal agency responsibilities to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. Specifically, the executive order requires federal agencies to:

- Conduct their programs, policies, and activities that substantially affect health and the environment so as not to exclude, deny benefits to, or discriminate against persons because of race, color, or national origin.

- Ensure that public documents, notices, and hearings relating to human health or the environment are concise, understandable, and readily accessible to the public.

- Whenever practicable and appropriate, collect, maintain, and analyze information assessing and comparing environmental and human health risks borne by populations identified by race, national origin, or income. To the same extent, Federal agencies shall use this information to determine whether their programs, policies, and activities have disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. Similarly, Federal agencies are to collect and analyze information on race, national origin, income level, and other readily accessible and appropriate information for areas surrounding facilities or sites expected to have a substantial environmental, human health, or economic effect on the surrounding populations, when such facilities or sites become the subject of a substantial federal environmental administrative or judicial action.

- Collect and analyze information on the consumption patterns of populations who principally rely on fish and wildlife for subsistence.

The Council on Environmental Quality (CEQ) has published guidance regarding federal agency NEPA analyses addressing environmental justice. The CEQ guidance notes that the Executive Order recognizes the importance of research, data collection, and analysis, particularly with respect to multiple and cumulative exposures to environmental hazards for low-income populations, minority populations, and Indian tribes. Thus, data on these exposure issues should be incorporated into NEPA analyses as appropriate. Second, the guidance notes that the EO requires agencies to work to ensure effective public participation and access to information. Third, the guidance references the presidential memorandum accompanying the EO, and states that the memorandum identifies important ways to consider environmental justice under NEPA.

In addition, state regulatory programs, while not specifically required to comply with EO 12898, must still comply with all federal laws that provide the statutory framework for environmental justice. To obtain federal funding, state regulatory authorities must certify to OSM that they will comply with all federal statutes relating to nondiscrimination. For example, states must certify compliance with Title VI of the Civil Rights Act of 1964 (P.L. 88-352) which "prohibits discrimination on the basis of race, color or national origin."

b. Demographic Data Pertinent to Environmental Justice Populations

Environmental Justice statistics on the study areas' populations were collected from the 1980 and 1990 Censuses. These statistics focus on three environmental justice parameters–poverty levels, per capita income levels, and minority population levels. The following narratives present statistical evidence of the degree to which the environmental justice populations exist within the study area. Note that due to programmatic nature of this EIS, it is not feasible to identify specific mining operations and any specific environmental justice populations that may be impacted.

b.1. Poverty Levels

Census statistics for 1980 and 1990 identify an environmental justice population based on the poverty level data presented in Table III.P-1, which starkly depicts a poverty problem throughout most of the study area counties located within the states of Kentucky, Tennessee, Virginia, and West Virginia. The statewide percentage of the population living below the poverty level increased in West Virginia between 1980 and 1990. The poverty rate in all study area counties in West Virginia grew between 1980 and 1990, and in 1990 all but one of these counties had a higher poverty rate than the statewide rate of 19.7 percent. Over the entire study area, only four of the counties had a lower poverty rate than their respective state and only ten had a poverty rate below twenty percent in 1990. In twenty-four of the study area counties, over one in every three residents is estimated to live below the poverty level.

A more compelling analysis of impoverished communities is detailed in the report funded by the Appalachian Regional Commission (ARC) entitled, "Recent Trends in Poverty in the Appalachian Region: The Implications of the U.S. Census Bureau Small Area Income and Poverty Estimates on the ARC Distressed Counties Designation" (2000). This report examines the Census Bureau's *Small Area Income and Poverty Estimates* effects on the ARC *distressed county* designation. According to this report, the greatest number of study area ARC distressed counties in 1980 were located in Kentucky (32 distressed counties or 65.3 percent of the state total), followed by Tennessee (16 distressed counties or 32 percent of the state total). In 1990, Kentucky continued to lead the study area states and increased its number of ARC distressed counties to 37 (75.5 percent of the state total). Tennessee, however, experienced a decrease in the number of distressed counties with only nine (18 percent of the state total) in 1990. Conversely, West Virginia experienced a significant increase in the number of ARC distressed counties; in 1990 the state had 27 distressed counties (49.1 percent of the state total).

Table III. P-1
ARC Distressed Counties by State, 1980 and 1990

State	ARC	1980 Distressed		1990 Distressed		Change	
	Counties	#	%	#	%	#	%
Alabama	35	3	8.6	7	20.0	4	133
Georgia	35	1	2.9	0	0.0	-1	-100
Kentucky	49	32	65.3	37	75.5	5	16
Maryland	3	0	0.0	0	0.0	0	0
Mississippi	21	6	28.6	13	61.9	7	117
New York	14	0	0.0	0	0.0	0	0
North Carolina	29	3	10.3	2	6.9	-1	-33
Ohio	29	2	6.9	7	24.1	5	250
Pennsylvania	52	0	0.0	0	0.0	0	0
South Carolina	6	0	0.0	0	0.0	0	0
Tennessee	50	16	32.0	9	18.0	-7	-44
Virginia	21	1	4.8	3	14.3	2	200
West Virginia	55	7	12.7	27	49.1	20	286
Total	**399**	**71**	**17.8**	**105**	**26.3**	**34**	**48**

Source: Appalachian Regional Commission, 2000

b.2. Per Capita Income

Table III.P-3 reveals that the per capita income levels of the majority of the study area counties are starkly lower than the per capita income levels of their respective states. Just four of the sixty-nine study area counties had a per capita income exceeding their respective state average per capita income in 1990. Moreover, in most study area counties, per capita income grew more slowly from 1980 to 1990 than in the state. Among the states, West Virginia had the lowest per capita income in 1990 and the slowest growth from 1980 to 1990.

b.3. Minority Populations

The population within the study area may be characterized as predominantly white and non-Hispanic. From 1980 to 1990, the majority of the counties within the study area experienced slight increases in minority levels. Statewide, West Virginia has the lowest proportion of population as minorities. On the other hand, the study area portion of West Virginia shows some of the highest percentage of minorities of all study area counties; five of the study area counties in West Virginia have more than five percent of their population as minority. The highest percentage (13.7 percent) of minorities are located in McDowell County, West Virginia.

Q. ECONOMIC CONDITIONS

1. Recent Trends in Unemployment Rates and Employment

Table III.P-2 includes a comparison of the county unemployment rates to those of the state as of 1998. Only five of the 65 study area counties had a lower unemployment rate than the state in 1998. As for the states, each state total shows consistency with the national trend of declining unemployment from 1990 to 1998. West Virginia's unemployment rate was the highest of the four states in 1990 and 1998. West Virginia's unemployment rate in 1990 was higher than in 1980. In contrast, the other study area states had lower unemployment rates in 1990 than in 1980.

The study area counties nearly all show decreases in unemployment rates from 1990 to 1998, and many of the counties show greater improvements than their state average for the period. On the other hand, many study area counties had increases in unemployment rates for the preceding period (1980-1990), or had slower improvements than the state average. Taken together, the changes for the two periods suggest that the study area counties lagged the states in the 1980's in employment improvements and have begun "catching up" in the 1990's.

Employment totals for 1990 and 1997 reveal increases in employment for all study area states in the 1990's, with Tennessee enjoying the fastest employment growth and West Virginia the slowest growth. For the preceding period (1980-1990), West Virginia saw a slight loss of jobs, while the three other states gained jobs. Many study area counties did not share in the employment growth. However, the study area as a whole gained jobs in the 1990's and all but West Virginia's study area gained jobs in the 1980's. In Kentucky, Tennessee, and Virginia, employment in the study area grew more slowly than in the state in the 1990's. In West Virginia, the study area and the state added jobs at the same rate.

ALL STATES AND EACH STATE'S STUDY AREA GAINED JOBS OVERALL BETWEEN 1990 AND 1997. MANY STUDY AREA COUNTIES, HOWEVER, DID NOT SHARE IN THE EMPLOYMENT GROWTH.

2. The Economic Role of Coal Mining

a. Coal Mining Employment

Table III.Q-1 displays mining employment statistics for the years 1980, 1990, and 1997. For the study area, most mining employment is in coal mining. The statistics reveal a decline in mining employment over both periods, with Kentucky and Tennessee experiencing an accelerating decline. Mining employment losses in West Virginia have actually slowed (but not reversed) over the period 1990-1997 compared to the previous decade. The study area portion of West Virginia saw great declines over the period 1980-1990, losing half its mining jobs. The rate of loss has slowed considerably for the period 1990-1997, and is a slower rate of job loss than the state overall. Nevertheless, in 1980, six of the West Virginia study area counties had more than 4,000 mining employees; in 1997 none of the counties had 4,000 or more employees.

DRAMATIC INCREASES IN MINE PRODUCTIVITY SINCE 1980 HAVE LED TO DRAMATIC DECREASES IN COAL MINING EMPLOYMENT, DESPITE INCREASED COAL PRODUCTION.

An examination of mine employment statistics by researchers at Marshall University's Center for Business and Economic Research (CBER 1999) points to the role of increasing productivity in the declines in West Virginia mining employment. The CBER study noted that coal production increased by 40 % over the period 1980-1998 while underground employment declined by 70% and surface mining employment declined by 50%. The study noted that average underground mining productivity in West Virginia increased from 2,100 tons per employee in 1980 to 8,000 tons per employee in 1998.

Table III.Q-1
Coal Mining Employment[1] by County

Place of Work	1980	1990	1997	Avg Annual Percent Change	
				80-90	90-97
Kentucky	58,117	39,566	26,066	-3.8	-4.1
KY Study	*38,774*	*27,199*	*NA*	*-3.5*	*-4.7*
Bell	2,052	1,383	1,007	-3.9	-3.1
Boyd	185	937	859	17.6	-0.9
Breathitt	1,094	895	137	-2.0	-17.1
Carter	164	197	113	1.9	-5.4
Clay	1,727	222	92	-18.5	-8.4
Elliott	131	L	L	NA	NA
Estill	250	178	110	-3.3	-4.7
Floyd	3,595	2,161	1,034	-5.0	-7.1
Greenup	212	48	D	-13.8	NA
Harlan	4,132	3,456	1,384	-1.8	-8.7
Jackson	37	D	D	NA	NA
Johnson	861	469	249	-5.9	-6.1
Knott	1,105	1,124	1,398	0.2	2.2
Knox	657	325	196	-6.8	-4.9
Laurel	583	367	D	-4.5	NA
Lawrence	116	170	D	3.9	NA
Lee	208	241	99	1.5	-8.5
Leslie	502	1,235	1,199	9.4	-0.3
Letcher	2,517	2,153	1,034	-1.6	-7.1
McCreary	309	10	L	-29.0	NA
Magoffin	572	189	D	-10.5	NA
Martin	3,156	1,488	1,012	-7.2	-3.8
Menifee	22	0	0	-100.0	0.0
Morgan	304	35	24	-19.4	-3.7
Owsley	51	16	D	-10.9	NA
Perry	2,808	2,369	1,203	-1.7	-6.6
Pike	9,954	6,427	5,236	-4.3	-2.0
Powell	57	0	36	-100.0	0.0
Pulaski	262	166	131	-4.5	-2.3
Rockcastle	21	16	D	-2.7	NA
Rowan	0	0	12	0.0	0.0
Wayne	92	14	17	-17.2	2.0
Whitley	1,021	889	230	-1.4	-12.6
Wolfe	17	19	D	1.1	NA

Table III.Q-1
Coal Mining Employment by County
(Continued)

Place of Work	1980	1990	1997	Avg Annual % Change	
				80-90	90-97
Tennessee	11,160	8,859	6,654	-2.3	-2.8
TN Study	*5,144*	*2,704*	*1,308*	*-6.2*	*-7.0*
Anderson	511	266	169	-6.3	-4.4
Bledsoe	L	L	0	NA	NA
Campbell	997	433	353	-8.0	-2.0
Claiborne	684	489	117	-3.3	-13.3
Cumberland	462	352	273	-2.7	-2.5
Fentress	132	87	44	-4.1	-6.6
Grundy	64	64	16	0.0	-12.9
Marion	724	120	85	-16.5	-3.4
Morgan	150	104	52	-3.6	-6.7
Overton	95	78	D	-2.0	NA
Roane	221	123	27	-5.7	-14.1
Scott	1,021	334	58	-10.6	-16.1
Sequatchie	83	254	114	11.8	-7.7
Van Buren	0	0	0	0.0	0.0
Virginia	24,740	18,043	13,331	-3.1	-3.0
VA Study	*20,799*	*12,454*	*8,027*	*-5.0*	*-4.3*
Buchanan	7,920	5,002	2,990	-4.5	-5.0
Dickenson	2,598	1,566	627	-4.9	-8.7
Lee	488	345	483	-3.4	3.4
Russell	1,692	871	630	-6.4	-3.2
Scott	58	22	35	-9.2	4.8
Tazewell	2,646	962	754	-9.6	-2.4
Wise	5,397	3,686	2,508	-3.7	-3.8

Table III.Q-1
Coal Mining Employment by County
(Continued)

Place of Work	1980	1990	1997	Avg Annual 80-90	Avg Annual 90-97
WV	67,617	41,793	28,826	-4.7	-3.6
WV Study	*44,358*	*22,248*	*16,643*	*-6.7*	*-2.9*
Boone	5,813	3,826	3,116	-4.1	-2.0
Braxton	190	480	39	9.7	-22.2
Clay	276	233	D	-1.7	NA
Fayette	1,634	857	625	-6.3	-3.1
Kanawha	6,938	2,614	2,296	-9.3	-1.3
Lincoln	159	275	279	5.6	0.1
Logan	5,092	2,750	1,902	-6.0	-3.6
McDowell	7,601	1,665	908	-14.1	-5.9
Mingo	2,724	3,057	2,713	1.2	-1.2
Nicholas	3,337	1,564	593	-7.3	-9.2
Raleigh	5,117	2,423	1,836	-7.2	-2.7
Wayne	249	318	521	2.5	5.1
Webster	237	364	486	4.4	2.9
Wyoming	4,991	1,822	1,329	-9.6	-3.1

Notes:
[1]Includes surface mining, underground mining and coal mining services.
[2]Study area subtotal includes a small number of jobs not disclosed for one of the counties.

D = estimate not shown to avoid disclosure of confidential information
L = estimate less than 10 jobs
Source: U.S. Bureau of Labor Statistics

Table III.Q-2 displays the economic role of mining as measured by the percentage of total employment and earnings directly attributed to coal mining. The table indicates that, at the state level, mining employment and earnings are not significant in Tennessee and Virginia and are slightly over one percent for Kentucky. Although far from its past prominence, mining continues to play a notable role in West Virginia, accounting for over three percent of that state's total employment and over five percent of total earnings. At the county level, mining can be an extraordinarily prominent economic sector. In 1998, mining made up more than ten percent of employment and personal earnings in a number of the study area counties. The higher proportions for earnings compared to employment reflect the high wages in mining. It should be noted that employment earnings are only a portion of all income in a given county. Other income sources include interest, rent, dividends, pensions, and government transfer payments such as social security.

b. Economic Multiplier Impacts of Coal Mining

The economic role of coal mining is understated by these percentages. Coal mine operators purchase goods and services from other firms and coal miners spend much of their wages on goods and s0ervices sold in their regions and states. These purchases have a multiplier effect on the regional and state economies. The Marshall University Center for Business and Economic Research (CBER) study (Marshall University, 2000) used IMPLAN economic multipliers for West Virginia to examine the impacts of coal mining on the state's economy. According to these multipliers, every direct job in coal mining in 1996 supported two other jobs in the state. In terms of the value of output, every dollar's worth of coal production supported an additional 52 cents in sales in the other sectors of the state economy.

Boone County, West Virginia, is an extreme example of how much one county's economy can depend on coal. Coal mining accounted for approximately one-third of all employment in Boone County in 1998. Marshall University's study estimates that the 30.6 million tons of coal produced in Boone County in 1997 supported 5,032 direct and multiplier jobs, $308.3 million in wages at these jobs, and $985 million in output. These direct and multiplier figures attributed to coal, amount to over half of all jobs, two-thirds of all wages, and over four-fifths of the total value of output for the county.

It is worth repeating that Boone County is a very extreme case of a coal dependent economy. Moreover, the statistics quoted above for Boone County apply to all coal mining, while the majority of mining employment in Boone County is in underground mining. No part of the study area is nearly as dependent on mountaintop mining as Boone County is dependent on coal mining in general.

There are a few ways to express the Boone County impacts in terms of unit impacts. At the rates used in the CBER analysis, every million tons of coal produced in Boone County supported 164 jobs, over $10 million in wages, and over $32 million in total output in the county. Expressed as economic multipliers, every direct coal mining job supported another 0.7 of a job elsewhere in the county. Every dollar of coal output supported another 34 cents in output in other sectors of the county economy. As expected, the multiplier effects for the county are lower than those for the state because businesses and individuals make a smaller proportion of their purchases within the county than they do within the state.

Table III.Q-2
Coal Mining Employment and Earnings Percentages

Location	Mining as Percent of Total	
	1998	
	Employment[1]	Earnings[2]
Kentucky	1.2	1.8
Bell	7.5	D
Boyd	D	D
Breathitt	D	D
Carter	D	D
Clay	D	D
Elliot	D	1.5
Estill	D	D
Floyd	9.3	11.9
Greenup	D	0.8
Harlan	12.6	23.0
Jackson	D	0.0
Johnson	2.9	4.0
Knott	26.6	41.8
Knox	1.9	D
Laurel	D	D
Lawrence	D	D
Lee	3.3	0.3
Leslie	D	D
Letcher	13.1	D
McCreary	D	D
Magoffin	6.4	10.1
Martin	26.5	D
Menifee	D	0.0
Morgan	D	0.2
Owsley	D	D
Perry	7.8	D
Pike	17.0	28.0
Powell	D	0.0
Pulaski	D	D
Rockcastle	D	0.0
Rowan	D	1.2
Wayne	D	0.0
Whitley	1.0	1.4
Wolfe	D	0.0

Table III.Q-2
Coal Mining Employment and Earnings Percentages
(Continued)

Location	Mining as Percent of Total	
	1998	
	Employment	Earnings
Tennessee	0.2	0.1
Anderson	0.3	0.3
Bledsoe	0.0	0.0
Campbell	1.8	3.2
Claiborne	D	1.4
Cumberland	D	0.7
Fentress	D	0.2
Grundy	D	0.3
Marion	D	D
Morgan	0.8	D
Overton	D	0.0
Roane	D	0.2
Scott	D	D
Sequatchie	2.8	D
Van Buren	D	0.0
Virginia	0.3	0.3
Buchanan	20.5	33.4
Dickenson	14.9	22.5
Lee	4.3	8.5
Norton	D	D
Russell	4.7	9.9
Scott	D	0.9
Tazewell	3.5	5.0
Wise	D	D
West Virginia	3.3	5.4
Boone	33.0	59.7
Braxton	0.7	0.0
Clay	D	D
Fayette	3.8	D
Kanawha	1.7	2.2
Lincoln	6.2	1.9
Logan	12.1	23.5
McDowell	12.6	D
Mingo	24.2	42.1
Nicholas	5.6	17.0
Raleigh	5.0	10.3
Wayne	16.4	8.6
Webster	15.3	31.0
Wyoming	18.4	34.5

D = Information not Disclosed or Less than $50,000 or 10 jobs.
[1]Employment recorded by county of work, not of residence
[2]Earnings data is reported by place of work and includes wage and salary disbursements, other labor income, and proprietor's income. It does not include dividends, interest, rent or transfer payments, which together account for as much as one-half of income in a county.
Source: U.S. Bureau of Economic Analysis, 1997

The economic impact of mining extends beyond the county where the mine is located. It is common among coal miners to commute long distances to jobs. Thus, while the published employment figures indicate where the wages are earned, they do not reflect where they are spent. In addition, the businesses that provide inputs to the coal industry can be located in other counties or states.

c. Mining-Related Tax Revenues

Coal production provides tax revenues to state and local governments directly through severance taxes and indirectly through royalty payments on public lands, income taxes, property taxes, and federal Reclamation Fund fees. A severance tax is essentially an excise tax imposed on the present and continuing privilege of removing, extracting, severing, or producing a mineral. State and local governments generally levy severance taxes in the form of a percent of the value of the resources removed or sold. Severance tax receipts usually are dependent on energy prices, hydrocarbon production levels, and state and local severance tax rates (EIA 1997). Throughout the study area, coal severance taxes are an important source of revenue for state and local governments and school districts.

COAL PRODUCTION PROVIDES TAX REVENUES TO STATE AND LOCAL GOVERNMENTS DIRECTLY THROUGH SEVERANCE TAXES AND INDIRECTLY THROUGH ROYALTY PAYMENTS ON PUBLIC LANDS, INCOME TAXES, PROPERTY TAXES AND FEDERAL RECLAMATION FUND FEES.

Coal production supports abandoned mine land reclamation projects and the United Mine Workers Combined Benefit Fund through the Special Reclamation Fund fee levied under SMCRA Section 402. Surface mined coal is levied a fee at a rate of 35 cents per ton; underground mined coal is levied a fee at a rate of 15 cents per ton. Half of these revenues are supposed to be returned to the state in which the coal was produced, to be used in funding reclamation or acid mine drainage abatement projects at abandoned mines. However, an ongoing controversy over federal congressional management of the AML Fund surrounds the continuing accrual of “excess” funds into the account as collections substantially exceed distributions from the fund. Although the management concerns exist, a significant amount of money does flow to the study area states from the fund. In FY 1999, more than 47 million dollars went to AML programs in the study area states. Kentucky received 22.7 million dollars, West Virginia received 20.2 million dollars, Virginia received 4.4 million dollars, and Tennessee received 0.1 million dollars (OSM Annual Report 1999).

c.1. Kentucky

Kentucky’s severance tax rate for coal is 4.5 percent of the gross value of all coal severed and/or processed, with a 50 cent per ton minimum. In 1998, the effective severance tax rate as a percent of the price of coal averaged 4.3 percent. The state collected 186 million dollars in coal severance taxes in that year, accounting for three percent of the general revenue fund and approximately 1.3 percent of total state revenues (Commonwealth of Kentucky, Office of the Controller 1999).

The continued decline in coal prices produced a reduction in receipts received from energy severance taxes. For example, Kentucky collected 203.3 million dollars in fiscal year 1992-93 and 186.1 million dollars in fiscal year 1997-98. Although still an important source of revenue-particularly for local governments–the reliance on coal severance tax receipts has generally declined.

The state established the Local Government Economic Development Fund to provide coal severance tax revenue grants to coal producing counties to assist in the diversification of their local economies. Each coal producing county is allotted a portion of the fund money for use exclusively in that county, and a portion is set aside for multi-county or regional projects. The fund has grown to 82 million dollars in 1997. The percentage of coal severance taxes returned to counties from the fund has increased from 12 percent in 1992 to 31 percent in 1998.

c.2. Virginia

Virginia's local coal and gas road improvement tax and natural gas severance tax are used to provide funds for economic development loans through the Virginia Coalfield Economic Development Authority. According to the Authority's 1998 annual Report, six projects received loans totalling over 3.1 million dollars and six projects received grants totalling 270,000 dollars.

c.3. West Virginia

The major categories of revenue for the West Virginia state government include the General Revenue Fund, the State Road Fund, lottery funds, federal funds and special revenue funds. The General Revenue Fund includes funds from income tax, sales tax, business and occupation taxes and the Natural Resource Severance Tax. The severance tax is levied as a 5 percent privilege tax on the gross receipts on the sale of the product severed. Ninety percent of severance tax revenues come from coal production. Severance tax receipts are allocated to the General Revenue Fund (77 percent), the State Infrastructure Fund (13 percent), local governments (8 percent), and the State Division of Forestry (2 percent). (West Virginia State Budget Office 2000). Based on estimates by the State Budget Office, coal severance taxes contribute roughly five percent of the General Revenue Fund. Recent and projected severance tax receipts are shown in Table III.Q-3.

Approximately 80 percent of severance tax revenues are distributed to local governments. One-fourth of this amount is distributed among municipalities in proportion to population and the remaining three-fourths is reserved for distribution among the coal producing counties in proportion to value of coal production.

Coal mining also contributes to public finance through other taxes, including the various property taxes and income taxes. Property taxes related to active coal mines contributed approximately 43 million dollars statewide in the past fiscal year. Taxes collected on the assessed value of coal reserves contributed another 14 million dollars. Combined, these property taxes accounted for approximately 34 percent of all property taxes collected statewide. Property taxes are a major income source for county governments and school districts in West Virginia. Approximately 68 percent of property tax revenues are allocated to schools and these revenues account for roughly 30 percent of the typical school district budget (Muchow 2000).

Table III.Q-3
West Virginia Severance Tax Receipts, 1997-2003

Fiscal Year	Severance Tax Receipts ($ million)
1997	176.9
1998	175.2
1999	148.4
2000*	161.5
2001*	145
2002*	139.5
2003*	133

* = Projected
Source: West Virginia State Budget Office 2000.

Boone County is an example of a county with a considerable role for coal in its finances. Approximately 4 million dollars in property tax revenue is directly linked to coal production (approximately 10% of its school district budget) and the county received 2.2 million dollars in severance tax distributions in the previous fiscal year (Muchow 2000).

d. The Economic Role of Surface Coal Mining

As labor productivity improved between 1970 and 1997, the number of miners fell by 2.1 percent per year on a national average level and 4.9 percent in the study area. The numbers of miners in surface mining and all coal mining in the study area are displayed in Table III.Q-4 below.

The table illustrates a substantial decrease in the number of miners between 1989 and 1998. In all states and regions shown, the rate of decline in the number of surface miners is less than that of all miners, indicating that the numbers of underground miners have fallen even more notably than the numbers of surface miners. With productivity improvements expected to continue through 2020, the EIA projects a further decline of 1.3 percent a year in the number of miners in the U.S. (EIA, 2000).

Table III.Q-4
Average Number of Coal Miners

Region	1998		1989		Avg. Annual % Change (1989-1998)		Surface Miners as % of Total	
	All Mines	Surface Mines	All Mines	Surface Mines	All Mines	Surface Mines	1998	1989
Eastern Kentucky	14,617	5,164	24,620	8,034	-5.6	-4.8	35%	33%
West Virginia Total	17,167	4,019	29,482	6,434	-5.8	–5.1	23%	22%
So. West Virginia	13,028	3,507	19,202	4,810	-4.2	-3.4	27%	25%
Tennessee	517	244	1,857	386	-13.2	-5.0	47%	21%
Virginia	5,734	1,108	10,371	1,482	-6.4	-3.2	19%	14%
Study Area	38,035	10,535	66,330	16,336	-4.7	-4.0	28%	25%

Source: U.S. Department of Energy, Energy Information Administration. 2000. *Coal Industry Annual 1998.*

SLIGHTLY OVER ONE IN THREE EASTERN KENTUCKY COAL MINERS IN 1998 WAS A SURFACE MINER, WHILE JUST OVER ONE IN FOUR MINERS IN SOUTHERN WEST VIRGINIA WAS A SURFACE MINER.

The table displays that surface mining employs a minority of the coal miners in the study area. Slightly over one in three eastern Kentucky coal miners in 1998 was a surface miner, while just over one in four miners in southern West Virginia was a surface miner. In 1988, approximately one in five miners in southern West Virginia was a surface miner. The more rapid declines in underground mining employment have increased the share of surface miners in total mining employment for all states and regions shown.

Data from the West Virginia Bureau of Employment Programs were used to estimate the proportion of total mining employment in the West Virginia study area counties which corresponds to surface mining. Use of the category "surface mining" is essentially equivalent to "mountaintop mining" for the West Virginia study area counties. Surface mining employment data were not identified for the counties in the other study area states and were not available for all study area counties in West Virginia.

According to the West Virginia Bureau of Employment Programs, approximately 23 percent of bituminous coal mining employment in Boone County was engaged in surface mining in 1998 and 37.5 percent of all employment in the County was in coal mining, including coal mining services. Combining these percentages yields the statistic that 8.6 percent of Boone County employment in 1998 was directly related surface mining. Surface mining proportions for the other West Virginia counties with available data are shown in Table III.Q-5

The data in Table III.Q-5 indicate that, as measured by percent of workers, surface mining is particularly important in the economies of Boone, Logan, and Mingo counties. Although not shown directly in the table, underground mining is a major source of employment in Boone, McDowell, Mingo, and Wyoming counties.

Table III.Q-5
West Virginia Surface Mining Employment, 1998

	All Coal Mining	Surface Mining Employment	
County	% of All Employment	Percent of Bituminous Mining Employment	Percent of Total County Employment
Boone	37.5	22.8	8.6
Fayette	4.6	61.2	2.8
Kanawha	1.1	53.2	0.6
Logan	13.2	58.6	7.6
McDowell	15.7	12.3	1.9
Mingo	29.1	37.7	11.0
Nicholas	7.1	30.0	2.1
Raleigh	5.9	7.8	0.5
Wyoming	21.9	1.4	0.3

Source: West Virginia Bureau of Employment Programs, 1999

3. Economic Projections

a. Central Appalachia Baseline Coal Economy Projections from EIA and University of Kentucky

The year 2001 Energy Information Administration (EIA) baseline scenario forecast for central Appalachia (the coal production region that encompasses the study area exclusive of Tennessee) projects a modest (4.8 percent) decline in coal production, combined with a considerable (14.2 percent) fall in prices over the period 1997 to 2010. The two decreases combine for an 18.3 percent decrease in coal sales and a projected loss of 7,700 coal mining jobs (Univ. of Kentucky Center for Business and Economic Research 2000, p.115).

This direct employment loss is estimated as corresponding to a 2.4 percent decline in employment in the central Appalachian region. The associated earnings loss is estimated as accounting for a 3.4 percent decline in earnings in the region (Univ. of Kentucky Center for Business and Economic Research 2000, p.117). The University of Kentucky study applied economic multipliers to the direct employment changes to estimate a 6.5 percent decrease in all jobs (directly and indirectly related to coal mining) and a 6.1 percent decrease in total earnings (Univ. of Kentucky Center for Business and Economic Research 2000, p.120).

b. Marshall University Study for the West Virginia Senate Finance Committee

A study commissioned by the West Virginia Senate Finance Committee and conducted by Marshall University's Center for Business and Economic Research found a similar result for a nine-county study area in southern West Virginia. The Marshall University study examined economic impacts of three different coal production scenarios for a one-year period (2000). Their baseline forecast projects a one percent decline (1,646) in total private sector employment resulting from an approximately seven percent decline in coal production. Their county-by-county analysis projected greatly varying results among counties, with some projected to actually gain employment, and others to lose as much as 7.8 percent of total employment as a result of a decrease in mining jobs and associated multiplier jobs (Marshall University CBER 2000).

The Marshall University study and the University of Kentucky study reported above focus on the coal-mining economic impacts. The losses projected in these studies are the jobs and earnings that would be subtracted from these economies due to coal mining losses. These studies do not project actual total employment and earnings changes, net of other economic changes. Indeed, there are other economic forces at work that are projected to bring new economic base jobs and associated multiplier employment. The direct and multiplier losses reported in these studies indicate the extent to which the mining losses place a drag on the subject economies. That is, they measure (very roughly) how many more jobs the economy would have gained, had the mining jobs not been lost. The West Virginia statewide economic outlook described below illustrates a projection of a net overall positive change in the statewide economy, despite considerable losses in coal mining.

c. Statewide Overall Economic Forecasts

A 10-year forecast in the West Virginia Economic Outlook (WVU BBER 2000) calls for a continuation of the recent trend of slower growth in the state. The forecast calls for West Virginians to be better off (in terms of real per capita personal income) in 2010 than they are now. The forecast also suggests that state growth will fall short of that expected for the nation. This slowed relative growth implies a widening per capita personal income gap with the nation in coming years.

The long-term outlook for job growth calls for modest annual gains through 2010, with state job growth falling well short of national growth. All net job gains are expected to come in the service-producing sectors, with goods-producing jobs continuing their downward slide. Mining jobs (especially coal mining) are expected to drop at a swift pace. (WVU BBER 2000)

Job growth in construction is expected to be slower during the next 10 years than it was during the 1990s. The outlook also calls for manufacturing jobs to decline, although at a slower pace than during the previous 10-year period. This slowdown in manufacturing job losses is primarily due to job gains in durable manufacturing (especially lumber and wood products and transportation equipment). Nondurable manufacturing jobs decline during the forecast, as job losses in chemical products and apparel overwhelm gains in printing and publishing and food products. (WVU BBER 2000)

A large factor in the overall job growth slowdown during the forecast is the deceleration in job growth in services. This sector is expected to remain the fastest growing industry in the state (in terms of generating jobs), but that growth is likely to be slower than it has been. The slowdown is

expected to permeate all services sectors, including business services, health care services, social services, and membership organizations. The forecast calls for business services (which has produced very strong job gains this decade) to continue to lead the pack in services job growth during the next 10 years. Further, travel-related services are likely to continue to grow in the state. (WVU BBER 2000)

The forecast calls for the state's population to register moderate losses during the forecast, as slow job and income growth are insufficient to stem outmigration. Finally, the forecast calls for the unemployment rate to stabilize in the 5.5-6.0 percent range. (WVU BBER 2000)

R. LAND USE AND POTENTIAL DEVELOPMENT

1. Historical and Current Land Uses

The two most important features of the study area in determining land uses are the natural landscape and the ownership of rights to the potentially mineable coal beneath the land surface. The steep slopes and the narrow, flood prone river valleys severely constrain the available supply of developable land. Most of the land is in forest cover and human occupation is generally concentrated in stream valleys.

a. Current Land Uses, Study Area Overall

The overwhelming land use in the study area is forest which covers approximately 11 million acres or 92 percent of the approximate 12 million acre study area. Deciduous forests cover over 9 million acres or 79 percent of the study area. Mixed deciduous and evergreen forest comprise 9 percent of the study area. Developed areas (residential, commercial and industrial) account for about 1 percent of the study area.

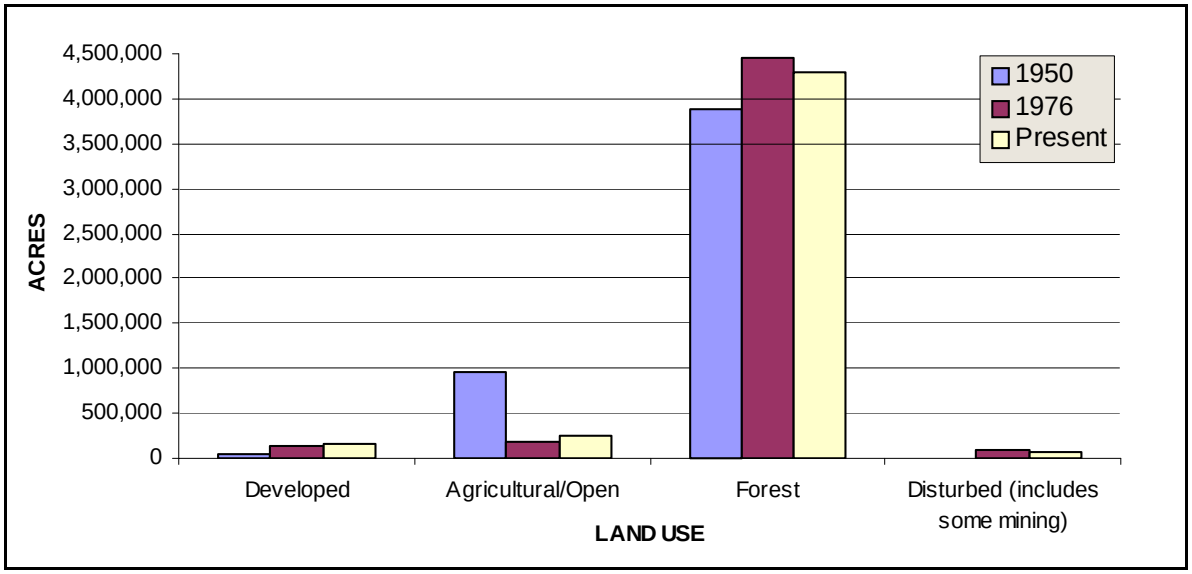
b. Current Land Uses, West Virginia Study Area

The *West Virginia University Land Use Assessment* (2002) was conducted to examine land use issues associated with mountaintop mining in the 14 county study region of southern West Virginia. The results were derived from a classification of recent Landsat satellite data. The satellite data were classified and converted to a GIS (geographic information system) coverage for analysis and display. Results confirm the forested/lightly developed character of the West Virginia mountaintop mining region. Almost 88%, or slightly over four million acres, was classified as mature forest land with the diverse mesophytic forest type being most prevalent at almost three million acres of area. All developed land uses (intensive urban, moderately intensive urban, light urban, populated areas, major roads, and infrastructure such as power lines) accounted for 155,000 acres or roughly three percent of the land area. Agricultural land uses were found on approximately a quarter of a million acres or five percent of the land area. Other general land use/land cover categories include: shrub land and woodland areas with slightly over 63,000 acres; water/wetlands with 56,000 acres or one percent of the land area; and barren land – mining being 74,000 acres or 1.5% of the study area.

c. Patterns of Land Use Changes, West Virginia Study Area

Figure III.R-1 presents general land use/land cover changes for the 14 county West Virginia study area examining three different time periods – 1950, 1976, and 2001 (“current conditions”). Data for 1950 were obtained from detailed paper maps that were compiled during a four-year land cover-mapping project that was completed by the U.S. Forest Service for West Virginia. The 1976 data source is the USGS GIRAS land use data that were digitized by USGS from 1976 vintage 1:48,000 scale aerial photography. The current data are from the results of the WVU – NRAC satellite data classification effort.

Figure III.R-1
Land Use Characteristics for the West Virginia Study Area



Source: WVU 2002, *West Virginia Land Use Assessment*

An analysis of the data from these three periods reveals the following general patterns of land use change in the region:

- The acreage of developed area increased from 42,533 acres in 1950 to 154,966 acres currently. This acreage probably does not include much of the dispersed development that dominates the region.
- Agricultural acreage *decreased* from almost a million acres in 1950 to 188,000 acres in 1976 and then *increased* to 246,000 acres by 2001. Much of the acreage increase in this second period is due to coal mining and reclamation that converted areas from existing forest land to grassland/pasture.
- Forest areas increased from under four million acres in 1950 to almost 4.5 million acres in 1976 and then fell to under 4.3 million acres by 2001. The current loss of forest land is due to patterns in mine reclamation converted land from forest to open–grassland/pasture and to new urban development in the region.
- Disturbed areas increased from just over 3,000 acres in 1950 to a high of 85,000 acres in 1976 and over 73,000 acres currently. This acreage are areas that were not vegetated in those time periods. Lands that are not vegetated and otherwise fit in no other categories are classified as "disturbed". Revegetated mined lands would not fall under this category.

A separate estimation of the extent of mining was developed by WVU for the land use study because other sources generally significantly underestimate mined areas by placing reclaimed areas into other land use/land cover categories such as grassland/pasture and forest. A compilation of various data sources indicate that over 244,000 acres or approximately 5% of the West Virginia mountaintop mining study area contains evidence as having been disturbed by past or current mining. Mining related land uses are the second most prevalent land use/land cover in the region – after forest land.

This total includes a number of different mine types – unreclaimed abandoned mines, unreclaimed mines with forfeited bonds, reclaimed mines (where the resulting post-reclamation land use allowed for identification and delineation), and active mines. Again it is probable that significant mined areas were undetected by the various data sources, as well as subsequent checking and verification. Also, this estimate does not include areas that have been fully reclaimed or converted to a post-mining land use or off-site impact areas such as clogged stream channels.

2. The Role of Land and Mineral Ownership

In many coal producing areas, the surface and subsurface ownership rights are held by different parties. This separation became a source of conflict with the growth of surface mining because the removal of the mineral entails destruction of surface uses and structures. SMCRA requires the permission of the surface owner or explicit rights by deed or contract as a prerequisite to processing a permit application.

Because the economics of coal production favor large scale operations, it is common for coal mining interests to control potentially mineable land in large blocks. These owners may be land companies that own the land for the purpose of collecting royalty payments from coal mining companies, coal mining companies themselves, diversified fuel conglomerates, electric utilities, or others. When the potential value of the underlying coal is greater than the return from surface development of the land, mineral owners have an incentive to prevent land development (Miller 1974).

Concentration of mineral ownership and associated limitations to the availability of developable land occur in the study area. For example, a study in West Virginia in 1974 found that 23 owners owned 91 percent of surface acreage in Boone County, 17 owners controlled 59 percent of Fayette County, and six major landowners owned 23 percent of the acreage in Kanawha County (Miller, 1974). The Mountain Association for Community Economic Development (MACED) examined private mineral ownership maps and deeds for Letcher County, Kentucky in 1998. MACED found that eighteen owners (sixteen corporations and two private individuals) owned mineral rights in at least 65 percent of the county's land mass of 217,000 acres (MACED 1999). The 65 percent is a minimum because information on parts of the county was not available to MACED. Few of the owners were located regionally. Several of the top owners were based outside of the Appalachian region.

3. Land Use and Economic Development Planning

The region's economic dependence on its exhaustible coal resources, its need to diversify, and its need to further develop the human resources and infrastructure to support economic development are widely recognized. Most leaders are also keenly aware that its coal resources are its best source of leverage for investments needed to build an economy that can continue to flourish after the inevitable decline of coal mining. The collection and distribution of coal related taxes was described in section III.Q. This subsection describes the institutional framework for economic development planning and promotion.

There are a number of agencies at the regional level which address planning and development issues within the study area. Regional agencies include those created at the federal level, such as the Appalachian Regional Commission (ARC) and those created at the state level such as Kentucky's Office of Coal County Development. The following is a brief overview of these agencies.

a. Appalachian Regional Commission (ARC)

ARC was established by Congress in 1965 to support economic and social development in the Appalachian Region. ARC undertakes projects that address five goals: 1) developing a knowledgeable and skilled population; 2) strengthening the region's physical infrastructure; 3) building local and regional capacity; 4) creating a dynamic economic base; and 5) fostering healthy people.

To meet these goals, ARC helps fund such projects as education and workforce training programs, highway construction, water and sewer system construction, leadership development programs, small business startups and expansions, and the development of health care resources. ARC's area development funding functions include the Distressed Counties Program, which provides special funding for the region's poorest counties. Forty-seven of the study area's 69 counties are designated as "distressed counties" for fiscal year 1999.

ARC works with the states to support a network of multi-county planning and development organizations, or local development districts (LDDs). The LDDs most important role is to identify priority needs of their local communities.

b. Kentucky

In 1997, the state of Kentucky created the Office of Coal County Development to assist coal producing counties in diversifying their economies beyond coal. The Office of Coal County Development is charged with overseeing the Local Government Economic Development Fund (LGEDF). This fund, described briefly in section III.Q, distributes coal severance tax revenues. The principle economic development planning functions in eastern Kentucky are carried out by the Area Development Districts (ADD).

c. Virginia

The Virginia Area Development Act authorized the establishment of twenty-one planning district commissions in the state. Of the twenty-one, two serve the seven counties and one city within the Virginia coalfield area. Examples of planning district commisstion projects range from recreation programs to zoning and comprehensive planning assistance.

d. West Virginia

The land use planning function in West Virginia, when it is carried out at all, has usually been carried out by ad hoc boards and commissions, which are not integrated into local policy development or decision making. Planning has not been internalized as a central policy or program concern of local government. A number of counties have no planning commission and, of those that do, some have no staff and no effective power. Only some of the counties have adopted comprehensive plans, zoning ordinances, or subdivision/land development ordinances. There is a consensus for local planning in the three more heavily developed counties in the region – Fayette, Kanawha, and Raleigh Counties, but not in a majority of the region. Within the counties, there are several incorporated municipalities that have adopted various levels of planning functions and controls.

At the state level, the West Virginia Development Office has a number of functions relating to economic development in the study area. The Community Development Division administers a variety of state and federal programs to help develop human resources and install public utilities, access roads, buildings, streets, sidewalks and other public improvements.

Enrolled Senate Bill 681 of 1999 established the Office of Coalfield Community Development within the West Virginia Development Office. Among other duties, the office is responsible for overseeing the preparation of community impact statements by coal operators and for coordinating the preparation of coal field community development statements.

Local communities (even those with active planning) do not really have much direct control over post-mining land use planning and reclamation. However, post-mining land use compatibility with community zoning or subdivision ordinances may be evaluated by the SMCRA regulatory authorities. Local planning and ordinances may be considered during WVDEP's review of the mining permit and proposed post-mining land use plans (WVU Land Use Assessment 2001).

4. Land Use Needs and Development Potentials

a. Intensive Human Use

Two of the factors most often cited as hindering economic development in Central Appalachia are the rugged terrain and the poor access. The Appalachian Regional Commission has been attacking the access limitations since its inception in the 1960s, with an aggressive highway funding program. Access to much of the study area has improved over the years, although not all counties are readily accessible. The steep slopes and narrow, flood prone valleys have limited the availability of land parcels suitable for large scale development. The provision of large parcels of flat to gently sloped terrain is therefore sometimes cited as a positive potential side effect of mountaintop removal and steep slope AOC variance reclamation. The usefulness of such flattened land is dependent on the presence of other factors supportive of development, such as infrastructure and excess market demand for developable land.

THE STEEP SLOPES AND NARROW, FLOOD PRONE VALLEYS HAVE LIMITED THE AVAILABILITY OF LAND PARCELS SUITABLE FOR LARGE SCALE DEVELOPMENT.

An analysis of West Virginia region-wide land development potentials, limitations, and demands was completed as part of the WVU Land Use Assessment study using the Clarke Urban Growth Model (WVU Land Use Assessment 2001). The results indicate that over 1.3 million acres or 28% of the land in the region were placed into the highest category that was judged to be land with some opportunity for development – though some development restrictions might be present (e.g. unstable soils). An additional 20% of the region was placed into a moderate development potentials category indicating development potential with potentially significant development restrictions (e.g. flood potentials). The remaining three classes: limited, severely limited, and highly restricted, represent areas where development restrictions generally far outweigh the development opportunities that are present. Almost 50% of the region has limited development potentials due to the presence of what are often multiple severe development restrictions.

These results indicate that though much of the undeveloped land in the region has limited development potentials, there is a significant supply of undeveloped but developable land. However, these lands are not evenly distibuted among the counties, and moderate development restrictions may need to be addressed in developing most of these areas (e.g. flood protection or special methods for steep slope conditions).

b. Recreation

Public land needs and demands are very heavily tied to recreation development in the region. There are certainly localized demands for public lands for uses such as schools, community parks, and other public facility developments (WV State Comprehensive Outdoor Recreation Plan 1997). However, the acreage requirements for most of this development are minimal, and will be linked to existing community locations in most cases. A compilation of the major demands for public lands in the region identified by various federal and state agencies shows significant differences between counties in the region in the need/demand for hunting and fishing, water recreation, and special needs recreation areas – facilities that generally require significant areas. Counties that have a high demand/need for one or more of these activity areas are Kanawha, Lincoln, Logan, Raleigh and Wayne Counties (WVDNR Capital Improvements Plan 1998) (WVU Land Use Assessment 2001).

c. Commercial Forestry

The wood products industry in West Virginia has been a growing economic force in the state. However, a Division of Forestry inventory indicates that industry growth could become constrained by timber supply limitations. An increase in the lands in commercial forestry would help to continue to feed the growth of the study area's wood products industry.

d. Future Land Use Needs

Future land use development needs are difficult to estimate for the West Virginia study region because it is anticipated that the majority of the region will continue to lose population or current population levels will remain static. Population projections for current conditions to 2010, estimate that only Raleigh County will have a significant demand for new land use development based on anticipated population growth. This demand is estimated to range between 1,483 and 3,954 acres of required new development for the ten-year time period. Kanawha County is also expected to require new land for urban expansion. However, much of this area is actually due to shifting development patterns rather than new growth. Projections indicate between sixteen and thirty new square kilometers of new urban land uses will be potentially developed in Kanawha County between 2000 and 2010. The other counties in the study area will require insignificant acreage for the new development that is anticipated during the ten year 2000 to 2010 time period (WVU Land Use Assessment 2001).

S. HISTORIC AND ARCHAEOLOGICAL RESOURCES

Historic and archaeological resources are sometimes broadly categorized as "cultural resources." Cultural resources consist of prehistoric and historic districts, sites, structures, artifacts, and other physical evidence of human activities considered important to a culture, subculture, or community for scientific, traditional, religious, or other reasons. Prehistoric and historic archaeological resources are locations where human activity measurably altered the earth or left deposits of physical remains. Typical environments in which archaeological resources can be found include rock shelters, terraces, floodplains, Native American burial mounds, and ridgetops. Architectural resources, which may include dams, bridges, and other structures having historic or aesthetic importance, generally must be older than 50 years to be considered for protection under existing federal cultural resource laws.

Cultural resources that may be present within mine sites include cemeteries, historical sites and structures, archeological sites, public parks, and other features of cultural significance to surrounding communities. Historical cemetery sites may exist in coal mining areas because they were often located on mountaintops and ridge crests. SMCRA prohibits mining within 100 feet of a cemetery, although cemeteries may be relocated if authorized by applicable state laws or regulations. Mining may not be conducted in public parks or places listed in the National Register of Historic Places without joint approval of federal, state, and local agencies with jurisdiction over these features. Consultation under Section 106 of the National Historic Preservation Act compels agencies to consider the impact of mining projects on historic properties and the various alternatives to minimizing adverse effects. Permit applicants may be required to conduct archeological surveys of proposed mine sites if the reviewing agencies believe that archeological sites may be present. Mining is not allowed in the National Park System, the National Wildlife Refuge System, the National System of Trails, the National Wilderness Preservation System, the Wild and Scenic Rivers System, or National Recreation Areas unless valid existing rights can be demonstrated under the guidelines established in 30 CFR 761.16.

Areas of community concern but not otherwise designated for regulatory protection may also become a consideration during the permitting process. An example of this would be the recent controversy over proposed plans to mine on Blair Mountain in West Virginia, site of a bloody conflict between coal operators and miners attempting to unionize in 1921.

Lists of known recorded cultural resource sites for the study area are maintained by the Kentucky, Tennessee, and West Virginia State Historic Preservation Offices, and the Virginia Department of Historic Resources. In addition, the National Park Service maintains an online version of the National Register Information System (NRIS) [http://www.nr.nps.gov/nrishome.htm].

The first evidence of human habitation in the Appalachians relates to the Paleo-Indians period, perhaps as far back as 13,000 B.C. Such sites have been investigated in Pennsylvania and Virginia. Gardner has investigated the earliest known structure in the New World at the Thunderbird site in Virginia (1974) and has associated it with a Paleo-Indian occupation (Cunningham, 1973). A nearby butchering station also has been associated with a Paleo-Indian occupation. Both sites date to about 11,000 B.C.

Typical artifact assemblages found at known Paleo-Indian sites include: fluted, lanceolate projectile points; uniface, blade-like, snub-nosed scrapers; uniface side blades; gravers; and other blade and flake tools. Evidence from known occupation sites indicated that individual sites were occupied temporarily or seasonally over a long period of time.

Paleo-Indian occupation sites have been found on sandy alluvial hillocks at elevations of about 100 feet above major river valleys as well as on upland flats. Ridge tops, being presumed routes of travel for people as well as game, have potential for Paleo-Indian sites. Saline springs and salt licks on terraces attracted large herbivores, serving to draw in the big game hunting Paleo-Indians. Salt licks have been associated with coal formations (Cunningham 1973).

Remains of Archaic cultural groups have been found in the Appalachians. Projectile points, chipped flint hoes, flint scrapers, drills, and fragments of faceted hematite have been recovered.

The later Archaic sites contained evidence of increasing dependence on grain and vegetables as food sources. Pigweed and goosefoot may have been cultivated. Bowls of the mineral steatite were made prior to the introduction of vessels made of clay. Grave offerings and red ochre often accompany burials.

Late Adena sites contained evidence of cultural influences from groups to the north and west, known as Hopewell cultural groups. Mounds covered log tombs in which one or more burials had been placed, and many tombs were destroyed during the later construction of a mound. Grave goods included ornamental offerings such as effigy pipes, pendants, gorgets, copper bracelets and rings, and grooved stone tablets. Late Adena houses were of double post side wall construction.

In the period between 900 and 1700 A.D., the Fort Ancient people lived in large, compact villages surrounded by stockades, with rows of rectangular houses. The villagers farmed corn, beans, and squash. Burials were no longer made in mounds. The dead were placed in pits inside the villages or inside house walls. Artifacts included small, triangular projectile points, drills, scrapers, blades, hoes, celts, awls, fish hooks, bird bone flutes, shell beads, ear plugs, and pottery vessels and pipes. Some late Fort Ancient sites contained European trade goods.

Settlers arrived in Appalachia during the 1700s. Cultural resources related to first permanent settlements, pioneer settlers, Revolutionary War forts, Civil War battles, and Civil War hospitals have been identified in the study area and are recorded by the state historic preservation offices.

T. ECONOMIC IMPORTANCE OF EXISTING LANDSCAPE AND ENVIRONMENTAL QUALITY

The natural environment is the key defining feature of the study area. The rugged terrain, the vast mixed hardwood forests, the narrow river valleys and the extensive coalfields have profoundly shaped the culture, economy, and quality of life of the region's residents. The land provides the livelihood, and forms the basis for a way of life for much of the population. This section provides an overview of some of the ways in which the landscape and quality of the natural environment play a role in the economy and quality of life in the study area.

1. Outdoor Recreation and Tourism

The tourism and travel industry represents a major component of the study area's economy. As an industry, tourism encompasses a variety of the other employment and industrial sectors, such as wholesale and retail trade, services, amusement and recreation. Tourism and travel businesses directly include: public and private campgrounds; hotels; motels; restaurants; gift shops; service stations; amusements; and other recreation facilities. Tourism is an export industry in the sense that it brings outside money into the regional economy. Also, tourism spending by the region's residents benefits the regional economy compared to the alternative of residents traveling elsewhere for recreation. The tourism industry produces an indirect positive effect on all economic sectors of the study area.

RESIDENT AND NON-RESIDENT TOURISTS TRAVEL TO VARIOUS OUTDOOR RECREATIONAL SITES THROUGHOUT THE STUDY AREA FOR CAMPING, HIKING, FISHING, SWIMMING, CANOEING, HUNTING, BOATING, AND SIGHT SEEING.

Resident and non-resident tourists travel to various outdoor recreational sites throughout the study area for camping, hiking, fishing, swimming, canoeing, hunting, boating, and sight seeing. In addition, tourists are also drawn to the many visual, cultural, and natural amenities found throughout the study area. For example, within the study area in West Virginia alone there are approximately 15 state parks and forests, in addition to 10 designated wildlife management areas for hunting and fishing.

There is a positive correlation between environmental quality and tourism growth. Most national and international tourism experts believe that a clean and healthy natural environment is an essential ingredient for tourism growth in both urban and rural areas (World Travel and Tourism Council 2000).

Tourism revenue information was not available by county or as a subgroup of any state; therefore, the specific significance of tourism to the study area cannot be put in numeric terms. The importance of outdoor oriented tourism to each individual state is discussed below.

a. Kentucky

According to Kentucky's 1995 Outdoor Recreation Plan, "...tourism is one of Kentucky's top industries: the third largest revenue producer, and the second largest private employer (Commonwealth of Kentucky, 1985). The Kentucky Tourism Development Cabinet reported that tourism and travel contributed 7.4 billion dollars to the state's economy in 1997, and is the state's second largest private employer, providing 146,738 full time, year round jobs. According to the Kentucky Department of Travel, visitations to Kentucky's state parks increased slightly from 8.66 million in 1996 to 8.72 million in 1998 (Department of Travel, 1999).

The Kentucky portion of the study area is located in the tourism region that the Kentucky Department of Tourism names the "Eastern Highlands." Tourism and recreational activities in the this area relate to the scenic beauty of the Appalachian Mountains. A significant attraction is the Daniel Boone National Forest, which includes the Red River Gorge. The Red River Gorge is a unique landscape containing unusual flora, which is surrounded by more than 80 natural arches sculpted by wind and water for 70 million years. The Red River is Kentucky's only National Wild and Scenic River. Another significant attraction in the Eastern Highlands is the Cumberland Gap National Historic Park. This 20,305 acres area of wilderness is the largest National Historic Park in the country.

The 1997 state average for foodservices and accommodations sales per capita (in thousands) was 1.04. Boyd, Perry and Rowan Counties had higher sales per capita than the state average (1.38, 1.11, and 1.09, respectively). Laurel and Whitley counties were just below the state average (1.02 and 0.98, respectively). This suggests that these five study area counties may be tourism destinations. The five counties mentioned all contain major transportation corridors and/or tourist attractions. Rowan County contains Cave Run Lake, a popular tourist destination, as well as the Red River Gorge. Morehead State College is also located in Rowan County, and I-64 bisects the county. The Daniel Boone Parkway terminates on I-80 in Perry County. The city of Hazard is also located in Perry County.

Whitley County is located along the Kentucky-Tennessee border, and Laurel County is located just north of Whitley. I-75 bisects Laurel and Whitley counties, and the Daniel Boone Parkway terminates on I-75 in Laurel County. The Laurel and Whitley county area also contains the Daniel Boone National Forest and Cumberland Lake.

Boyd County, located along the Kentucky-West Virginia and Kentucky-Ohio borders, contains a section of I-64. However, the oil refinery industry located in Boyd may also be responsible for the higher than average accommodations and foodservices sales in the county.

b. Tennessee

According to the Tennessee Department of Tourism Development (Department of Tourism Development, 1999), "Tennessee's 8.5 billion dollars tourism industry, drawing almost 40 million visitors in 1997, is a major economic factor for a majority of Tennessee's 95 counties." The importance of Tennessee's outdoor recreation facilities, and their relationship to the state's tourism industry is exemplified in the 1995 Tennessee State Recreation Plan: "Parks and recreation programs and facilities are vitally important to local economies. Leisure programs provide an economic stimulus that in some communities is the driving economic force and the anchor of the tourism

industry"(State of Tennessee, 1995). Some of Tennessee's most valuable outdoor recreation areas are located in the study area, particularly on the coal bearing Cumberland Plateau. Fall Creek Falls State Resort Park, which is partially located in the west central portion of Bledsoe County, "is one of the most scenic and spectacular outdoor recreation areas in America" (Department of Environment and Conservation, 1999).

The 1997 state average for foodservices and accommodations sales per capita (in thousands) was 1.26. All the study area counties were below the state average. Cumberland County was the closest to the state average with sales per capita of 0.92. Route 40, which connects the major cities of Nashville and Knoxville, runs through Cumberland County. Cumberland County's higher sales in comparison to the other counties may be related its location. The other study area counties do not appear to be tourism destinations.

c. Virginia

Tourism is one of Virginia's largest industries and is the third largest retail industry Virginia Department of Conservation and Recreation,(Virginia Tourism Corporation, 1999). Park visitation has a profound effect on the state and local economies. According to the 1996 Virginia Outdoors Plan, day use park visitors spend approximately 16 dollars per day, which amounts to a 68 million dollars contribution annually to Virginia's economy (Virginia Department of Conservation and Recreation, 1996)." The number of annual visitations to Virginia's state parks has risen in recent years.

As stated in the 1996 plan, outdoor recreational activities are vital to Virginia's rural economies: "Outdoor recreation also offers much in the way of supplemental income and small-business opportunities to entrepreneurial residents of rural communities, including: land-leasing for hunting, hunting preserves and hunt clubs, fee-fishing…. Economic development and tourism officials in rural Virginia are increasingly aware of the economic potential associated with promoting outdoor recreational opportunities and related services."

A popular tourist attraction located in the study area is the Blue Ridge Parkway. The parkway, which is one of the nation's premiere scenic roads, is being impacted by the effects of urban development. Overlooks that once provided scenic views of forests and rolling agricultural land are now revealing factories and residential developments. As emphasized in the 1996 plan, "This increasing encroachment will impact the quality of visitors' recreational experiences."

In 1997, all of the study area counties had significantly lower sales per capita in comparison to the state average for accommodations and foodservices. This suggests that none of the study area counties are tourism destinations.

d. West Virginia

The Bureau of Business Research at West Virginia University estimated the total economic impact of travel and tourism in West Virginia at 2.54 billion dollars in 1991. Employment and payroll were estimated at 49,665 persons and 535 million dollars, with another 116 million dollars in state tax revenues (West Virginia University, 2000). The economic impact of outdoor recreation activities is gaining increased recognition among West Virginia's state and local officials. Tourism, in particular, has been identified as one of the state's target industries in its strategic plan for economic development (WVSCORP, p. 38).

In 1999 the West Virginia Division of Tourism studied the impacts of "domestic leisure visitation" on the state for a five year period from 1993 to1998. The results of that study indicate that the number of visitors and length of their stays have increased overall from 1993 to 1998. The increase in length of stay from 1993 to 1998 was 7.1 million days, and the total visitors to the state increased by 2.3 million people (Department of Tourism, 1989). This study also indicates a 21% increase in direct revenues from tourism spending between 1997 and 1998, a significant increase which is reflects of the growing importance tourism has on the economy.

West Virginia's tourism industry is highly dependent upon its natural resources and scenic beauty. According to the state's 1993 Statewide Comprehensive Outdoor Recreation Plan (SCORP), the most popular activity among non-resident visitors is sightseeing, followed by visiting national and state parks, attending fairs and festivals, visiting cultural sites, hiking, rafting, camping, hunting/fishing, golf, and skiing (State of West Virginia, 1983).

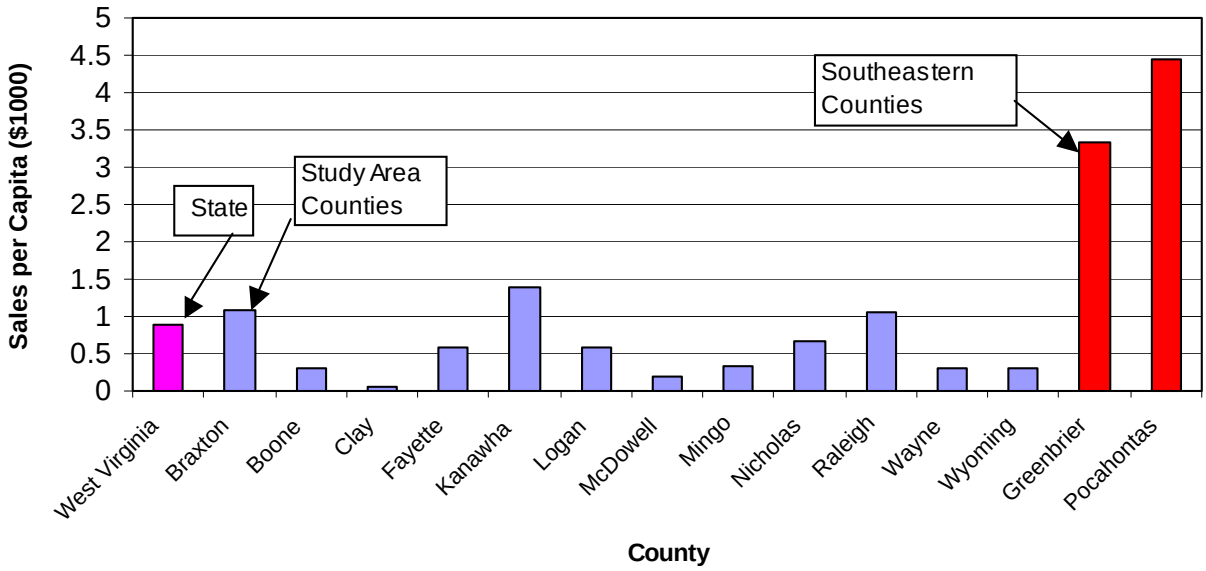
Outdoor recreation activities are closely entwined with natural resource preservation. A very large proportion of the study area's outdoor recreation experiences are highly dependent upon the quality of the natural environment. To quote promotional materials used by the Southern West Virginia Convention and Visitors' Bureau (1999), "The mountains, as we refer to them, of southern West Virginia call out to your inner soul. Their rivers offer the best whitewater rafting east of the Colorado and scenic hiking, biking and rock climbing trails abound". Development activities threaten this valued environment through effects such as diminished scenic viewsheds and degraded water quality.

Within the study area in West Virginia there are approximately 15 state parks and forests, in addition to 10 designated wildlife management areas for hunting and fishing. Whitewater rafting, hunting, and fishing are drawing increasing numbers of tourists to southern West Virginia. These activities can only take place in the proper setting, thus further emphasizing the importance of maintaining these settings to draw tourists to the area. About 250,000 whitewater rafting enthusiasts raft West Virginia waters each year. In southern West Virginia the New River is an important rafting resource, named by the AAA Mid-Atlantic Tour Book as a world renowned whitewater rafting location.

In 1998 hunting and fishing generated over 15.5 million dollars in license sales, and of those licenses about 308,000, or roughly 27 percent were sold to non-residents (Department of Tourism, 1989). Based on West Virginia Division of Wildlife Data, the study area portion of the state is not the highest revenue generating area for hunting and fishing license sales, however, the location of sale is not necessarily the location of the hunting and fishing activity.

In general, the study area counties have much lower sales per capita in the foodservices and accommodations sector than the two southeastern counties of Greenbriar and Pocahontas, and the state as a whole, suggesting that the study area is not a major tourism destination. West Virginia has an average sales per capita of 900 dollars in the food services and accommodations sector. The average sales per capita for the study area counties is 620 dollars (U.S. Bureau of the Census, 1997). In contrast, Greenbriar and Pocahontas counties had sales per capita of 3,340 and 4,440 dollars, respectively.

Figure III.T-1
West Virginia Food Services and Accommodations Sales Per Capita, 1997



Two study area counties, Kanawha County and Fayette County, have somewhat higher sales per capita in foodservices and accommodations. Kanawha has sales per capita of 1,380 dollars and Fayette has sales per capita of 1,740 dollars (U.S. Bureau of the Census, 1997) [see Figure III.T-1]. The higher sales in these counties may be due to several factors. Kanawha County contains the city of Charleston, the state capitol of West Virginia. Interstate 64, Interstate 79, and Route 77, the West Virginia Turnpike, and the Kanawha River, a tourist destination, all run through the county as well. Fayette County also contains a section of the West Virginia Turnpike, as well as Amtrak. The New River Gorge National River is primarily located in Fayette County as well.

2. Non-traditional Forest Products

POPULATIONS IN THE APPALACHIA REGION RELY UPON THE NATURAL ENVIRONMENT FOR A RANGE OF ACTIVITIES INCLUDING THE HARVESTING OF NON-TRADITIONAL FOREST PRODUCTS AND SUBSISTENCE GARDENING.

Populations in the Appalachia region rely upon the natural environment for a range of activities including the harvesting of non-traditional forest products and subsistence gardening. Both activities are more difficult to document than traditional economic activity, however, a growing amount of research shows a significant reliance upon these activities. There is a cultural tradition in the region of reliance upon the harvesting of non-traditional forest products and subsistence gardens rather than welfare or other public assistance. This reliance upon the natural environment becomes part of a work ethic of sorts which centers around frequently isolated and tightly knit communities. "Phoebe Fields, raised her [family of 17] practically herself, growing most of their own food,… none of [the] siblings has ever received government assistance" (Wenger 1998). A recent study from the West Virginia University found that environmental concern was highest in the most rural, low educated, nonprofessional population in the state (Ward 1999). This type of result reflects not only reaction to the mining industries, but also concern for their livelihood.

Estimated to account for 970 million dollars of a global market worth over 60 billion dollars (Hammett and Chamberlain 1998) the market for non-traditional forest products is estimated to have grown "by nearly 20 percent annually over the last several years". Non-traditional forest products include sassafras, ginseng, goldenseal, mayapple, slippery elm and other botanical products which can be harvested in the Southern Appalachia region. The market specifically for "wild" ginseng can be worth between 350 to 500 dollars per pound dried, as compared to so called "tame" ginseng harvested in other regions of the country worth roughly 25 to 50 dollars per pound (Hufford 1998). In the Appalachia region specifically, the harvesting of non-traditional forest products contributes a significant amount to the local economy. In 1995, non-traditional forest products contributed an estimated 35 million dollars to Virginia's economy (Hammett and Chamberlain 1998).

The natural environment, specifically small patches of rich soils, further contributes to the livelihood of people within this region. This region is not known for its prime farmland, however, small patches of good soil too small to be documented in traditional surveys, occur in the mountains of Appalachia. According to Mary Hufford, of the Library of Congress, official sources with the Soil Conservation Service report "as much organic matter as any prime farmland in the midwest occurs in Appalachia. Land is used for community and private subsistence gardening.

Much of the knowledge about non-traditional forest products, including folk medicine, or "home remedies," is passed down from generation to generation as a part of family traditions. The populations in this region also have an unusual relationship to the land itself. Much of the land from which non-traditional forest products are harvested is owned by private landowners. (Hammett and Chamberlain, 1998) A history of public admittance to this land is referred to as "the commons" or "the mountains," by which the population traditionally had understood access to the land.

Frequently, colloquial place names given to the landscape of these commons reflects an oral history of land use and community settlement. In a letter to the West Virginia Governor's Taskforce, Mary

Hufford writes, "Through continuous use of this commons . . . residents have kept alive a history reaching back to pre-Civil War settlement. Place names and stories attached to ridges, knobs, hollows, homeplaces, cemeteries, rock shelters, newgrounds, roads and trails scattered all over 'the mountains' keep this heritage alive" (Hufford, 1998).

This identity with common geography creates a culture that is closely tied to mountains, which are by tradition a common asset. In a public comment letter, West Virginia resident Al Justice writes, "Unlike the plains of the Midwest, mountain farmers and miners were accustomed to living within their environment. Integrated so closely to the cycles of nature in the mountains, they were in fact part of the mountains in both humanistic and environmental terms" (Justice, 1999).

The harvesting of forest products is also linked to social activity in the region. In the springtime throughout Southern Appalachia a number of feasts and community gatherings center around the collection of ramps, (wild leeks, *Allium tricoccum*) which are the first of the wild foods able to be harvested. "Historically, in these mountains, female sociality has flourished around the gathering and processing of greens and other wild produce." (Hufford, 1998) These spring festivals allow Appalachian residents to display and reinforce their cultural heritage by sharing music, stories, and handicrafts, such as basket weaving and quilting (Appalachian Tales, 2000).

In recent years, the evolution of mining practices from underground to surface mining has affected the public's relationship to "the commons." Historically, underground mining operations allowed for surface land uses such as gardening or wild gathering to take place. Surface mining operations, by nature, do not allow for concurrent alternate land uses. Therefore, private landowners have increasingly begun to close off these lands to the public. This has a deep cultural as well as economic impact upon the communities in the region.

U. SOCIAL AND CULTURAL CONNECTIONS TO COAL MINING AND THE NATURAL ENVIRONMENT

Coal mining practices have profoundly affected the communities and residents of the Appalachian coalfields since coal mining first commenced in the region. Sections III.U.1. through III.U.4. provide an overview of the past and current interaction between the coal mining industry and the residents of Appalachia.

Appalachian coalfield residents have a unique social and cultural connection to the natural environment. For coalfield residents, the quality of the natural environment is important both as a source of income and an integral element of Appalachian culture. Sections III.U.5. and III. U.6. present an overview of the relationship between the natural environment, Appalachian culture, and coal mining.

IDENTITY WITH COMMON GEOGRAPHY CREATES A CULTURE WHICH IS CLOSELY TIED TO MOUNTAINS, WHICH ARE BY TRADITION A COMMON ASSET. IN RECENT YEARS, PRIVATE LAND OWNERS HAVE INCREASINGLY BEGUN TO CLOSE OFF THESE LANDS TO THE PUBLIC, HAVING A DEEP CULTURAL AS WELL AS ECONOMIC IMPACT UPON THE COMMUNITIES IN THE REGION.

1. Company Town Social Environment

Today, the company town structure has largely disappeared across Appalachia. Throughout the 20th century, however, company towns played an important role in the life of Appalachian residents. "Social Control, Social Displacement and Coal Mining in the Cumberland Plateau, 1880-1930", written by Dr. James B. Jones, provides a general overview of company town structure. Selected passages are presented within this section.

While company towns existed in many parts of the United States in the first half of the 20th century, the effects of coal company towns in the Appalachian Mountains were more far reaching. The mining company controlled nearly every essential aspect of community life, from work, to shopping, education, retail merchandising, and medical care.

The social structure of these company towns was impacted by the paternalistic nature of the relationship between the company and the residents, resulting in a highly dependent relationship for the residents. Research indicates that this typical company town relationship has both psychological and physical manifestations. The nature of company towns has been documented across numerous industries; however, the relative isolation of the communities, the predominance of the coal industry and the relative poverty of the region prior to industrialization all arguably contribute to a more pronounced community structure based on company paternalism.

Despite the varying quality of the provided infrastructure, it was frequently much needed in the isolated communities of Appalachia. With the withdrawal of the coal company from a local community, infrastructure is abandoned. In some cases the impact is visual, such as dilapidated, abandoned housing; however, in other cases, it has a direct effect on the quality of life of the residents such as lack of potable water or the closing of local schools. In addition to the lack of physical infrastructure, the paternal role of coal companies extended to the maintenance of these

systems. Local communities frequently do not have a civic structure in place to take-over the maintenance of public infrastructure systems. One community member from McDowell County, West Virginia described the abandoned water system in her community as follows: "There'd be worms coming out of your spicket… The only thing we use our water for is to clean… We don't cook with it. We don't drink it. We haul all our water from a mountain spring." (Beyond Measure 1995)

Researchers looking at typical coal mining communities, specifically company towns, have noted a number of social themes in the development and mentality of residents including a sense of resignation, and feelings of lack of mastery in individuals lives. It is a logical progression that residents living in communities commanded by one powerful group should feel a lack of control over their own lives. This feeling of lack of control and mastery in both an individual and collective sense leaves the community as a whole ill-prepared to cope with the decline in the coal industry and specifically the shut-down of the local mines.

Herman R. Lantz studied a typical coal mining community in Pennsylvania at the middle of the century. An important reason this particular town was chosen was the experience of rapid development and significant economic decline related to the coal industry. Lantz's research clearly indicated that the residents lacked the motivation and even an aversion to taking advantage of new opportunities and enterprise; they had a feeling of "resignation" (Lantz 64). Lantz concluded that this resignation was only partially due to the social framework of the company-resident relationship. He attributes this phenomenon in part to the nature and culture of the people who settled the area. Pre-industrial settlers came from impoverished and marginalized populations in Western Europe. These populations were predisposed to feelings of aversion to social change (Lantz 1964). The experience of the mine workers, the boom and bust cycle, fed into an overall fear of industrial change and feelings of inadequacy in terms of coping with that continuous change. "…The many years of tenuous living associated with mining foster in the miner futility about his having any control over his life or his destiny." (Lantz 1958).

The phenomenon of lack of motivation and feelings of hopelessness has been documented on a more individual level as well. Research done in a small community impacted by a plant closing, (the Radio Corporation of America plant) indicated that the majority of the displaced workers agreed with the statement: 'No matter what I do it will be near impossible to find a job in the months ahead.' (Perrucci, et al. 1985). Lantz research suggests that in fact, when faced with new opportunities "It is difficult for the people to maintain consistent interest in almost any enterprise, since they have serious doubts about things turning out well for them." (1964).

A decline in the physical state of the community creates a downward spiraling effect on the economic plight of the local residents as well. As described previously, coal companies frequently built and maintained local infrastructure, from housing to plumbing and even churches, in the coal towns of Appalachia in varying degrees of quality.

2. Evolution of Unions in the Coal Mining Industry

Conditions leading to and necessitating the bituminous fields' unionization were many and sufficient to inspire the formation of a national union. While the coal field unions of Pennsylvania and the Midwest were organized effectively within a few decades of the United Mine Workers of America. (UMWA) formation in 1890, those of central Appalachia, specifically eastern Kentucky and West Virginia, were far more difficult to incorporate into the union holdings (Lockard 1998). Miners in these areas lived largely in company towns tucked into isolated hollows between hills, bound by contracts which guaranteed the loss of their jobs and homes should they participate in union activity; unionization was branded "socialist" and "communist" by mine owners, who claimed that union demands would break company banks and make mining unprofitable–and therefore impossible (Scott 1995, Kahn,1973).

It was during the first third of the twentieth century in general that struggles between the miners and the coal companies in central Appalachia escalated to the status of "Mine Wars". The sub-cultural identity and unity based on class consciousness which company town living fostered led miners to rise up in conflicts with coal company operators, staff, and agents; the Paint-Cabin Creek War of 1912-1913, the Mingo-Logan Mine War of 1919-1921, and the Northern Coal Field War of 1925-31, all in West Virginia, followed by the Harlan County, Kentucky, strike and violence of 1931-1939, were all examples of protests for local miners' demands which turned into miner-company clashes violent and ugly enough to draw national attention (R. Lewis 2000). "War" was an accurate name for the situation; Appalachian communities suffered greatly at the union-operator impasse.

The election of Franklin D. Roosevelt in 1932 ushered in a new era for labor unions in the U.S. The UMWA rode the wave of rank-and-file union drive to a new high of union membership, and by September of 1933, more than 90% of the bituminous coal mines in the U.S. worked under UMWA agreements (Singer, 1996).

3. Mechanization of the Coal Mining Industry

As the unionization was changing work conditions in the mines, the characterization of mining methods was also profoundly changing work conditions in the mines and social conditions in the coalfields. Today , coal mining is characterized by relatively high-paying but less abundant jobs. For example, from January 1987 to December 1996, roughly one out of every two mining employees lost their jobs in southwestern Virginia. In Dickenson County, mining employment decreased by more than half in a two year period from 1,401 workers in 1993 to 694 at the end of 1995 (Mooney 1998). Many of the jobs that remain are specialized, skilled labor positions. A Virginia Center for Coal and Energy Research study concluded that the future coal industry will be "a highly technical, highly mechanized industry run by just a few very skilled individuals who are going to be very well compensated" (Mooney 1998).

Inside the mines, there are fewer workers and job descriptions have become increasingly specialized. Since miners are no longer trained to do most jobs in the mine, their ability to share work or assist a co-worker is eliminated. The shift to skilled and specialized labor meant a shift to a commuter workforce and away from the company town system.

4. Local Culture and Ties to the Natural Environment

There is a great deal of literature and study on the distinct way of life known as the Appalachian culture. The nature of the Appalachian culture has shaped the manner in which company town residents react to the loss of jobs and community. While some scholars debate the beginnings of this unique culture, most agree on the common traits of which it is composed. Appalachians are thought to be pioneering in nature, strong, independent and resilient. Appalachian women in particular are considered hardier and more resourceful out of necessity; one local to Whitesville, WV referred to them as "Iron Weed" women (Judy Bonds, December 2000). Anecdotal evidence suggests that the female employment in Appalachia has been more widely accepted historically than in the rest of the country, again a phenomenon born of necessity. Based on these traits, the company town residents are well prepared to face situations of economic hardship.

In some cases however, the independent nature of the culture has made the transition from coal mining jobs to a more diversified and frequently less skilled job market difficult. Traditionally, men working in the mines held on to their independent nature within the workplace largely until mechanization. Anecdotal evidence also suggests, that many Appalachian men have more difficulty than women accepting lower-skilled and frequently lower-paying jobs in replacement of the coal mining jobs (Judy Bonds, December 2000). The loss of employment is a statement about a man's traditional role as breadwinner, whereas, a woman would be more significantly impacted by her inability to care for her family and children (Perrucci, etc. 1985) (Broman, etc. 1990). Social research into the impacts of unemployment also show that men are often more susceptible to depression related to job loss than women.

The cultural ties to the Appalachian region are also strongly seen in discussion of population migration as a result of mine closures. As families disperse, frequently it is understood that given time they will return to Appalachia. Migration is thought to be temporary. (Montgomery, 1968). While this is frequently not the case, it demonstrates the psychological ties that remain. The wife of a miner, trapped by poverty and her husband's black lung illness in Cincinnati said, "Maybe there's some way we can find to make it, to survive. If we find a way, I imagine we'll go back home to Kentucky and just stay there until we die." (Chandler, 1973). Part of the belief that migration is temporary stems from the typical boom and bust cycle of mining work. When a local mine is shut-down, there is a period within the community when residents still believe it will re-open despite repeated and clear signs from the companies. Initial migration is thought to be temporary until the mine re-opens; however, ultimately this is not the case. "People had been through the boom and bust cycle so many times that they just said… go on down to North Carolina and get you a job for a little while. And then, when they open up the mines back up you can come home and work… For about a year, people kinda kept that hope alive." (Beyond Measure, 1995)

V. RELATIONSHIP OF SURFACE MINING AND AIR QUALITY

1. Discussion of Study Area Air Quality

Surface mining involves a number of activities that can impact air quality or generate noise. Blasting activities are a particular concern in that they can produce particulate matter, fumes, and potentially damaging low-frequency noise and pressure waves. Basic equipment operation in the disturbed areas of mine pits, backfill areas, and haul roads can generate airborne particulate matter. Wind passage over open areas of mine sites also produces airborne particulate matter. Truck haulage of coal on public roads is also a source of particulate matter. Applicable statutory provisions are summarized in the human and community programmatic review presented in Appendix B. Performance standards for the protection of air quality are also discussed in Appendix B.

There are 42 monitoring stations located in the study area. Except for ozone levels, monitoring stations in the study area reported good air quality for all criteria air pollutants. Stations monitoring ozone concentrations in Boyd and Greenup Counties (KY) reported multiple years where levels exceeded EPA air quality standards.

2. Effects of Blasting on Air Quality

Potential health risks of airborne dust and fumes from blasting and other mining operations generally result from inhalation of particulate matter, fugitive dust, and re-entrained dust emanating from the mining operations. Fugitive dust usually refers to the particulate matter that becomes airborne due to the forces of wind and is not emitted from a stationary source such as a stack. Re-entrained dust is that which is put into the air by vehicles driving over dusty roads.

A study was recently completed by the Department of Mining Engineering at West Virginia University which included the study of dust and fume emissions from 10 blasting events at three mines. The results of this initial study indicate that detectable concentrations of respirable dust, total dust, nitrogen dioxide, nitric oxide, carbon monoxide and ammonia were found in ambient air at locations both in close proximity to the mining operation and at a distance greater than 1,000 feet from the blasting operations. Although specified in the Work Plan, crystalline silica measurements were not performed as a part of this study. Crystalline silica monitoring is needed to evaluate potential health risks associated with silicosis.

A significant reduction in detected concentrations of measured contaminants was found when the distance from the blasting operations was increased. This investigation was concerned with fugitive dust and fumes and investigators found no indication that there are any significant health risks due to exposure when no personnel are in close proximity to the blast zone. Conclusions of this investigation indicate that fugitive dust and fume emissions present no potential health problem for the following reasons:

- No event produced any “harmful” levels of any duration at distances exceeding 1,000 feet, except one measurement of 3.6 ppm NO_2 at 1,251 feet;

- The NO_2 measurement at 1,251 feet and all others were of short duration;

- Fugitive emissions are those that leave the property; if the property boundary is closer than 2,000 feet, persons within this area are evacuated.

The study included a discussion concerning four-wheel drive vehicles which can produce 75 pounds of fugitive dust per mile traveled on a dirt road (Hesketh, 1983), and that many county roads in the vicinity of a surface mine are unpaved; therefore, blasting would appear to be an unlikely source of significant dust at off-site locations.

The text of the West Virginia University Mine Dust and Blasting Fumes Study can be found in Appendix G of the EIS.

3. Effects of Hauling on Air Quality

a. On-site Heavy Equipment

Heavy equipment used during mining operations release the following criteria pollutants: nitrogen oxide (NO_x), sulfur oxide (SO_x), volatile organic compounds (VOCs), and carbon monoxide (CO).

b. Dust and Other Pollutants along Transport Roads

Hauling extracted coal from surface mines requires the use of trucks, trains or conveyors**.** The equipment used to haul the coal and other waste materials from the surface mines generates particulate from disturbance of the ground surface. Additionally, this transportation equipment also may emit NO_x, CO, SO_x and VOCs.

4. Effects of Mining on Air Quality

a. Particulates Released During Mining

Surface mining operations involve the release of particulates into ambient air during operations. Particulates can affect human health, animal health and can negatively impact crop growth. The EPA enforces National Ambient Air Quality Standards (NAAQS). There is a NAAQ standard for particulate matter sized at 10 microns in diameter or smaller, referred to as PM-10 emissions. Regulatory standards and guidelines for airborne dusts and fumes are further discussed in subsection 7 of this section.

b. Crystalline Silica

One issue of particular concern in the mining industry is exposure to crystalline silica. Workers in both surface and subsurface mining operations have the potential to be exposed to crystalline silica. Surface mine workers operating highwall drills, end loaders, dozers and trucks on mine property have a high probability of exposure to silica-containing dust.

Respirable dust disease, a progressive pulmonary disorder that builds up over years of inhaling high levels of airborne dust particles, is known in many forms: coal miners' pneumoconiosis, black lung disease, silicosis, and asbestosis. Government studies estimate that between 1,600 and 3,600 working miners and retirees has one of these fatal lung disorders. Ron Eller, director of the University of Kentucky's Appalachian Center, stated in the Louisville Courier-Journal, "Almost

every family in Central Appalachia has a family member who died of black-lung disease. It's as ordinary as diabetes or high blood pressure or cancer in the region" (Harris, 1998).

5. State Implementation Plans

The 1990 Clean Air Act is a federal law which covers the entire country. EPA establishes limits on primary National Ambient Air Quality Standards (NAAQS). Also under this law, States are required to develop State Implementation Plans (SIP). The SIP should explain how each state will perform activities to comply with the Clean Air Act. The SIP generally consists of a collection of regulations which the state will use to enforce the Clean Air Act. Each individual SIP is submitted to the EPA for approval. SIPs vary between states.

Air emissions associated with mining operations (such as blasting, earth and rock removal, transport-related dust) are considered "fugitive emissions" under the Clean Air Act. Thus far, mountaintop mining has not been considered to meet the criteria for major source air quality permits (Title V of the CAA), defined as sources which emit at least 250 tons/year of a regulated pollutant.

6. Regulatory Standards and Guidelines

The Environmental Protection Agency has established air quality standards to protect human health from dust and other forms of particulate air pollution. There are two National Ambient Air Quality standards (NAAQS) for dust. One standard applies to particulate matter sized at 10 microns in diameter or smaller (PM-10). In 1997, EPA also promulgated a NAAQS for particulate matter sized at 2.5 microns or smaller (PM-2.5), but there are no regulatory requirements associated with this standard as yet, and it is under litigation.

The PM-10 NAAQS pertains to all dusts that fit the aerodynamic diameter requirements. This includes the fugitive emissions which may contain crystalline silica. The NAAQS does not include specific limits on silica itself.

Air emissions associated with mining operations (such as blasting, earth and rock removal, transport-related dust) are considered "fugitive emissions" under the U.S. Clean Air Act (CAA) and the federal government generally does not have the authority to regulate fugitive emissions which are not associated with a permanent stationary source. Thus far, mountaintop mining has not been considered to meet the criteria for major source air quality permit (Title V of the CAA), defined as sources which emit at least 250 tons/year of a regulated pollutant. The West Virginia air pollution control program does not currently require best management practices nor does it issue air permits to mountaintop mining operations although the Surface Mining Control and Reclamation Act of 1977 (SMCRA) indicates mining permits may contain control practices for some fugitive emissions.

NIOSH has developed criteria documents pertaining to occupational exposure to respirable coal mine dust. The Recommended Exposure Limit (REL) established by NIOSH for exposure to respirable coal mine dust is 1 milligram per cubic meter of air. The NIOSH REL for occupational exposure to crystalline silica is 0.05 milligrams per cubic meter of air. The REL represents the upper limit of exposure for a worker for up to a 10-hour workday during a 40-hour work week. The NIOSH publication: Criteria for a Recommended Standard for Occupational Exposure to Respirable Coal Mine Dust, dated September 1995, contains historical sampling data for both surface and

underground mines. These tables provide useful information concerning occupational exposures and may provide some insight into potential residential exposures for the sampled mines.

The Mine Safety and Health Administration maintains separate air monitoring requirements for mining operations and the requirements are designed to protect mine workers. The Permissible Exposure Limit for respirable coal mine dust adopted by MSHA is 2 milligrams per cubic meter of air. This standard is reduced when the content of respirable quartz (crystalline silica) in the coal dust is greater than 5 percent. Inspectors for MSHA have the authority to inspect each surface mine at least twice a year. MSHA inspectors collect both personal and area air samples for each mechanized mining unit. Area air samples at the intake of the mine are collected periodically. The location and type of samples collected by the MSHA inspector are based on several things, including the adequacy of the mine operator's dust control measures.

Coal mine operators are required to collect five respirable occupational exposure samples in each mechanized mining unit for each bimonthly sampling period. Additionally, the operators are required to collect work area air samples. MSHA requires that coal mine operators submit a "Ventilation System and Methane and Dust Control Plan" every six months. This plan must include information about ventilation equipment and operating parameters for dust control. Once again, most of the requirements pertain to the protection of the coal mine workers rather than the residential population living in the vicinity of the mine.

The World Health Organization (WHO-1986) recommended a "tentative health-based exposure limit" for respirable coal mine dust with less than 7 percent respirable quartz. This information is cited in the NIOSH Criteria for a Recommended standard document referenced above. According to the NIOSH reference, the risk of disease when using the WHO approach could be determined separately for each mine or group of mines.

Most established exposure limits for all of the potential contaminants associated with surface mining apply only to exposure in an occupational setting. The following is a list of references with exposure limits established for the "general population:"

- The Department of Energy has established Temporary Emergency Exposure Limits (TEELS) for over 1250 chemicals
- The California Environmental Protection Agency has established Recommended Exposure Limits for use in comparison of monitoring or modeled air contaminant concentrations
- EPA has established Acute Emergency Guidance Levels (AEGLS)
- The National Academy of Sciences has Short-term Public Emergency Guidance Levels (SPEGLs).

7. Potential Health Risks

Potential health risks of airborne dust and fumes from blasting and other mining operations generally result from inhalation of particulate matter, fugitive dust and reentrained dust emanating from the mining operations and hauling. Impacts to air quality are localized within the immediate area of the mining site. Increased awareness of the dust emitted from hauling operations in recent years has improved air quality problems associated with hauling in the vicinity of the mining operations.

In order for a negative health effect to occur, a complete exposure pathway must be in place. A complete exposure pathway exists if there is, (1) a source or chemical release from the source (i.e., fugitive dust and fumes and chemicals in these sources), (2) an exposure point where contact with the chemical can occur (residents coming into contact with the fugitive dust or fumes), and (3) an exposure route by which contact can occur (inhalation of the dust or fumes). If one of these components is missing, then the exposure pathway is considered incomplete and the potential for negative health effects is considered to be negligible (EPA, 1989).

Federal legislation has addressed the health and safety hazards associated with both surface and underground mining operations. Additionally, many state governments maintain regulatory bodies for the oversight of mining operations. Increased technology has also allowed for the use of remotely operated machinery to decrease workers' exposure to dangerous work environments, and the use of more sophisticated air monitoring equipment. Some states have implemented "free chest x-ray" programs for mine workers to provide diagnosis and treatment of work-related lung diseases.

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Specific potential health effects associated with exposure to the fugitive dust and fumes emitted from mines are dependent on the chemical constituents of the emissions.

a Fugitive Dusts/Particulate Matter

Fugitive dust usually refers to the dust put into the atmosphere by the wind blowing over bare soil, plowed fields, dirt roads or desert or sandy areas with little or no vegetation. Reentrained dust is that which is put into the air by reason of vehicles driving over dirt roads (or dirty roads) and dusty areas. The emission rates of fugitive dusts are highly variable and dependent on the prevailing atmospheric conditions, including wind speed and direction.

Particulate matter (PM) of concern for protection of lung health are the fine particles. PM in the

form of respirable coal mine dust are particles with aerodynamic diameters less than 10 microns. This size of airborne dust is capable of entering the lungs if inhaled. According to the American Lung Association, particles of special concern are less than 2.5 microns in diameter. These particles are more easily inhaled than larger sized particles and can either become embedded deeply into the lungs or absorbed into the bloodstream.

Inhalation of particulate matter air pollution is particularly harmful to sensitive members of the population who have pre-existing conditions such as asthma and chronic obstructive pulmonary disease. Inhalation of particulate matter containing respirable coal mine dust may lead to a condition called coal workers' pneumoconiosis. This condition is prevalent in coal mine workers who have worked in underground coal mines for a period of eight years or longer. Chronic bronchitis, emphysema and decreased lung function are also prevalent among coal mine workers. Pneumoconiosis is a general term used to describe lung diseases which have resulted from the inhalation of dust, usually inorganic (rock or mineral) dust.

Another form of pneumoconiosis associated with coal mining is silicosis. The inorganic dust exposure which causes silicosis is respirable crystalline silica. Silicosis is a nonreversible lung disease caused by inhalation and retention within the lungs of silica dioxide crystals. Silica is the second most common mineral in the earth's crust and a major component of sand, rock and mineral ores. In addition to silicosis, other lung diseases have been associated with inhalation of crystalline silica. These diseases include chronic bronchitis and tuberculosis.

There are three types of silicosis:

- Chronic silicosis occurs after 10 or more years of overexposure
- Accelerated silicosis results from higher exposures and develops over 5-10 years
- Acute silicosis occurs where exposures are the highest and can cause symptoms to develop within a few weeks to 5 years of exposure.

b Fumes Released During Blasting

Additional possible potential health effects associated with surface mining operations include those related to the potential inhalation of toxic fumes generated from the blasting operations. Blasting operations may involve the release of fumes including: carbon monoxide, nitrogen dioxide, nitric oxide and ammonia. The type and amount of fumes released is dependent on the frequency and type of blasting operation conducted for the particular mining operation.

Exposure to carbon monoxide causes a variety of health-related symptoms including headache, nausea, weakness and dizziness. Additionally, exposure to high concentrations of carbon monoxide results in a condition referred to as asphyxial anoxia in which there is inadequate oxygen delivery in the presence of adequate blood flow. Carbon monoxide is commonly referred to as a "chemical asphyxiant."

According to research published by the National Institute for Occupational Safety and Health (NIOSH), over the past 30 years, blasters have switched to using less expensive blasting agents such as ammonium nitrate/fuel oil (ANFO) mixtures. Ammonia is released during this combustion process. Exposure to ammonia causes eye and respiratory irritation.
Table of Contents

W. BLASTING AND THE LOCAL COMMUNITY

Because of the relatively close proximity of some mountaintop mining operations and populated areas within the EIS study area, blasting associated with mountaintop mining can impact local communities. Blasting activities are a particular concern in that they can produce particulate matter (dust), fumes, flyrock, ground vibrations, and air pressure waves (airblast). This section of the document focuses only on flyrock, ground vibrations, and air pressure waves produced by blasting at mountaintop mines. Air quality and potential health risk is discussed in Section V of this chapter.

1. Trends Associated With Blasting at Mountaintop Mining Sites

Blasting activities have used larger quantities of explosive materials to fracture greater amounts of coal mining overburden over the years as mining operations have increased in size and productivity. For example, the West Virginia Governor's task force reported that over the last 20 years, blast detonations associated with the larger mines have increased from approximately 100,000 pounds to over one million pounds of explosives. In addition to more explosives used in blasting, the time periods over which blasting may occur in a general location have changed. For example, as the location of a typical contour mine nears a house and passes, blasting influence may last for weeks or perhaps a few months. For a large mountaintop mine, removing multiple coal seams, the blasting near a home may last years. This occurs where numerous blasts facilitate overburden removal as underlying seams in the same location are successively mined. These trends have, in turn, exacerbated local citizens' perceived impacts of MTM/VF mining operations. Many of the comments received during scoping for this EIS dealt with concerns over impacts that were reportedly occurring to structures, water wells, and the general quality of life in communities as a result of blasting.

2. Studies Relating to the Impact of Blasting on the Community

A number of studies have been conducted over the years to determine the effects that blasting can have on traditional structures and wells. These studies were used in the development of OSM regulations, establishing thresholds for air blast and ground vibrations that would prevent injuries to persons or damage to public or private properties outside the permit area. Since the scale of blasting, as indicated above, has changed, and coalfield residents continue to allege blasting-related problems, OSM routinely evaluates the blasting control portion of the regulatory program to assure it adequately provides for protection of the public and property. For example, OSM recently performed a national review of 1,317 blasting complaints recorded over a one-year period (between July 1998 and June 1999). From readily available data in Federal and State files, collected as part of the national citizens' complaint review, the report entitled "Blasting Related Citizen Complaints in Kentucky, West Virginia, Virginia and Tennessee" was prepared (see Appendix G). The study gathered data in three general categories: (1) reason(s) for the complaint; (2) methods of investigation used in the complaint investigation; and (3) resolution of the complaint.

The following general observations are made from the study data.

- The EIS study area accounted for 54% of the blasting-related complaints nationally. If one mine in Pennsylvania (outside the EIS study area) were omitted, the EIS study area accounted for 72% of the complaints.
- Within the EIS study area, approximately 50% of the blasting-related complaints were lodged in West Virginia. Kentucky accounted for approximately 37%, with Virginia and Tennessee accounting for approximately 12% and 1%, respectively.
- Annoyance/noise concerns were a component of 75% of the blasting-related complaints in the EIS study area.
- Damage to structures (residential dwellings) was alleged in approximately 33% of the blasting-related complaints in the study area. In investigating these complaints, no instances of blast-induced vibration damage were found attributable to the mining operation by the regulatory authority.
- Alleged damage to domestic water systems was a component of approximately 14 percent of the blasting-related complaints in the study area. One of the investigations resulted in a finding of impact on water quantity or quality.
- Flyrock (earthen materials such as rock) beyond the permit boundary was alleged in approximately 2 percent of the blasting-related citizen complaints.

Investigations of blasting-related citizen complaints resulted in the issuance of a notice of violation and/or cessation order in the states within the EIS study area, as follows:

- 44 violations were issued in West Virginia in response to 30 of 352 complaints (9%).
- 36 violations were issued in Kentucky in response to 23 of 263 complaints (9%).
- 17 violations were issued in Virginia in response to 12 of 87 complaints (14%).
- No violations were issued in Tennessee in response to 6 complaints (0%).

Most of the violations were issued for exceeding vibration limits or keeping inadequate records and were generally issued for violations unrelated to the original complaint(s).

Occasionally, structures that either: 1) do not fall into the "typical" category; or, 2) may not have been included in the body of research data on which the SMCRA regulations were founded, are identified near proposed mine sites. An OSM study, entitled "Comparative Study of Structure Response to Coal Mine Blasting – Non-Traditional Structures" was designed to provide information on the impact of blasting on such structures (see Appendix G). Non-traditional structures may include pre-fabricated houses, trailers, log homes, sub-code homes and adobe structures. This study, conducted near eleven mine sites in nine states, measured the response characteristics of these structures to determine if the current rules provide for their protection, or if modified vibration limits were prudent. As in earlier studies of similar structures, this study concluded that certain types of non-traditional structures (e.g., those constructed of earth, masonry, or two story "camp" homes), responded more strongly than traditional frame or masonry structures to blasting vibrations and air blast. When these structures are present near coal mine blasting, lower site-specific limits may be a prudent action for the regulatory authority to take. This provision is currently an option for the regulatory authority that is provided within the existing regulatory program. This study provides the basis for site-specific investigations on non-traditional structures and should result in improved levels of protection for these structures.

Previous scientific research has generally not supported a connection between blasting and permanent adverse impacts to domestic water supplies (wells). The recent OSM study entitled "Comparative Study of Domestic Water Well Integrity to Coal Mine Blasting" was designed to determine if the available information on wells and impacts from blasting remained valid--considering the larger blasts that are typical in today's mountaintop mining operations. This study was conducted in southern West Virginia, eastern Kentucky, and southwestern Virginia. The study concluded that, similar to earlier studies on wells and blasting, few changes could be directly attributed to a blast event (e.g. no major differences in the observed water quality and well yield data). The study report related to blasting and water wells is under development, but an executive summary is provided in Appendix G.

3. Regulatory Standards and Guidelines

Federal SMCRA regulations related to blasting have not changed substantially since 1983. Under the SMCRA regulatory program, limitations and controls are placed on blasting with the intent of protecting public safety and limiting flyrock, airblast, and ground vibrations to prevent offsite damage to structures. The SMCRA regulatory program provides specific blasting-related performance standards that must be complied with when conducting mining operations. Mine permit applications are required to contain a blasting plan detailing the measures to protect surrounding areas from damage and adverse effects. The general public is notified of proposed mining activities by an advertisement placed in local newspapers at the time of the permit application. This plan can be reviewed by the public during the public comment period and discussed at public meetings.

The Federal rules require that all persons directly responsible for use of explosives on a mine site be trained and tested through a program that includes a written examination and demonstration of field experience. At a minimum, the training and testing includes the technical aspects of the blasting operations and State and Federal laws governing the storage, transportation and use of explosives. A certified blaster may utilize non-certified personnel as assistants in a blasting operation only when they are under the direction of and given on-the-job training by the blaster. Certifications may be suspended or revoked if the blaster violates Federal or State laws.

Once the permit is issued, coal operators are required to place blasting schedule announcements in local newspapers prior to initiation of blasting, and to continue to do so annually as long as blasting continues. At least 10 days prior to initiation of blasting, residents and owners of other structures within one half mile of the proposed blast sites are also mailed a blasting schedule. The blasting schedule mailing is required annually as long as blasting continues. The schedule outlines the location of proposed blasting, the dates and time periods of blasting, and the warning signals. The SMCRA regulatory authority must approve this schedule and can limit the blasting, if necessary and reasonable, in order to protect the public health and safety or welfare.

Pre-blast surveys are offered by mining operators at no cost to (or may be requested by) residents and owners of structures located within one-half mile of the permit area. These surveys are designed to identify any sensitive structures where additional safeguards may be necessary and to document conditions of structures near the mine site prior to blasting. This provides important baseline information to facilitate the resolution of potential blasting damage complaints. A pre-blast survey typically includes written documentation, supplemented by pictures, of existing structure condition,

such as wall cracks, foundation cracks, and broken windows. 30 CFR Section 816.62 also requires that consideration be given to utilities and water systems during a pre-blast survey, however assessment of these structures may be limited to surface conditions and other readily available information. Well quantity measurements, such as pump tests or other yield estimates, are not typically included in pre-blast surveys. Copies of the pre-blast surveys are provided to both the resident and the regulatory authority.

Prior to initiation of blasting, signs warning of blasting activities must be placed at identified locations of possible public access to the site and must be maintained until blasting will no longer occur. Warning and all clear signals audible up to one-half mile from the blast site must be used in association with each blast. Access to the site prior to a blast must be controlled to prevent persons or livestock from entering the blast area. Once blasting is initiated, it must be conducted in a manner to prevent personal injury, damage to public or private property beyond the permit boundary, and adverse impacts to nearby underground mines or surface and groundwater availability outside the permit area. Specific limits on airblast, ground vibration, and flyrock are identified in regulations that will generally provide the required protections. If unique circumstances are identified in the pre-blast survey, as a result of a citizen's complaint, or through a mine site inspection, the regulatory authority can establish lower ground vibration or airblast limits to ensure prevention of damage. Detailed records of each blast must be maintained and available for review for at least 3 years.

SMCRA statutes and regulations provide a mechanism for anyone who has reason to believe that a violation of blasting or other requirements may have occurred to file a complaint with the regulatory agency. Generally, complaints are made to the regulatory agency, which will then investigate the complaint and render a written finding to the complainant. If the investigation confirms a violation, of blasting or any other requirement, enforcement action is taken against the coal operator. If citizens disagree with the findings of a complaint investigation, they have appeal rights in all four states within the EIS study area. The initial appeal is generally conducted internally by the regulatory agency. If a satisfactory resolution is not achieved in this way, appeals may proceed to civil court for judicial resolution, or though other agencies (the appeal agency varies in the individual states).

4. Recent Program Improvements

Although studies and surveys have shown current regulatory controls provide adequate protections for nearby properties/structures, SMCRA regulatory authorities recognize that blasting complaints continue at a relatively high level and are particularly contentious in the steep-slope coalfields where larger mining operations are adjacent to populated areas. While compliance records indicate that a relatively small number of blasts actually exceed performance standards, additional guidance, analysis tools, and training will increase the capabilities of inspectors and blasting specialists to further minimize blasting effects and more successfully address citizens' sensitivity to blasting issues.

OSM has several initiatives directly related to this issue. OSM recently developed and provided the Blast Log Evaluation Program (BLEP) to the state SMCRA programs as part of its Technical Information Processing System. BLEP is designed to help the mine inspectors compile blast log data to: 1) identify record-keeping problems; 2) identify unusual site conditions; 3) "red-flag" quality control problems by the blast crew; and 4) facilitate review by blasting specialists. The OSM

Blasting Guidance Manual (1987) is being rewritten to reflect the current technology and 15 years of regulatory experience on blasting. This manual not only assists in the evaluation of blasting complaints, but provides the coal mining industry with an awareness of the particular areas where regulatory focus will occur and methods for minimizing problems through blast design, controls, and monitoring techniques. Also, in addition to the basic technical training course entitled "Blasting and Inspection", the OSM National Technical Training Program has developed a class entitled "Advanced Blasting: Investigation and Analysis of Adverse Effects." This additional training places emphasis on monitoring and evaluating ground vibration and airblast to heighten the inspectors' understanding of potential adverse effects and may improve protection of nearby structures and potentially reduce nuisance impacts. The training describes the response of buildings to vibrations and teaches recognition of weather conditions when blasting would create more nuisances (e.g. days with temperature inversion). Training also explains the existing flexibility in blasting regulatory requirements that allow states to limit blasting based on site-specific conditions (i.e. use of pre-blast surveys), as well as re-evaluation of blasting limits if damage allegations arise. Increased technology transfer on the latest techniques and methods for assessment of potential adverse effects from blasting enhance the regulatory authorities' ability to:

- Monitor ground vibrations and airblast,
- Evaluate blasting records,
- Recognize unique site conditions,
- Adjust blasting plans accordingly, and
- Communicate more effectively with citizens.

West Virginia has also demonstrated a leadership role in passing laws and regulations that highlight the importance of mining companies being good corporate neighbors and addressing citizens' blasting concerns. The West Virginia Legislature and WVDEP have recently developed and implemented state statutes and regulations that created the Office of Explosives and Blasting (OEB). The OEB establishes dedicated blasting specialists and new regulatory standards including:

- For single permits of greater than 200 acres (or contiguous permits of 300 acres or more), revising the pre-blast survey requirements to 0.5 mile from the permit boundary or a distance of 0.7 mile from any proposed blasting site, whichever is greater;
- Requiring that a well water sample and yield test be part of the pre-blast survey;
- Mandating that those who conduct pre-blast surveys must be trained and certified, including a minimum of 12 hours of refresher training every three years for certified blasters;
- Implementing an improved blast damage claims process, whereby the state retains the services of independent, qualified third parties to evaluate claims of damage; and
- Developing a binding arbitration process for use if the determination of the third party investigator is challenged.

5. Conclusions

The blasting studies completed as a part of this EIS reveal that existing regulations provide appropriate controls for preventing damage to structures, including wells. OSM's recent programmatic oversight review of blasting-related citizen complaints confirmed that when blasting complaints occur, the complaints are investigated and responded to as required. The complaint study appears to indicate that, while blasting activities are noticeable by adjacent residents and often perceived to cause damage and trigger a complaint, the cases of confirmed blast-related damage comprise a small portion of total complaints. Additional research by OSM has not indicated that existing damage thresholds are inadequate. Moreover, the regulations provide for states to adjust limits in circumstances where lower damage thresholds are warranted. As such, the existing programmatic controls (statutes, regulations, policies, and guidance) provide adequate levels of protection. No additional actions to control blasting are warranted at this time. OSM diagnostic tools, training, and updated guidance should enhance application of the existing standards as well as blast monitoring and investigation of future complaints.

The agencies recognize that, in spite of enforcement of the existing regulations and implementation of the recent program improvements, blasting concerns/complaints will continue. Concerns and subsequent complaints are likely to decrease as a result of the identified recent program improvements. However, when mountaintop mining operations are near populated areas, complaints, particularly those related to noise and vibration of homes (nuisance impacts), may still occur in relatively high numbers. Although regulations provide a limited ability to control nuisance impacts (for example blasting may typically occur only between sunrise and sunset), these nuisance-type concerns will continue to have periodic adverse effects on the quality of life of residents living in close proximity to the mine sites. The regulations were designed to minimize damage potential and only indirectly address nuisance; however, citizens retain the right to take civil action against a mining operation for nuisance-related concerns. There have been court cases in the coalfields where mining activities have been ordered to adjust operational procedures (i.e., above-and-beyond existing regulatory program controls) to reduce public nuisances.

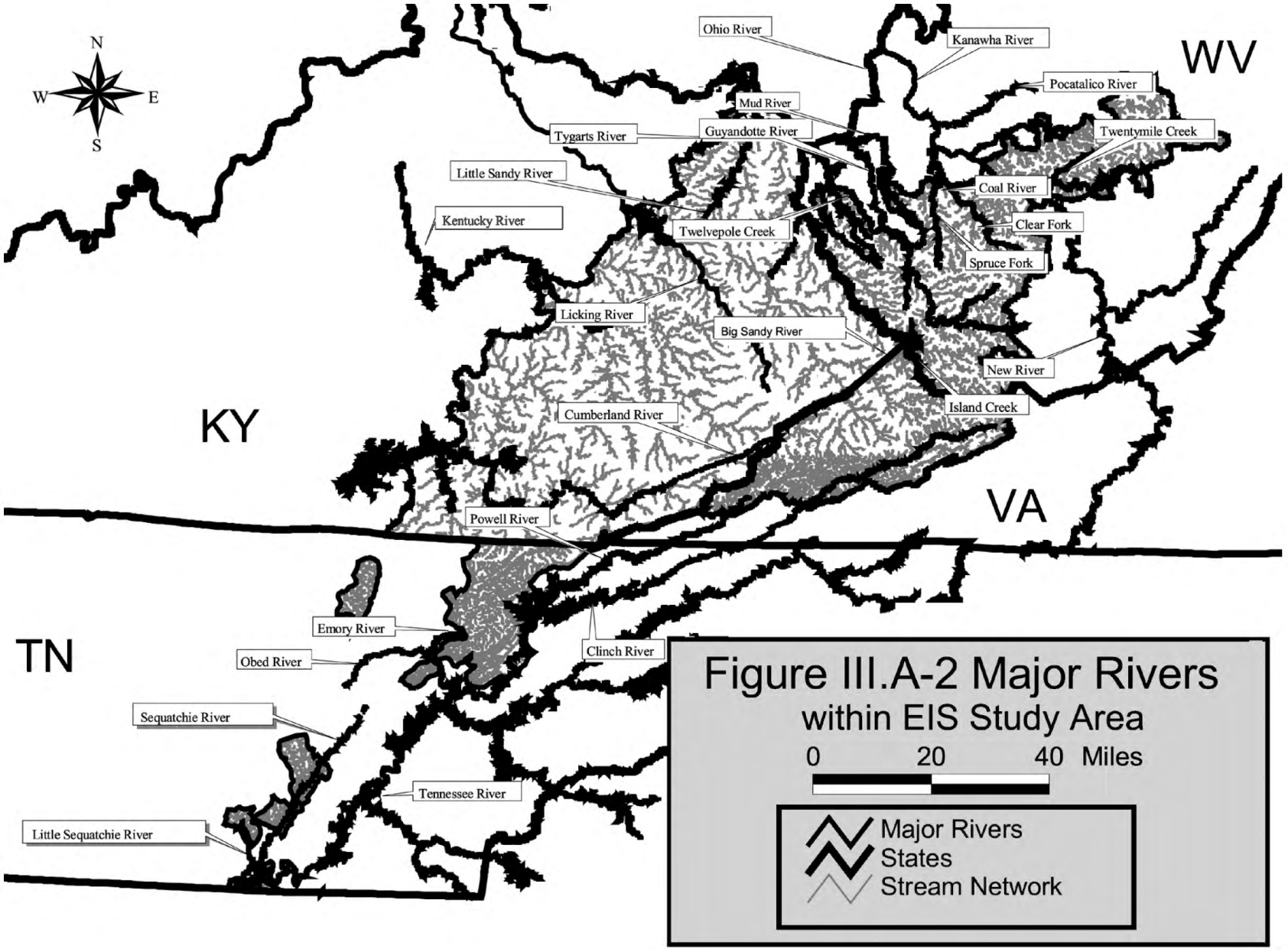
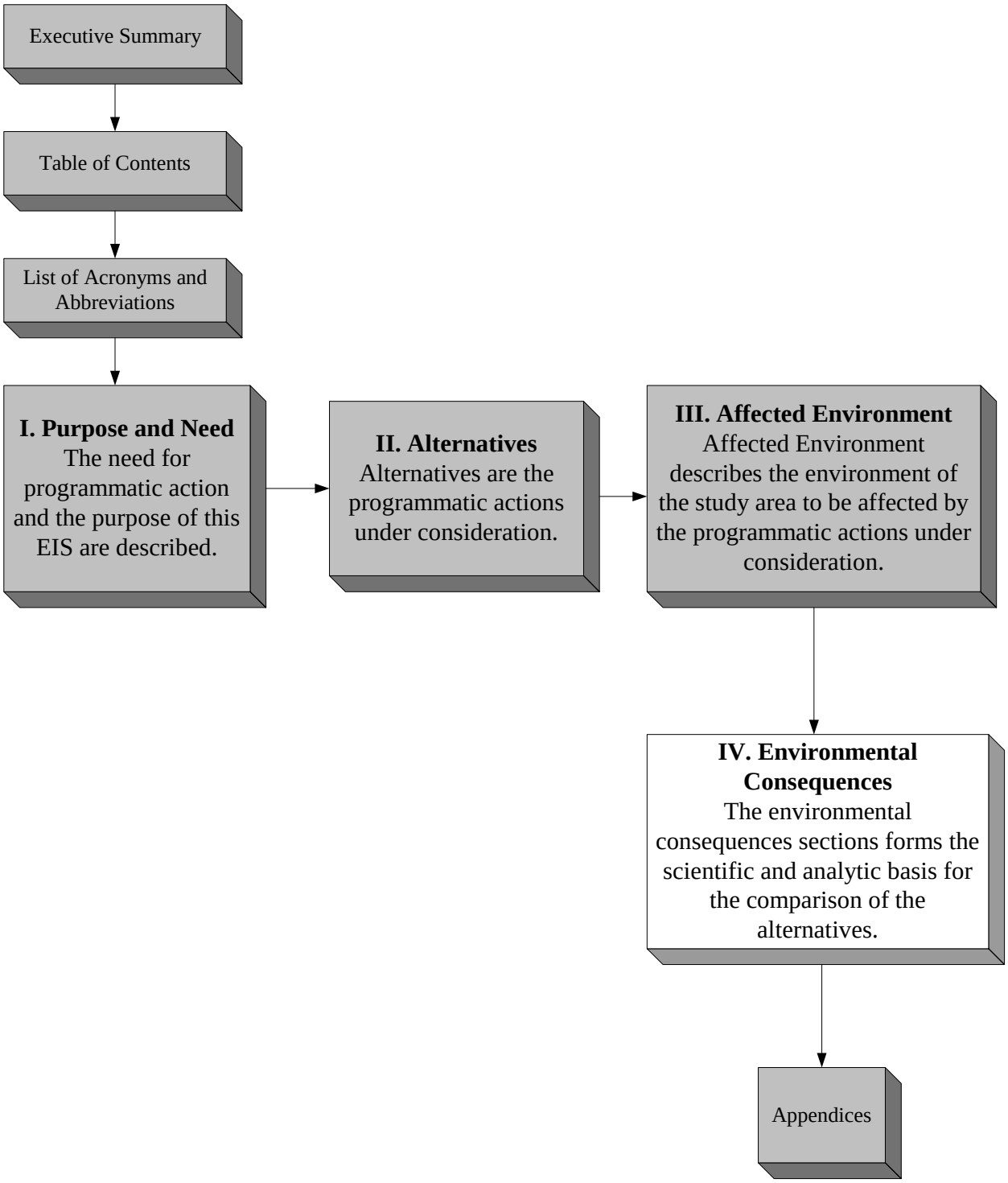


Figure III.A-2 Major Rivers within EIS Study Area

Chapter IV. Environmental Consequences



IV. ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES ANALYZED

A. INTRODUCTION

Chapter IV describes the effects on the human environment of the no action and proposed action alternatives described in Chapter II. Chapter III provides a detailed discussion on the affected environment of the study area and results of technical studies of environmental effects of mining, including MTM/VF operations. Technical information gathered for this EIS assists in delineating consequences and may also be a useful tool in the regulatory decision making process on a case-by-case basis. To give proper context to the discussion of consequences of the alternatives in this chapter, each section of this chapter sets out additional information on the consequences of MTM/VF activities.

The information on consequences of the alternatives includes the benefits of the alternatives, anticipated outcomes of proposed actions, and available information on the impacts of proposed activities regulated by the programs analyzed in this EIS. This programmatic EIS is necessarily broad given its purpose of addressing policies, guidance, and coordinated agency decision-making processes to minimize the adverse environmental effects from MTM/VF and the size and location of excess spoil disposal sites in valleys. The proposed actions and alternatives consist of many potential changes to data collection and analysis protocols, guidelines for best management practices, regulations, and mitigation requirements for MTM/VF operations. They are aimed at improving agency efficiency and effectiveness, increasing consistency within and between agencies, and meeting other public policies.

The proposed action alternatives are largely administrative and as a result, accurately projecting their environmental consequences is difficult. All three action alternatives share the goal of a better regulatory process and improved environmental protection. Therefore, projections of the positive and negative consequences of the action alternatives and the No Action Alternative must be made to compare the alternatives, even though accurately projecting impacts of administrative measures is difficult.

Environmental consequences can be categorized and presented in many ways, including the following:

- Direct effects of implementing an action
- Indirect effects, occurring in combination with other influences, that may occur at a later time or at some distance from the activity
- Short term or temporary effects
- Long-term or permanent effects
- Adverse effects
- Beneficial effects
- Cumulative effects
- Economic or social effects

This chapter discusses environmental consequences in these various ways.

1. Cumulative Effects

The Council on Environmental Quality (CEQ) regulations [40 CFR 1500-1508], implementing the procedural provisions of NEPA, define cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions [40 CFR 1508.7]." "Actions," as used in CEQ regulations, may include a broad range of activities from those as specific as individual construction projects to those as general as implementing regulatory programs. Individual adverse impacts from an action may be insignificant individually, but may accumulate over time from one or more origins and collectively result in significant adverse impacts that degrade important natural resources. The cumulative impacts of a particular action can be viewed as the total effects on natural resources, socioeconomic resources, human health, recreation, quality of life aspects, and cultural and historical resources of that action and all other activities affecting those resources, compounding the effects of all actions over time.

The proposed actions and alternatives are broad in scope. As a result, this EIS is programmatic, addressing environmental consequences that are correspondingly broad in scope. Furthermore, none of the proposed actions or alternatives would be implemented in a vacuum. Implementation of the selected actions are interwoven with many other actions, events, and trends taking place at local, regional, national, and international levels.

For example, surface coal mining is not the only factor that affects vegetative cover in the study area. Land management practices, which include harvesting of timber and development for residential, recreational or commercial purposes, are also key considerations. The future of forest land in the eco-regions of the study area cannot be predicted by considering changes in surface coal mining reclamation alone.

Similarly, the CWA and SMCRA regulatory programs are not the only factors that affect coal mining and communities in the study area. Also of major importance are regional population loss or growth; changing demographics, lifestyles, property values, and alternate energy sources; economic competition and restructuring; and changing laws, policies, and practices implemented by other Federal and state agencies.

Population growth or decline and demographic changes in the study area will continue to transform communities in the study area. Communities that continue to lose population due to a lack of economic growth and diversification will further decline or be strained by decreases in employment opportunities in coal mining. However, communities that are positioned to sustain and promote economic growth through diversification will avoid a decline in growth. Demographic and land use changes might increase or decrease a community's tax base. Where economies are stable or growing, the tax base would likely be stable. Where populations continue to decline or mineral production significantly declines, the state and local tax revenues might decline.

The protection of Federally-listed species and their habitats can change the way mining activity is conducted. Future activities designed to avert habitat loss and endangered species listings will be implemented under any of the regulatory alternatives considered in this EIS.

A fundamental assumption of this analysis is that, with or without changes to the CWA and/or SMCRA regulatory programs for MTM/VF operations, the human environment within the study area will continue to change. The environmental regulatory programs for MTM/VF operations are but one factor in defining the future conditions of the human environment. The potential environmental consequences of the proposed actions and alternatives, including cumulative effects, are discussed by resource in this chapter. The surface mining of coal, including MTM/VF operations, is regulated by the laws and regulations discussed previously in Chapter II and Appendix B. None of these alternatives would reduce the effectiveness of the current regulatory programs described in Chapter II.

This EIS evaluated the cumulative effects of MTM/VF on various resources, socio-economics, and the human or natural environment in the following sections: Chapter III.N, Past and Current Mining in the Study Area; Chapter III.O, The Scope of Remaining Surface-Minable Coal in the Study Area; Appendix G, Post Mining Land Use Assessment--Mountaintop Mining in West Virginia, Mountaintop Technical Team Report, Phase I and II Economic Studies, Case Studies Report on Demographic Changes Related to Mountaintop Mining; Appendix I, Landscape Scale Cumulative Impact Study of Mountaintop Mining Operations and Figure III.O., The Extent of Potential Mountaintop Minable Coal.

2. Irreversible and Irretrievable Commitment of Resources

A resource is irreversibly committed when an action alters the resource so that it cannot be restored or returned to its original or pre-disturbance condition. A resource is irretrievably committed when it is removed or consumed. For example, in the surface mining of coal, the removal of coal would be an irreversible and irretrievable commitment of resources. While the coal would be irreversibly committed from the geologic formations, it is also irretrievably committed when burned for electrical generation.

Another example of irreversible loss involves native soil loss or erosion. Soil losses from handling, erosion losses from topsoil stockpiles, and other unavoidable erosion losses of native soils would be irreversible. CWA and SMCRA require that soil erosion and sedimentation be minimized and otherwise controlled to mitigate these effects to the maximum extent technologically feasible. Also, studies of reclaimed sites have shown that non-native mine soils, with time, become more like stable developed native soils.

The direct burial of stream segments by excess spoil for MTM/VF operations is a long-term irretrievable commitment of resources for the buried stream segment. However, the CWA and SMCRA provisions are designed to assure that adverse impacts to aquatic resources are minimized and that significant degradation of the downstream watershed does not occur from MTM/VF activities. Consequently, the effects of MTM/VF on aquatic resources are irreversible for a buried stream segment, but may produce varying levels of impact to the overall hydrologic regime depending on the watershed considered.

Impacts on terrestrial resources, such as forests and wildlife may be either permanent or temporary depending on the time frame considered. For instance, a mine site without reforestation as the post-mining land use may still result in a reversion to forestry through natural succession–despite the problems of excess compaction, lack of native seed sources across the reclaimed area, and other

conditions hostile to reforestation. With sufficient time, although it may take hundreds of years, natural processes for mine soil improvement and succession can overcome conditions limiting reforestation, and the resource loss is not irreversible. Conversely, intensively managed reclaimed mine sites may never regain trees due to long-term use as industrial, residential, agricultural, or other non-forest uses. Reclamation techniques may exist to equal or exceed natural forest regeneration and productivity. In the cases where these techniques are applied, the loss of forest resource may be no less reversible than timbering; and in some cases productivity gains surpassing forestation on native soils. Reclamation of mine sites to forest conditions (commercial or otherwise) may not reestablish wildlife habitat to pre-mining conditions. While no program can dictate post-mining land uses, many programs encourage and promote the tangible benefits for return of mined land to forest conditions so as to minimize and mitigate adverse effects.

While loss of individuals of certain species within the mined areas may be irreversible, individuals of other species may be mobile enough to relocate to adjacent interior forest tracts. The adjacent forest tracts, which include their own resident populations, may or may not be able to support the additional populations due to competition for habitat. Again, the reclamation methods employed and post-mining land uses selected will determine whether or not the loss of wildlife resources is irreversible. Researchers have debated the benefits and detriments of forest edge habitat versus forest interior habitat, centered on the concept of biodiversity. Studies have shown that a post mining change in habitat can provide transitional habitat for declining grassland species uncommon to forested ecosystems. Accordingly, a shift in wildlife resource species may be temporary in nature, as with the vegetative cover, and provide arguments both for and against irreversible change–depending on the viewpoint of the observer.

Environmental controls on surface coal mining and reclamation may render some coal resources irretrievable. Avoiding and minimizing valley fill stream impacts could make portions of coal seams recoverable only by inefficient methods or not feasible to recover at all. However, these effects may be temporary for some coal resource blocks if different mining methods become feasible or the coal market makes it economical to mine the reserves in compliance with environmental controls. That is, rising energy prices or new technology might allow reclamation techniques that currently cannot be performed within profit margins. The loss of these reserves would not have an immediate, irreversible effect on energy production, because sufficient coal reserves exist elsewhere to meet current energy demands. However, long-term effects on energy production could occur, since rendering some Appalachian surface mining coal reserves unminable could ultimately hasten reserve depletion when other coal sources dwindle.

The level of future surface coal mining and reclamation operations under the proposed actions or alternatives would directly affect the magnitude of the irreversible and irretrievable commitment of resources. Provisions of the alternatives would also define the nature and extent of these commitments. These types of irreversible and irretrievable effects are discussed as part of the environmental consequences of the alternatives for resources susceptible to such effects.

B. AQUATIC RESOURCES

This section addresses the environmental consequences of MTM/VF associated with the alternatives as they affect the aquatic resources. These consequences include direct impacts such as the physical loss of streams and their associated biota, as well as indirect and cumulative impacts such as changes in water temperature, downstream chemistry and sediment transportation. This section discusses these direct and indirect impacts in the context of future conditions under the four alternatives.

Stream habitat and functions have been discussed in Chapter III.C.1 and the potential impacts to the streams from MTM/VF have been presented in Chapter III.D. Among the ecological functions of headwater streams are nutrient cycling and the maintenance of unique species and populations which provide a reservoir for genetic diversity in aquatic systems on a national basis. Changes in downstream thermal regimes, flow regimes, chemistry and sedimentation due to MTM/VF are discussed under the stream impairment issue in Chapter II.C. The impacts from MTM/VF, along with other disturbances such as road building, logging, and influx of residents, may result in a cumulative affect on aquatic resources within a watershed. A number of actions are proposed to standardize data collection, collect and analyze water quality and stream data, and develop a BMP manual for stream mitigation.

1. Consequences Common to the No Action Alternative and Alternatives 1, 2, and 3

a. Direct Stream Loss from MTM/VF

This section portrays consequences of past MTM/VF regarding loss of streams projected into the future using two measures: valley fill area and mining permit area. The amount of stream loss may differ with alternative selected, but stream loss will occur under all alternatives. Data on loss of linear miles of stream are available from the Cumulative Impact Study [Appendix I] and from the Fill Inventory [Chapter III.K.2]. The cumulative impact study estimated direct stream impacts based on the *permit boundary footprint* (including fills, mineral removal, roads, and incidental support areas), while the fill inventory estimated direct stream impact based only on *valley fill footprints*. Estimation of direct stream impacts based on the entire permit area footprint may overestimate actual direct impact, since not all of the area within the permit boundary is disturbed. Estimates of direct stream impacts based only on the valley fill footprint may underestimate actual direct impact because direct stream impact can occur in production and support areas.

MTM/VF impacts (including valley fills and other permit features) estimated in the Cumulative Impact Study (based on ten years, 1992-2002 of *permit* footprints) were 1,208 miles (2.05 %) of the 58,998 stream miles in the EIS study area. If that rate continued for another 10 years, a total of 4.10% would be impacted by 2013. [Appendix I] The following is a breakdown of stream impacts by *permit* footprint by state in the past ten years in the EIS study area. Kentucky had direct stream impacts of 730 miles (2.1%) of its EIS study area. Tennessee had direct stream impacts of 20 miles (0.4%) in the Tennessee portion of the study area. There were 151 miles (2.1%) of direct stream impacts in the Virginia portion of the study area. Direct impacts totaled 307 stream miles (2.6%) of the West Virginia portion of the study area.

The Fill Inventory calculated miles of streams under approved valley fill footprints in permits issued for the seventeen year period from 1985 to 2001. The total direct stream impact from *valley fill* footprints for the EIS study area for this period is 724 miles, or 1.2 % of the miles of streams within the study area [Chapter II.K.5 and Table IV.B-1]. If valley fill construction continued at this historical rate documented in the Fill Inventory for the next seventeen years (2003-2020), an additional 724 miles (for a total of 2.4%) could be impacted.

Table IV.B-1
Study Area Stream Miles Under Valley Fill Footprint

Year	KY	TN	VA	WV	Total
1985	26.98	0.22	4.60	21.02	52.82
1986	18.00	1.42	4.04	7.39	30.85
1987	32.07	0.51	2.22	1.66	36.46
1988	34.96	0.33	4.27	7.55	47.11
1989	20.81	0.00	4.32	11.66	36.79
1990	17.85	0.02	4.05	4.66	26.58
1991	26.60	0.65	5.16	10.73	43.14
1992	34.90	0.68	4.31	15.12	55.01
1993	26.30	0.00	4.50	11.31	41.81
1994	24.59	0.00	2.33	12.25	39.17
1995	36.83	0.00	3.46	21.58	61.87
1996	31.94	0.58	4.01	15.91	52.44
1997	28.99	0.43	3.00	15.58	84.00
1998	24.60	0.92	5.36	13.55	44.43
1999	25.19	0.31	4.06	19.90	49.46
2000	15.56	0.24	6.58	22.41	44.79
2001	10.19	0.00	1.09	1.73	13.09
Total	436.36	6.31	67.36	214.01	724.04

[Source: Valley Fill Inventory, Chapter III.K.2., Table K-8]

Studies show that while invertebrates and microbiota in headwater streams are only a minute fraction of living plant and animal biomass, they convert leaf litter to coarse and fine particulate organic matter. Scientific literature, for studies in states outside the EIS region, estimate that about one kilogram of organic matter per meter length of stream transports downstream on an annual basis. This matter is transported downstream and is part of the food supply for invertebrate populations; which, in turn, become food for fish populations. Accordingly, the length of stream buried by mining or valley fills displaces the biomass and proportionate amount of energy provided by fine- and coarse-particle organic material leaving a particular reach of headwater stream. [Chapter III.D.; Appendix I; Appendix D (Value of Headwater Streams Workshop); Wallace, 1992.]

Research outside of the EIS study area found that when leaf litter was excluded from a stream, macro invertebrates dependent on the litter declined, as did invertebrate predators and salamanders. The research also established that rapid recovery of aquatic organisms occurred when leaf litter was restored. Consequently, leaf litter exclusion as a result of MTM/VF may affect aquatic productivity downstream to some extent due to this terrestrial-aquatic interrelationship.

No widely-accepted, standardized testing procedures exist for measuring the presence/absence of the fine and coarse organic matter and consequent energy contributions of stream. Thus, the EIS stream chemistries studies in West Virginia and Kentucky did not document the effect of stream loss on the downstream energy continuum.

The estimates of potential future stream loss are liberal, in that they do not take into account the focus on avoidance, minimization, and mitigation requirements in the 2002 NWP 21. Independent of any other future actions, the 2002 NWP 21 will likely reduce the rate of stream loss that occurred in the preceding ten-year time frame for permit footprints; or in the 17-year time frame for fill footprints.

Similar effects to headwater and larger streams occur from other human activities, such as road building and development for industrial/residential/commercial sites in steep-slope Appalachia. As discussed by Yuill in the post-mining land use report, suitable developable land is in short supply in some parts of the West Virginia study area [Appendix G]. Consequently, creation of areas suited for roads and development often places fill materials in streams. Based on the current demographics in the EIS study region, coal mining operations are likely to have the consequences of disturbing more land than residential, industrial or commercial development in the coalfields. Nonetheless, the CWA requires consideration of the cumulative effects of all activities and SMCRA requires assessment of the hydrologic cumulative effects for all coal mining in a watershed. These evaluations are integral to decision making on authorizing MTM/VF projects and aid in minimizing the cumulative effects of direct stream loss.

The No Action Alternative and action alternatives will not eliminate the loss of stream segments and reduction in organic matter transported downstream. In the absence of standardized testing and research, it is not clear to what extent this direct stream loss indirectly affects downstream aquatic life. It is also not evident to what degree reclamation and mitigation (e.g., drainage control and revegetation) offset this organic nutrient reduction. The direct impacts of stream loss are permanent, but the downstream effect from organic energy loss may be temporary. Existing CWA programs indirectly address these effects through technology-based effluent limits, state water quality standards, TMDLs, and other provisions designed to assure overall watershed health.

SMCRA and CWA program improvements common to the action alternatives, summarized in Chapter II.B and described in Chapter II.C, will serve to reduce future direct stream loss. Implementing requirements, policies, and guidance relative to increased/shared data collection and coordinated analysis of predicted impacts by the agencies; emphasis on avoidance, fill minimization, and site selection; mitigation of the loss of aquatic functions; use of ADIDs and BMPs; and, establishing minimal/cumulative impact thresholds (if feasible) and consistent stream definitions and delineation techniques, will operate to minimize future direct stream loss under all action alternatives.

b. Indirect Stream Impacts

The consequences of direct stream loss and energy transport reductions, discussed above, also indirectly affect downstream stream reaches. MTM/VF has the potential to alter the chemistry, water temperature, flow regime and geomorphological features downstream. Stream chemistry showed increased mineralization and a shift in macroinvertebrate assemblages from pollution-intolerant to pollution-tolerant species. Water temperatures from valley fill sites exhibited lower daily fluctuations and less seasonal variation than water temperatures from reference sites. Daily stream flows from studied valley fill sites exhibited greater base flow than reference sites. Smaller sediment particle sizes were found in downstream substrate. [Chapter III.D; Appendix D]

Scientists postulate that stream thermal regimes, which can influence microbial activity, invertebrate fauna, fish egg development, larval growth, and seasonal life cycles, may be affected by valley fills and sedimentation ponds at the base of the valley fills. Scientists also theorize that, as mining or other human development practices eliminate first order streams, unique biological diversity may be affected, especially if rare species occur in only one or two spring or seepage areas and are impacted. [Chapter III.D; Appendix D]

Headwater stream systems do not have a tremendous capacity to provide purification functions. Although these ecological processes are not one requiring protection, the absence of streams to provide this function reflects the sensitivity of the system to inputs of a variety of potentially toxic materials. As groundwater and infiltration move through surface coal mining operations a variety of potentially toxic materials are released into the environment, including metals and mineral constituents such as sulfates which, if at high enough levels, may act by altering physical characteristics of water (e.g. pH or specific conductance). Headwater streams, with their innately limited buffering capacity and lack of ability to sequester and precipitate out contaminants, tend to be at risk from any input of toxic materials exceeding the streams limited capacity to assimilate. [Chapter III.D.]

The EPA Water Chemistry Report found elevated concentrations of sulfate, total and dissolved solids, conductivity, selenium and several other analytes in stream water at sampling stations below mined/filled sites [Appendix D; USEPA, 2002b]. Other studies found elevated concentrations of sulfates, total and dissolved solids, conductivity, as well as other analytes in surface water downstream from MTM/VF sites.

Studies conducted as part of this EIS show that aquatic communities downstream from MTM/VF differ from unmined headwater streams in several ways. In most cases, there were differences in biological assemblages. Generally, macroinvertebrate communities below mined areas were more pollution tolerant than those below unmined watersheds. However, biological conditions of filled sites represented a gradient of conditions from poor to very good, demonstrating a wide range of conditions that may be found in aquatic communities downstream from MTM/VF or other human disturbances [Appendix D; USEPA, 2000 (Green, et. al.)].

The Aquatic Impacts Statistical Report indicated that ecological characteristics of productivity and habitat are easily disrupted in headwater streams [Appendix D; USEPA, 2003)]. Accepted indices and comparisons correlated chemical and biological (macroinvertebrates and fish) parameters in unmined, filled, filled/residential and mined sites. The analysis indicated that biological integrity

is hampered by mining and that unmined sites have a higher biotic integrity with more taxa and more sensitive taxa. The strongest association with water chemistry suggested that zinc, sodium, and sulfate concentrations were negatively correlated with fish and macroinvertebrate impairments. Selenium and zinc were negatively correlated with the West Virginia Stream Condition Index (WVSCI). The potential drivers of these conditions are mining practices, material handling practices, and the geological factors associated with specific coal seams and overburden. However, the study also concluded that insufficient data existed to determine the temporal nature of the impact or the distance downstream that the impacts persist. Due to the limited scope of the studies performed for the EIS, no correlation could be made of downstream impacts with the age, number, and size of mining disturbances and fills, nor could data differentiate impacts of mining, fills or other human activity in a watershed.

Wetlands are among the most effective ecosystems for removing pollutants and purifying wastes. Wetlands operate through a series of interdependent physical, chemical and biological mechanisms that include sedimentation, adsorption, precipitation and dissolution, filtration, biochemical interactions, volatilization and aerosol formation and infiltration [USEPA, 1999; Appendix D]. Constructing wetlands is a possible mitigation measure for impacts to headwater streams. While this issue is complex, there may be opportunities to construct wetlands at MTM/VF operations, including at the toe of fills where groundwater emerges to improve the water quality of streams downstream from fill areas. The success of these wetland systems to improve water quality would be highly dependent on the toxicity of the water initially.

Other human development activities, such as logging and other types of excavation, also pose potential threats to the nutrient cycling function, sedimentation, and other physical, chemical, and biological impacts to headwater streams in the EIS study area. However, the permanent nature of filling discussed under direct loss, as compared to the more temporary impacts from forestry, would suggest that MTM/VF impacts (e.g., nutrient cycling function, biological diversity, mineralization, substrate composition, etc.) of headwater stream systems may have a longer-term impact on this system, although data do not currently suggest the duration of these impacts.

The indirect impacts from MTM/VF will continue regardless of alternative selected by decision makers. However, CWA programmatic controls discussed in direct stream loss are in effect under all alternatives and share the common objective of assuring the overall health of the watershed [Chapter II.C.3.a.1]. The NWP 21 and IP process require the following:

- use of functional assessment stream protocols to identify the type and character of aquatic resources that may be impacted
- prediction of potential impacts and alternatives analysis
- avoidance of high quality resources, if practicable to site activities elsewhere
- minimization of impacts
- adequate mitigation to offset unavoidable impacts, function for function
- demonstration that impacts, individually and cumulatively, are minimal for NWPs and less than significant degradation for IPs
- meeting water quality requirements

The actions proposed and common to Alternatives 1, 2, and 3, when implemented, will further mitigate indirect impacts. In particular, the coordinated and collaborative MTM/VF proposal review

described in the alternatives should result in improved environmental outcomes because of the synergy of joint reviews and shared expertise, on top of improved and increased data collection and analysis. Consideration of the necessity of additional water quality parameters by EPA will take into account the indications of increased mineralization and biological effects from MTM/VF, along with additional study of the duration and downstream extent of these impacts relative to size, number, and age of MTM/VF impacts. The development of a BMP manual for mitigation, in concert with a similar document for improved forestry reclamation, would suggest practices designed to reduce the indirect effects in association with the existing CWA controls described above.

c. Stream Hydrology

Hydrologic modeling studies performed for the MTM/VF EIS found that peak storm water flows are slightly higher during and after mining. The West Virginia Governor's study on flooding found similar peak runoff increases due to timbering. The studies concluded that whether or not these increases exceed bank-full conditions and contribute to flooding are highly site dependent. Hydrologic results from field studies indicate that runoff and ground water are stored in valley fills, tending to increase the base flow of the stream and decrease the peak flows during storm events. As discussed in indirect impacts above, since valley fills create more perennial base flows, the water temperature is less variable than in unfilled watersheds. [Chapter III.G.; Appendix H]

These types of flow impacts appear to be unique to MTM/VF and timbering activity in the study area. Other activities that might affect hydrologic patterns, such as agricultural practices or water withdrawals, appear to have limited impact. MTM/VF, forestry, and human modifications to stream channels and flood plains (fills, bridges, stream crossings, and other encroachments) are the dominant impacts altering the hydrologic patterns in the study area. Alterations in hydrologic patterns may have further impacts on other ecological processes and are discussed under those processes.

CWA Section 404 reviews of MTM/VF activities consider flooding potential. SMCRA considers not only the flooding potential of individual projects, but also the cumulative impacts to the hydrologic balance (including the impacts to quantity and quality of surface water) of all surface coal mining and reclamation operations in a defined cumulative impact area. In addition to the existing flooding and cumulative impact requirements in effect under all alternatives, the action alternatives consider clarifying the appropriate analytical methods and potential remedial techniques to assess and counter flooding risk.

d. Fill Minimization

Fills sizes and numbers, over time, were previously discussed in relation to direct stream loss and are provided in Chapter III.K.2. Prior to 1999, the design of excess spoil disposal areas focused on ensuring that excess spoil fills were safely designed and stable as opposed to avoiding streams and minimizing the volume and areal extent of excess spoil fills. As discussed later under the heading of fill stability, this focus appears to have been effective in reducing the number of slope movements. Increased emphasis on SMCRA proposals attaining AOC since 1999 has resulted in smaller fills. Concurrently, increased accentuation on avoidance, mitigation, and mitigation in the CWA Section 404 program has reduced fill sizes. These regulatory provisions, along with the general 250-acre minimal impact threshold applied by the COE in West Virginia, shifts in coal

production, court injunctions, and difficulty in finding investment capital may have also resulted in fewer and smaller fill impacts. [Chapter II.D.]

The No Action Alternative would continue to emphasize AOC, minimizing the amount of spoil identified as excess, and, as a result, minimize valley fill volume and associated impacts. The SMCRA agencies in the EIS study area (OSM in Tennessee, DSMRE in Kentucky, DMLR in Virginia, and DEP in West Virginia) have developed technical guidelines that assist the surface mining permit applicant to demonstrate that excess spoil will be minimized by returning the maximum amount of mine spoil to the mined-out area. Policies established by the four SMCRA agencies for determining AOC and thus accounting for the excess spoil can be found in Appendix J. The West Virginia "AOC+ protocol" is a systematic method for maximizing the return of spoil to the mined out area. Chapter IV.I.4.a describes how this fill minimization analysis can result in fewer and smaller fills and commensurate reductions in stream impacts and mitigation costs.

The AOC+ and other guidelines do not, in of themselves, consider the condition of the streams considered for fill location; however integral aquatic ecosystem evaluations as part of the SMCRA review can result in narrowing the potential valleys evaluated for fills, based on a preference for disturbing previously-impacted or impaired streams segments over those in a natural, undisturbed condition. Such quantified, objective evaluations of excess spoil disposal plans result in reduced impacts to valleys and streams by requiring that applicants demonstrate that fill minimization has been achieved in their proposed mine plans.

Another consequence of fill minimization may be valley fill or backfill stability. The strong financial incentive to avoid streams will result in higher and, possibly, steeper backfills. Minimizing stream length impacted will also force valley fills higher in watersheds, where steeper foundation conditions are typical. Steeper and higher backfills and valley fill toes on steeper foundations present higher probabilities for slope instability. These conditions increase the challenge to geotechnical engineers to design fills and backfills to meet the SMCRA safety factor requirements. The SMCRA regulations do not allow construction of valley fills under steep foundation conditions without special measures to assure stability. Design and construction costs for more stable valley fills can be considerable if rock toe buttresses or key-way cuts are necessary to shore up the out slopes.

Under the No Action and action alternatives, the CWA Section 404 program requires demonstrations of avoidance, minimization, and mitigation of unavoidable impacts. The consequences of these provisions were discussed in the direct stream loss and indirect impact narrative above, and may not have markedly different consequences relative to project-by-project fill minimization. However, Actions 3 and 9 combine to clarify the OSM SBZ rule and develop rules requiring applicants to demonstrate excess spoil is minimized, streams have been avoided as practicable, and that fill locations represent the least environmental damaging alternative. By increasing SMCRA program consistency with CWA Section 404 objectives, fill minimization would become a common goal assessed with uniform importance across the programs. These proposed SMCRA changes, in aggregate with the coordinated decision making envisioned under the three action alternatives and other proposed actions, would provide incremental benefits over no action.

For instance, additional resource data and improved impact predictions would result in more-informed decisions about fill numbers, location, and sizes. Similarly, increased consideration of

mitigation requirements and better controls on mitigation success should improve environmental consequences over the No Action Alternative. The effect of alternative analysis and mitigation costs on reducing fill numbers and sizes is discussed in the Chapter IV.B.1.e and IV.I. EPA and COE exploration of designating certain streams as generally unsuitable for fills could reduce cumulative effects of valley filling [ADID, Chapter II.C.3, Action 4]. The information sharing and automation of data relative to aquatic resources should also have a positive effect on minimizing fills, individually and cumulatively.

The continued analysis of data collected during implementation of the CWA Section 404 program by the COE and possible future identification of minimal and cumulative impact thresholds has the potential to minimize fill sizes. Mining companies have demonstrated that these thresholds, which define the appropriate CWA Section 404 permit process, influence mining plans. During the interim permitting process in WV (as a result of the *Bragg* settlement), applicants for 81 MTM/VF projects limited fills to less than 250-acre watersheds. Only 5 applicants proposed MTM/VF projects with fills exceeding this watershed size. This threshold would continue to apply to certain geographic locations under the No Action and Preferred (Alternative 2) Alternatives and it is anticipated that the consequences to fill size would continue.

Although a minimal impact threshold may reduce the size of fills, it could actually cause greater stream impacts by requiring the construction of valley fills in a greater number of headwater stream segments. However, cumulative impact requirements of the CWA Section 404 and SMCRA are designed to evaluate the benefit of fewer larger fills versus greater numbers of smaller fills. This consideration should occur under all alternatives; although the action alternatives, with the greater coordination and increased data collection and analysis, should create improved results over the No Action condition.

e. Mitigation

The effectiveness of reclamation and mitigation practices to restore stream habitat and aquatic functions impacted by MTM/VF are discussed in Chapter III.D and Appendix D. The alternatives proposed, including the No Action Alternative, assume successful mitigation through on-site reclamation and on-site and off-site mitigation. These practices may include stream construction or enhancement, the construction of other aquatic systems, such as wetlands, and the restoration or enhancement of riparian habitat to compensate for the loss of aquatic functions. Preservation of high quality streams through creation of conservation easements or land trusts, and the payment of in lieu mitigation fees for stream protection and restoration measure would be included as compensatory mitigation possibilities. Mitigation requirements are described in Chapter II.C.6 and project examples are discussed in Chapter III.D.

Because all alternatives require mitigation of unavoidable impacts to the waters of the U.S., applicants will be seeking sites suited for restoration. Limitations exist for developing in-kind mitigation projects on reclaimed mine sites. In-kind mitigation must restore or create headwater stream habitat on the reclaimed mine area to replicate the functions lost from direct stream loss. The consequences of the No Action Alternative are dependent on the ability of the COE and SMCRA agencies to require the applicant to achieve functional replacement through on-site reclamation. Additionally, the COE must also require the applicant to make up any mitigation deficit through off-site, in kind or compensatory mitigation projects.

The Appalachian coalfields provide almost limitless opportunities for watershed improvement, following more than 100 years of abandoned mine land (AML) problems. Mine drainage pollution, eroding spoil on the downslope, clogged stream channels, abandoned highwalls and coal refuse areas, and other orphan land problems exceed the capacity of the SMCRA AML Trust Fund. Many of the problems are such low priority it is unlikely that the AML program will ever address them. Mitigation projects for watershed restoration of AML problems, oil and gas industry problems, and a host of other watershed management issues (encroachment, sewage treatment, dredging, creation of wetlands, re-channelization using state-of-the art stream restoration, etc.) could not only offset but also enhance aquatic resources. Some mitigation projects may be possible in the same watershed as the MTM/VF project and may provide a close fit to the functions lost by valley fills (in-kind, in-basin). Other mitigation projects may be in the same basin or elsewhere and not provide the exact match of functions lost by valley fills, although related aquatic resource improvements would occur (out-of-kind or in lieu fee).

The renewed NWP 21 has been in effect a little over one year. Due to the recent *Rivenburgh* injunction, the effectiveness of mitigation to offset unavoidable impacts from MTM/VF projects has not been widely demonstrated. If future mitigation mirrors past intentional or unintentional reclamation practices and state-required mitigation projects, successful restoration of habitat for organisms requiring lotic (flowing) conditions may be very limited. Selection of the No Action Alternative could also result in out-of-kind mitigation projects successfully developed on MTM/VF reclamation sites that generally result in the creation of palustrine or pond-like wetland or linear, drainage ditch-type wetlands. These water bodies provide some of the same functions as headwater streams, but they do not fully compensate for the physical loss of aquatic habitat or serve all of the functions affected by MTM/VF activities, especially if impacted streams were of high quality. Stream relocation, aquatic habitat restoration, and natural channel configurations are also utilized in reclamation. Sediment stabilization, wildlife support, and potential water quality improvements are other types of aquatic resource mitigation projects that were most successful in the past and could be employed under the No Action Alternative. The No Action Alternative provides, under NWP 21 and SMCRA, that on- or off-site mitigation plans must be successfully completed. Inspection and financial assurance of mitigation activities are required under the No Action Alternative; but mitigation procedures or the agencies are not as coordinated as proposed under the action alternatives.

In most situations, under all alternatives, some type of on-site restoration, as a component of reclamation, would be included as part or all of the mitigation needed to replace lost functions from headwater streams. Where the streams directly impacted from mining are of low quality, restoration of stream functions on-site may be the only required mitigation. However, for most sites it is anticipated that both on-site and off-site mitigation will be necessary to insure that only minimal individual and cumulative impacts occur. Under all alternatives, the utilization of a stream assessment protocol provides a more accurate characterization of the loss of aquatic functions and the ability to more accurately predict the opportunity to restore aquatic functions loss at the reclamation or mitigation site. The protocol, described in Chapter II.C.6.a.1, also plays a substantial role in identifying high quality streams for avoidance, to reduce the impacts to these aquatic resources as well as the associated mitigation costs.

The functional assessment will apply under all alternatives, and involves the application of the developed models and the calculation of ecological integrity indices for a defined headwater stream

ecosystem under existing (i.e., pre-project) conditions and predicted (post-project) conditions. The results of using the protocol are the following:

- Description of the potential impacts of a proposed project
- Description of the actual impacts of a completed project
- Identification of ways to avoid and minimize impacts of a proposed project
- Determination of the least damaging alternative for a proposed project
- Determination of compensatory mitigation needs for a proposed project
- Determination of restoration potential for headwater streams
- Development of design criteria for stream restoration projects
- Planning, monitoring, and managing stream mitigation or restoration projects
- Evaluation of performance standards or success criteria for headwater stream mitigation efforts
- Comparison of stream management alternatives or results
- Determination of appropriate in-lieu-fee ratios
- Identification of priority sites for in-lieu-fee mitigation projects.

An example of protocol application is provided in Chapter IV.I.4.c. In the case study, an eastern Kentucky coal company proposal to construct three valley fills in 1,562 linear feet of intermittent stream reaches and 3,132 linear feet of ephemeral stream reaches; the largest headwater stream reach drained 246 acres. Three temporary sediment ponds were proposed to impact 300 linear feet of ephemeral stream and 2,200 feet of intermittent streams. Approximately 950 linear feet of ephemeral stream and 1,844 linear feet of intermittent stream reaches were proposed for temporary sediment transport impacts between the fill areas and the sediment ponds.

After utilizing the stream assessment protocol to evaluate the stream impacts and the amount of mitigation necessary, the company presented a revised application and a new proposal. The use of the protocol provided a mechanism for identification of higher quality streams impacted by the original proposal and allowed consideration of costs of different alternatives for the mining plan. The company determined that they could dispose of more material in mined areas and reduce the amount of excess spoil proposed for valley fills. The company proposed to avoid placing fill material into waters of the U.S. except for one fill and one sediment pond. The valley fill was sited in the lowest quality stream (impacting 980 linear feet of intermittent stream), further reducing mitigation requirements. The applicant satisfied compensatory mitigation needs through a combination of on-site stream restoration of the areas between the fill and ponds (and beneath the ponds, upon removal), incorporating natural channel design into their new stream channel construction and payment of in-lieu-fees to make up the balance for the permanent losses associated with the one valley fill. By using the stream assessment protocol and choosing to avoid and minimize stream impacts, the required in-lieu mitigation fee was also reduced from approximately $300,000 to $128,000.

As a consequence of all alternatives involving mitigation, there will be a strong disincentive for the applicant to disturb stream segments. The cost of mitigating to restore aquatic functions is proportionate to the quality of stream segments impacted. That is, the consequences of mitigating high quality streams will be greater than impaired streams. Based solely on the COE example, the costs of mitigating (by in-lieu fee agreement) 724 miles of valley fill stream impacts in the Fill Inventory would exceed 516 million dollars.

The No Action Alternative and the three action alternatives could also provide additional environmental benefit through the mitigation requirement. If mitigation proves infeasible in certain locations, no mining could occur. If fill minimization/mitigation is difficult or impossible because of the application of the CWA 404(b)(1) Guidelines, some coal reserves may not be minable. The absence of mining in any area would result cumulatively and individually in less impacts to streams.

f. Stream Segment Definitions

As indicated in Chapter II.C.2, the Federal and/or state agencies propose to develop guidance, policies, or institute rule-making for consistent definitions of stream characteristics and field methods for delineating those characteristics. This action is common to all action alternatives.

Development of consistent definition in regulations and guidance for field delineation would provide another incremental benefit over the No Action Alternative. This benefit would occur because delineation of stream characteristics is key to understanding the aquatic resources proposed to be impacted and the level of mitigation required to offset unavoidable impacts. Consistent understanding of terms of regulatory significance improves communication among the regulated industry, the agencies, stakeholders, and provides the basis for both environmental, regulatory, and business decisions. Absent this action, confusion will continue in the No Action Alternative. The potential exists that misunderstandings on delineation could result in impacts to stream segments that might not occur with the additional information and understanding.

g. Bonding and Inspection

There are no defined, established procedures between COE and SMCRA authorities for coordinating on-site and off-site mitigation requirements, such as bonding and inspection. As such, there are both inefficiencies and risk in the current system. The risk is that in maintaining separate, uncoordinated systems, some aspects of a mitigation project may not be completed as required. The inefficiencies are present, as the current system now requires separate permitting, separate monitoring/inspection, and separate bonds for what is essentially a single (or at least closely-related) mining and mitigation project (reclamation/mitigation). Implementation of Action 10 would coordinate SMCRA and CWA requirements to establish financial liability (e.g., bonding sureties) to ensure that reclamation and compensatory mitigation projects are completed successfully.

2. Consequences Common to Alternatives 1, 2 and 3

Alternatives 1, 2, and 3 share actions designed to be more protective of aquatic and other resources, summarized in Chapter II.B and fully described in Chapter II.C, that would cause the following regulatory program changes, policies, or guidance:

- Consistent definitions of stream characteristics and field methods for delineation;
- Clarification of OSM stream buffer zone rule and development of excess spoil requirements for alternatives analysis, avoidance, and minimization;
- Continued evaluation of MTM/VF effects on water quality and EPA recommendations for new standards, as appropriate;
- Refined science-based protocols for assessing aquatic function, making permit decisions, and setting mitigation requirements;

- BMPs for the following:
  - functional assessment and mitigation
  - flooding analysis and remediation
  - reclamation with trees
  - control of fugitive dust and blasting fumes;
- Coordinated permitting, data collection and sharing, mitigation bonding and inspection;
- Development of science-based minimal impact thresholds for individual and cumulative impacts, if feasible; and,
- Program changes, if necessary to enhance ESA compliance

The action alternatives, by virtue of formalized coordination of agency roles, facilitate results that would be delayed or would not occur under the No Action Alternative:

- Enhanced environmental protection and minimized impacts through better information, analysis and collaborative government regulation.
- Improved government efficiency; implementing programs to achieve coordinated data collection/sharing and application processing that fulfill these objectives:
  - assure adherence to performance standards;
  - eliminate duplication by the agencies and applicants; and
  - provide for better integrated public participation.
- Supplemented data collection to accomplish the following:
  - better characterize environmental resources and establish their function in the ecosystem;
  - monitor impacts based on changes from baseline condition to determine if predictions were accurate; and
  - demonstrate compliance and/or reclamation/mitigation success.
- Strengthened prediction of impacts based on better data and analysis.
- Articulated regulatory concepts in the regulation of surface mining operations that accomplish these goals:
  - provide clear understanding of requirements and set expectations of industry and stakeholders
  - for making decisions;
  - improve environmental protection; and
  - assure public safety.
- Expanded best management practices in planning/design of mining, reclamation, and mitigation practices.

The action alternatives considered were developed to result in a better informed public and provide more meaningful participation, in part because plans would more thoroughly address impacts to environmental resources. Applicants would benefit from integrated regulatory programs under state and Federal environmental statutes. Many actions facilitate streamlined, sequenced review processes while improving environmental protection. Common data elements in a joint application form could lead to more efficient analytical approaches among the agencies. Reliance on these analytical results could facilitate agreements among agencies and provide a basis for one agency to confidently rely on the findings of another agency. A coordinated review process should reduce processing times and costs of permit applications, which may offset some of the increased costs and

times associated with the additional data collection and analysis requirements of the actions. The program costs of Federally- versus state-administered application reviews, inspection, and enforcement for these actions are described in Chapter IV.I.

The aquatic resource data mandated by different regulatory programs results in costly collection and analysis of voluminous information, typically only assessed for particular program requirements. Compiling similar data from varied sources could serve multiple program goals and objectives. The use of GIS to compile other relevant resource, ecosystem, or community information is a logical augmentation to the aquatic data for use in COE NEPA compliance. Use of information technology to collect, compile, screen, and update aquatic and other resource information in GIS, linked to various databases, would provide for better informed and timely permit decisions regarding aquatic impacts and a reference library to assist in future decisions.

Increased environmental benefits to aquatic and related resources would be realized from the use of a coordinated permit process in combination with other regulatory aids and tools such as ADIDs and the COE stream assessment protocol. For example, the collaboration that would occur among the agencies in this coordinated regulatory process under the action alternatives would facilitate the effective application of the alternatives test required by the CWA Section 404(b)(1) Guidelines. The institutional expertise unique to each agency could be employed in consideration of a greater range of alternatives, such as placing excess spoil in adjacent, previously-mined areas in order to avoid or substantially minimize fills in waters of the U.S.

Moreover, joint evaluations of MTM/VF proposals would result in more expansive considerations of both environmental impacts and effective treatments to mitigate those impacts. This coordinated process would also facilitate selection, implementation and monitoring of mitigation projects. The coordinated process and actions that make up the action alternatives could minimize adverse environmental effects by enhancing consideration of the least damaging practicable alternative in fill placement; minimization of excess spoil material; consideration of adverse cumulative environmental effects; and, technology transfer to identify the best practices reclamation techniques available to avoid or minimize adverse environmental impacts.

Better stream protection from direct and indirect effects would result from improved characterization of aquatic resources; operations designed to avoid and minimize adverse effects and restore aquatic functions; and compensatory mitigation plans with improved design, inspection, and enforcement. Excess spoil fills would become smaller and placed in locations that minimize adverse environmental effects.

Under all action alternatives, the consequences would include development of a Memorandum of Understanding (MOA), outlining coordinated data collection/sharing, the process for permit review sequencing, agency responsibilities, and other relevant matters. Common to all alternatives is also development of a Field Operating Procedure (FOP) document to elaborate on the specifics of the coordinated, collaborative review and regulatory processes of the agencies.

The development of an MOA and FOP would promote a coordinated permit process; regular pre-application and Joint Permit Processing (JPP) meetings, as appropriate; standardized data collection to address identified gaps; further refinement and implementation of the COE stream assessment protocol in evaluating permit applications; development of permit application assessment and

mitigation procedures based on these data; and utilization of and networking the expertise of the various agencies. The MOA could also reinforce protection of special environmental areas by containing information on existing regulatory tools for environmental protection of high value aquatic or other resources (e.g., underscoring the ADID process, designated special aquatic sites, and "Aquatic Resources of National Importance," as well as lands designated unsuitable for mining under SMCRA. An MOA could identify the role of the CWA Section 404(c) and (q) elevation process in the coordinated approach and describe the type of site-specific information necessary to justify formal written requests to the COE requesting NWP applications be processed as IP. The MOA or FOP could encourage interagency site visits to gather site-specific resource information on which to base impact predictions, allowing the agencies to make more informed decisions. The consequence is a coordinated, consistent impact prediction.

FOPs could establish particulars for efficient application sequencing and facilitate coordinated processing by a lead agency. A consequence of all of the action alternatives may be development of decision-making and dispute resolution procedures.

3. Consequences Unique to Alternative 1

Under this alternative, all MTM/VF projects proposing valley fills in waters of the U.S. would initially be reviewed by the COE as a CWA Section 404 IP rather than as a general permit [Chapter II.C.1.b.; Action 1.1]. The COE would make an initial case-by-case determination of the size, number, and location of valley fills in waters of the U.S. Following this initial determination by the COE, the applicant could commence the SMCRA and other requisite application processes (e.g., NPDES, MSHA, etc.). The result of this alternative would be a series of consecutive, coordinated reviews and decisions by the COE and appropriate SMCRA agency. Any subsequent actions under SMCRA or other laws on a permit application would recognize the constraints established by the COE. The COE would also rely on the subsequent SMCRA permit application for information pertinent to whether an EIS or EA is needed.

The consequences of processing most MTM/VF applications as IPs are the case-by-case application of the CWA Section 404(b)(1) Guidelines, the NEPA, and public interest review. These processes present the potential for a more lengthy permit process for the applicant and additional data collection and analysis. For instance, NEPA compliance may require either development of an EA/FONSI or EIS. NEPA focuses not only on the environmental effects of the proposal, but all human activities in the area. NEPA and IPs imposes greater scrutiny of the application by a wider audience of government agencies and the public.

Conversely, processing MTM/VF applications as IPs provides the applicant the possibility of receiving authorization for larger fills. While CWA Section 404 requires mitigation of all unavoidable impacts, an IP project must mitigate to a level less than significant adverse impacts. Projects processed under a general (e.g., NWP) permit must mitigate to minimal impacts. Accordingly, these impact levels could correspond with approval of larger fills under an IP.

Alternative 1 involves the COE performing the necessary avoidance, fill minimization, and mitigation assessment of MTM/VF proposals. The COE and EPA have affirmed that use of the WVDEP AOC+ policy satisfies the requisite alternative analysis required by the CWA 404 (b)(1) Guidelines. For consistent application across the various COE Districts with jurisdiction over CWA

Section 404 coal mining activities in Appalachia, the COE would either evaluate the adequacy of existing state SMCRA authorities AOC policies or develop other procedures for applicants in Virginia, Kentucky and Tennessee to demonstrate that projects have satisfied the CWA Section 404 (b)(1) Guidelines.

Inasmuch as the COE is initially determining the size, number and location of fills under Alternative 1, it would not include SMCRA agencies requiring or applying functional assessment protocols [Chapter II.C.6; Action 11]. The consequence of Alternative 1 not containing this requirement in the SMCRA program is insignificant since the COE would apply the protocol.

Alternative 1 also does not include a continuation of any regional conditions established as part of the No Action Alternative. This action would be unnecessary since the applications would all begin processing as an IP.

Alternative 1 includes the potential use of the advance identification (ADID) process by the EPA and COE to designate specific headwater resource locations as generally unsuitable as fill [Chapter II.C.3; Action 4.1].

4. Consequences Unique to Alternative 2

The consequences of Alternative 2 relevant to aquatic (and other environmental) resources would include those described in Chapter IV.B.2. and IV.B.3. The major distinction of Alternative 2 is the process and coordination among the COE, EPA, OSM, FWS, and their state counterparts in considering MTM/VF proposals. Another distinction of Alternative 2 is the concept of a joint application. Such an application would assure the most thorough description of the resources affected, projected impacts to those resources, and a detailed reclamation/mitigation plan.

The COE would make case-by-case evaluations of site-specific impacts to determine the appropriate CWA Section 404 review process (i.e., IP or NWP 21). Any existing regional conditions, such as a 250-acre watershed minimal impact threshold, would continue to be implemented under this alternative until revoked or replaced. These regional conditions are described in the No Action Alternative [Chapter II.C.1.a.1.].

Following the COE determination of the appropriate CWA Section 404 process applicable to the MTM/VF application, the consequences would be identical to Alternative 1 for any proposals determined to warrant an IP. Conversely, those applications determined to merit NWP 21 authorization would begin processing with the SMCRA regulatory authority, as described in Alternative 3. Following SMCRA processing, the COE would consider NWP 21 authorization, based largely on the SMCRA review.

These evaluations would be based on proposal-specific information sharing and early coordination of these agencies. Facilitated sequencing of agency permitting processes would have the consequence of better-informed and timely decision making. This alternative is the preferred alternative for the agencies because of the improved efficiency, collaboration, division of labor, benefits to the public and applicants, and the recognition that some proposals will likely be suited for IPs, and others best processed as NWP 21.

Independently, but in concert with these actions under Alternative 2, the current rule-making effort by OSM would continue, in order to clarify the SMCRA obligations to minimize excess spoil and the adverse impacts stemming from valley fill construction [Chapter II.C.5.a.2]. This revision to the SMCRA regulations would not only be in accord with SMCRA provisions, it would also increase consistency with CWA Section 404(b)(1) Guidelines. As a consequence of Alternative 2 OSM would also consider whether additional future rulemaking is warranted to increase consistency with the CWA Section 404 program and/or fine tune fill minimization and alternative analysis that grow out of the ongoing rule making [Chapter II.C.3.a.2]. OSM rule-making may be appropriate after experience is gained with Federal and state agencies involved in the development of elements of coordinated decision making and collaborative CWA/SMCRA permitting program.

The creation of the MOA, FOP, joint application, etc., may indicate that additional data collection, impact predictions, and analysis could increase SMCRA consistency with CWA standards, e.g., by satisfying other elements of CWA Section 404(b)(1) Guidelines analysis. OSM could consider future amendments to the excess spoil rules and/or other permitting/performance requirements in this regard. Following state modification of their SMCRA-based programs to conform with OSM rule making, a state might consider seeking CWA Section 404 authority for approval of MTM/VF proposals eligible for the NWP 21, using the COE state programmatic general permit (SPGP) [Chapter I.C.1.a.2]

5. Consequences Unique to Alternative 3

The goal of this alternative would be to enhance the SMCRA programs, as described in Alternative 2 above, to satisfy the informational and review requirements of the CWA Section 404 program. In this manner, the SMCRA process would minimize, to the maximum extent possible, the adverse effects of MTM/VF and create a more effective and efficient permit application review process. The principal difference between this alternative and Alternative 1 is that the enhanced SMCRA regulatory process could provide the regulatory platform to ensure that MTM/VF in waters of the U.S. comply, to the extent allowed by SMCRA through the proposed rule-making, with the CWA Section 404 program. This alternative differs from Alternative 2, which describes a coordinated interagency screening process to determine the type of COE CWA Section 404 permit needed for MTM/VF in waters of the U.S. That is, under Alternative 3, all applications would begin processing by the SMCRA regulatory authority to determine the size, number and location of valley fills.

Alternative 3 is based on an assumption by the COE that MTM/VF applications begin processing as NWP 21 because the SMCRA review is the functional equivalent of an IP. An exception to this assumption is the COE authority to require additional off-site mitigation to offset unavoidable impacts to waters of the U.S., which would be assured by the COE under CWA Section 404 review. Under this alternative, the SMCRA regulatory authority would be the lead review agency, reducing duplication of CWA regulatory control exercised by the COE. This would meet the purpose of the general permit process envisioned by the CWA Section 404(e). [Chapter II.C.1.d, Action 1.3.] While the COE retains responsibility for authorizing CWA Section 404 permits, the information collected and analyzed by the SMCRA agency would allow the COE to process most permits under NWP 21. Under Alternative 3, it is more likely that a state may seek partial CWA Section 404 authority through a SPGP, or through full assumption of the CWA Section 404 program [Chapter II.C.1.a.2].

The COE would also be responsible for mandating and retaining its jurisdiction for appropriate compensatory mitigation to offset unavoidable impacts to aquatic resources. Currently, unlike the COE, SMCRA agencies may not have the statutory basis to require off-site compensatory mitigation. Most states in the EIS study area require compensatory mitigation through either the CWA Section 401 water certification process or state water quality laws. Under this alternative, the SMCRA agency would work closely with the COE to determine the extent of on- or off-site compensatory mitigation needed to offset unavoidable adverse effects of MTM/VF to waters of the U.S. Any regional conditions established under the No Action Alternative will not be continued under Alternative 3.

C. SOILS & VEGETATION

Chapters III.B. and III.F, of this EIS describe the existing Appalachian forest environment (vegetation and soils) and the importance of this forest environment in helping to define the ecosystem as it exists today. As indicted in Chapter III.F., the vast majority (approximately 92%) of the study area is forest land. Mixed mesophytic hardwoods, predominantly comprised of various oaks, maples, yellow poplar, beech, white basswood, and other species, are the dominant forest cover type within the study area.

This EIS contemplates two actions specifically related to deforestation. These actions are identified and described in Chapter II.C.8.b. as Action 13 and Action 14. Action 13 includes the cooperative development and identification of state-of-the-science BMP's for enhancing establishment of forests as a post-mining land use. Action 14 states that if legislative authority were established on either a Federal or state level, reclamation with trees could be required as a post-mining land use. The benefits these actions would provide to the successful establishment of forests on reclaimed mine sites are described in the Chapter II.C.8.b discussion of the actions. These two actions are incorporated in Alternatives 1, 2, and 3.

MTM/VF operations generally impact large areas of the forest community as the development of an individual mine can result in disturbance or removal of a few hundred to a few thousand acres of forest cover. The quality of the forest and the associated habitat impacted by a mine can vary depending on a number of factors such as extent of previous mining, past logging activities, other mineral extraction activities such as oil and gas, previous land management practices, etc. Regardless of the type or quality of forest cover that existed prior to mining, certain impacts can be generalized in association with any mine or any activity that disturbs large areas of forest. For example, unlike traditional logging activities associated with management of a hardwood forest, when mining occurs, the tree, stump, root, and growth medium supporting the forest are disrupted and removed in their entirety.

The likelihood of natural regeneration within the mine site is contingent upon the reclamation practice and post-mining land use chosen. Given that MTM/VF occurs along the ridge tops, reclaimed mines, when the post-mining land use is a category other than forest, typically create large expanses of open area devoid of seed source trees. Seed source trees in adjacent unmined areas are typically at an elevation below the reclaimed ridge top, limiting natural succession of forest cover from adjacent areas [Appendix E (Handel, 2002)]. In this type of ridge line mining and reclamation environment, for a number of years to come, the forest is replaced by a grassland and/or herbaceous/shrub vegetative community with different topographic and hydrologic conditions than those that existed prior to mining.

The Landscape Scale Cumulative Impact Study modeled terrestrial impacts based on past surface mine permit data [Appendix I; EPA, 2002]. Tables IV.C-1 through IV.C-4 were developed from these data and provide a retrospective of the impacts to forest that occurred over the 10-year period from 1992 to 2002. The tables estimate impact to the forest environment (vegetation and soils) in the study area from surface mining during this period at 380,547 acres or 3.4 % of the forest area that existed in 1992. When adding past, present and future terrestrial disturbance, the study area estimated forest impact is 1,408,372 acres which equates to 11.5% of the study area. This number is derived by adding grassland as an indicator of past mining, barren land classification, forest lost

from the last ten years of surface mine permits and a projection of future forest loss that equates to the last ten years. The tables represent a worst case projection or overestimate of impacts to forest cover in the EIS study area because: 1) the data are projected under the assumption that the entire area within the permit boundary would be disturbed, and 2) the data do not include areas where forest regeneration is occurring on some mine sites, i.e., the amount of natural succession or managed forestry would decrease the affected acreage. Forests constantly change and evolve as a result of tree growth, aging, disease, and human disturbances continually affecting the extent and composition of the forest. For example, as one area is disturbed by mining or logging activity (i.e., forest cover removed), other areas which were affected years ago by similar activities such as logging or agricultural development revert back to forest.

The concept of forest regeneration is reinforced by information available on the National Geographic web site at http://magma.nationalgeographic.com/ngm/0211/resources_who.html. The link for the U.S. Forest Services's Forest Inventory and Analysis (FIA,"Forest Census"), provides data on the nation's forest census. This data, based on forest censuses in West Virginia (1989), Virginia (1992) and Tennessee (1999), shows the average annual cubic feet (c.f.) of forest growth (net growing stock) exceeds the c.f. of forest loss (removal and mortality) by 10 million c.f. in Virginia, 241 million c.f. in Tennessee and 257 million c.f. in West Virginia. This type of data for Kentucky was unavailable on this web site. Thus forest "losses" are generally offset by forest "gains" realized by the natural order of succession in the Appalachian region to a forested community. As indicated by these data, forests are dynamic. Neither the census, nor the "worst case" analysis of forest loss, can entirely characterize the "net" impact to forest as a result of a specific activity such as mining. With that in mind, the data in the tables is presented here simply to give the reader a "reasonable" estimate of the extent of forest that may have been affected by mining over the past ten years. The acreage of grassland and transitional areas represent an estimate of past impacts from mountaintop mining.

Table IV.C-1
Estimated Terrestrial Impacts: Kentucky Portion of the Study Area

	Baseline Condition (NLCDS)	Condition from Issued Permits	Projected Future Condition*
Forest Cover (ac)	6,400,838	6,145,256	5,889,674
Forest Cover (%)	92.8	89.3	85.6
Forest Loss (ac)	—	255,582	511,164
Grassland as indicator of past mining impact (ac)	268,603	267,414	—
Quarry/strip mines/gravel pits (ac)	37,710	271,972	—

NLCDS = National Land Cover Data Set
Source: Landscape Scale Cumulative Impact Study of Future Mountaintop Mining Operations, prepared by EPA, 2002.
* Projections are based on the assumption that, if no reforestation of mine sites ever occurred, forest loss acreage similar to the ten years (1992-2002) of permits would occur over the future ten years.

Table IV.C-2
Estimated Terrestrial Impacts: Tennessee Portion of the Study Area

	Baseline Condition (NLCDS)	Condition from Issued Permits	Projected Future Condition*
Forest Cover (ac)	960,455	951,301	942,147
Forest Cover (%)	89.5	88.6	87.8
Forest Loss (ac)	—	9,154	18,308
Grassland as indicator of past mining impact (ac)	59,173	58,980	—
Quarry/strip mines/gravel pits (ac)	1,208	10,601	—

NLCDS = National Land Cover Data Set
Source: Landscape Scale Cumulative Impact Study of Future Mountaintop Mining Operations, prepared by EPA 2002.
* Projections are based on the assumption that, if no reforestation of mine sites ever occurred, forest loss acreage similar to the ten years (1992-2002) of permits would occur over the future ten years.

Table IV.C-3
Estimated Terrestrial Impacts: Virginia Portion of the Study Area

	Baseline Condition (NLCDS)	Condition from Issued Permits	Projected Future Condition*
Forest Cover (ac)	1,166,652	1,137,428	1,108,204
Forest Cover (%)	86.5	84.3	82.1
Forest Loss (ac)	—	29,224	58,448
Grassland as indicator of past mining impact (ac)	129,110	128,120	—
Quarry/strip mines/gravel pits (ac)	18,982	49,458	—

NLCDS = National Land Cover Data Set
Source: Landscape Scale Cumulative Impact Study of Future Mountaintop Mining Operations, prepared by EPA, 2002
* Projections are based on the assumption that, if no reforestation of mine sites ever occurred, forest loss acreage similar to the ten years (1992-2002) of permits would occur over the future ten years.

Table IV.C-4
Estimated Terrestrial Impacts: West Virginia Portion of the Study Area

	Baseline Condition (NLCDS)	Condition from Issued Permits	Projected Future Condition*
Forest Cover (ac)	2,703,652	2,617,065	2,530,478
Forest Cover (%)	93.8	90.6	87.5
Forest Loss (ac)	—	86,587	173,174
Forest Loss from Valley Fills (ac)	—	18,338	—
Forest Loss from Mineral Extraction Area (ac)	—	45,544	—
Grassland as indication of of past mining impact (ac)	86,777	86,164	—
Quarry/strip mines/gravel pits (ac)	45,715	133,155	—

NLCDS = National Land Cover Data Set
Source: Landscape Scale Cumulative Impact Study of Future Mountaintop Mining Operations, prepared by EPA, 2002.
* Projections are based on the assumption that, if no reforestation of mine sites ever occurred, forest loss acreage similar to the ten years (1992-2002) of permits would occur over the future ten years.

There are also indirect effects related to removal of the forest associated with mining. Studies have shown that trees help remove certain elements from our air and sequester them. This process is know as "carbon sequestration." Thus the removal of forests means that those trees removed can no longer sequester carbon from the air, and depending on how the removed trees are utilized or disposed of, may re-introduce previously sequestered elements back into the air. [Chapter II.C.8.a.2.]

Another indirect effect is that, at least from a historical perspective, past mine reclamation practices have impacted the re-establishment of forests on the mine disturbance areas as described below in greater detail. When compared to pre-mine conditions, this has resulted in forest harvest cycles within the disturbed areas having been extended. Other indirect impacts also occur as the wildlife species occupying the pre-mining environmental niches are replaced by a different type of wildlife community adapted to the newly-established environment of the reclaimed mine site. Alterations of the hydrologic and terrestrial environments associated with the removal of the forest and subsequent mining are analyzed in Chapter II, III, and other sections of this chapter.

1. Consequences Common to the No Action Alternative and Alternatives 1, 2, and 3

When looking at the historical perspective of mountaintop mine reclamation between 1977 and 1997, information collected as part of this EIS indicated that the re-establishment of the forest community, either through reclamation or natural succession, was impaired [Chapter II.B.4]. At best, reforestation could only be considered marginally successful (poor survival and impaired rate of growth). In a desire to stabilize reclaimed mine sites to prevent slides, minimize erosion, maintain acceptable water quality, and achieve bond release in a reasonable time period, reclamation of mine sites created an environment that was not conducive to the establishment of trees. Reclaimed areas were heavily compacted to prevent slides, aggressive ground cover species were used to minimize erosion, and growth mediums having near to above neutral pH were selected and used to help maintain water quality. Each of these "typical" mine reclamation practices were subsequently found to contribute to the difficulties in re-establishing forest communities similar to those which existed prior to mining.

However, recent research at Virginia Polytechnic and State University (VPI) and the University of Kentucky has demonstrated that forest communities can be successfully re-established on reclaimed mine sites. Factors (such as compaction, competition from grasses, and wildlife browsing, etc.) impairing the ability to re-establish the forest on mine sites were identified and measures developed to correct these past problems [Chapter III.B.4]. Over the past few years, Kentucky, Virginia, and West Virginia have, through various regulations, advisory memorandums, etc., begun to press for use of many of the improved reforestation practices and procedures detailed in research.

Through efforts by the states, the OSM forestry initiative, and other technology transfer and regulatory incentive methods, landowners and the regulated community are becoming convinced to implement forestry post-mining land uses and on-the-ground results are meeting with some success. In Virginia, the majority of post-mining land uses proposed on coal mine sites are forestry. A study of the proposed post-mining land uses on current mountaintop mine sites in West Virginia revealed that 68% of the sites were to be reclaimed to forestry-related land uses [Appendix G; (Yuill, 2002)]. These efforts will not resolve all the problems that inhibited the successful establishment of forest communities on reclaimed mine sites. However, the research indicates that quality forest

communities that equal or exceed growth rates that existed prior to mining can be successfully and economically established on these mined sites. As the state and Federal initiatives to improve the establishment of forests on reclaimed mine sites have only recently begun to be implemented (i.e., within the last five years), it would be premature to attempt to evaluate the success of these efforts at this time. However, the recent efforts in the study area states to promote forestry land uses and implement the procedures necessary to successfully establish a quality forest community provide indications that forests can be established on many of the reclaimed mine sites in a timely manner.

In the short term, the timely re-establishment of a quality forest community on reclaimed mine sites would not prevent the various impacts associated with mining-related disturbance to forest and soils as described above and in Chapter III. When MTM/VF mining occurs, coal is extracted to help meet the energy needs of the nation. But forests and forest soils are removed; hydrologic and aquatic impacts occur; terrestrial wildlife is impacted; aesthetic and quality-of-life values are impacted, and economic costs and benefits are incurred. However, it is anticipated that, with the implementation of the research recommendations, long-term environmental and economic benefits (productivity improvements) will be realized. Environmental benefits realized would occur by reducing the number of years to re-establish a quality forest community. In other words, the mine site reclamation would result in selection and use of growth mediums more conducive to establishment of trees and tree survival and growth rates more similar to (or better than) those existing prior to mining.

Although research has demonstrated that many of the tree species present in this area can be re-established on reclaimed mine sites, it is unlikely that all forest communities existing prior to mining such as cove-hardwood forests can be restored on these reclaimed sites. As post-mined sites will likely lack the requirements of slope, aspect, and soil moisture needed for cove-hardwood forest communities, it is unlikely that these particular communities can be re-established through reclamation (Strausbaugh and Core, 1997). However, regardless of the tree species, the reduction in the time required to re-establish a forest (commercial or otherwise) equal or better than that which existed on the disturbed areas prior to mining will also provide other environmental benefits such as: 1) an improved aesthetic environment as grass-shrub habitats that typically follow mining will be more quickly replaced by forest habitats; 2) resumption of carbon sequestration; 3) resumption of forest product utilization; 4) return of forest wildlife species similar to those that were present prior to mining; and 5) resumption of more normal hydrologic cycles (e.g. evapotranspiration cycles, peak flow), etc.

As previously discussed, vegetation and soils of the forest environment are totally disturbed when an area is disturbed for the purpose extracting coal by surface mining methods. Although SMCRA regulations require salvaging and redistribution of topsoil or acceptable topsoil substitutes as a growth medium, comments were received during scoping specific to the impacts to soils as a result of MTM/VF. A study (Sencindiver, 2001) was commissioned during this EIS "to evaluate physical, chemical, and microbiological properties of mine soils developing on reclaimed mountaintop removal coal mines in southern West Virginia." Recognizing that minesoils are "developing in drastically disturbed earthen materials," the study evaluated soil development on reclaimed MTM/VF sites varying from 8 to 30 years in age. The study concluded that although the properties of the older minesoils were more similar to native soils than were the younger minesoils, in general, "the minesoils are approaching stable, developed soils and should become more like the native soils as they continue to develop." This study, presented in Appendix E, tends to support a conclusion

that impacts to soils from MTM/VF are not irreversible and that over time, soils similar to those that existed prior to mining are likely to be re-established on reclaimed mine sites.

As indicated in the discussion in Chapter IV.C.1.a., the Cumulative Impact Study in Appendix I was used to develop Tables IV.C-1 through IV.C-4. The impacts to forest and forest soils that occurred for the ten year period from 1992 - 2002 have subsequently been projected as the anticipated forest disturbance over the next 10 years (2003-2013). The tables project an estimated impact to the forest environment (vegetation and soils) in the study area from surface mining during this period at 380,547 acres or 3.4 % of the forest area that existed in 1992. So for the 20 year period from 1992 to 2013, the estimated impact in the study area would be 761,094 or 6.8% of the forest that existed in 1992. The "qualifications" of this estimate described in the Chapter IV.C.1.a., and the more recent trend data discussed in Chapter IV.B.2.a., must be considered when using this estimate. As indicated and discussed in detail in Chapter IV.B.2.a., recent changes have been made in the SMCRA and CWA programs which have resulted in reduction in the size and number of valley fills when compared to pre-1998 data. This reduction in size and number of fills would indirectly have resulted in a corresponding reduction in the number of acres of forest and forest soils impacted by MTM/VF. When the qualification statements and recent trend data are considered in totality, it is likely that the forest and forest soil impact predictions for the next ten year period will be less than the projected 380,547 acres.

2. Consequences Common to Alternatives 1, 2, and 3

Alternatives 1, 2, and 3 include Action 13. As described in Chapter II.C.8.b, this action envisions building on the recent efforts of the states and the OSM reforestation initiative by assembling the "best technology currently available" or proven "best management practices" (BMPs) for the design and implementation of mining and reclamation activities. A BMP guidance manual could subsequently be developed, in cooperation with the states and research community, for use by the regulatory agencies and the regulated community. A list of possible topics for which BMP's could be developed and a description of some of these topics is provided in Chapter II.C.8.b.

The development of a BMP manual as proposed in Alternatives 1, 2, and 3 could assist regulators in determining compliance with regulatory requirements such as selection of the best available growth medium, prevention of compaction, enhancement of wildlife habitat, and minimizing adverse impacts, to the extent practicable. As such, the overarching impacts of this action would be to expand the benefits described in the No Action Alternative beyond those who merely attend the reforestation symposia and beyond those states where the state regulatory agency has already implemented reforestation improvements.

Development and use of a BMP manual could have a number of potential benefits related to the use of trees in mine reclamation. The beneficial consequences might include:

- improving ability to establish trees and ensure the long-term success of the PMLU,
- reducing the time frames necessary for natural succession to occur,
- facilitating mine site reclamation by maximizing utilization of organic materials remaining after logging,
- enhancing wildlife habitat, and

- maximizing forest product recovery prior to mining to better meet demands for wood products and reduce the need for additional logging-related disturbances thus minimizing impacts to additional environmental resources

A number of BMPs could be developed, each of which may have economic implications for the landowners, regulatory agencies and/or the regulated community. Some BMP's may result in cost increases while others may lead to cost savings. However, the development and use of a BMP guidance manual could result in cost increases to landowners and the regulated community.

In a cumulative sense, the only difference between the No Action Alternative and the development and use of BMPs as a part of Alternatives 1, 2, and 3 is that this action anticipates broader acceptance and use of the BMPs to improve reclamation to a forest land use. The re-establishment of forests on mine sites would likely occur over a larger area, thus on a study area scale, further reducing the period required for sites to revert to forest, restore habitat, and provide forest products.

Post-mining land use (PMLU) selection is a key factor in the establishment of tree species on reclaimed mined land. Alternatives 1, 2, and 3 also include Action 14. As indicated in Chapter II.C.8.b, this action, if implemented, would have legislative authorities enact changes to SMCRA or similar State statutes, such that SMCRA regulatory authorities could require reclamation with trees as the post mining land use. If implemented, this action could further limit land use options available to a property owner under SMCRA regulations. The action could result in the more widespread use of trees as a PMLU and, from a cumulative impact standpoint, be more effective at assuring re-established values associated with a forest community following mining.

D. FISH &WILDLIFE

The southern Appalachians, of which the EIS study area is a part, have been identified by the Nature Conservancy as an important area in the United States for rarity and richness [Stein et al., 2000]. This region is known to have the highest regional concentration of aquatic biodiversity in the nation. For this reason, it is hypothesized that impacts which result in decreases in genetic diversity, as measured by loss of species, loss of populations or loss of genetic variants, may have a disproportionately large impact on the total aquatic genetic diversity of the nation. At the landscape or regional level, certain natural habitat types are especially important for the ecological functioning or species diversity of the ecosystem. Unusual climatic or edaphic (soil-based) conditions may create areas of important local biodiversity or disproportionally support ecological processes such as hydrologic patterns, nutrient cycling, and structural complexity. In general, these are remaining undisturbed natural areas, especially those that integrate the flows of water, nutrients, energy, and biota through the watershed or region (Polunin and Worthington, 1990). Headwater stream systems naturally provide these listed functions (USFWS, 1999).

Terrestrial impacts related to forest fragmentation, neotropical migratory birds, wildlife habitat loss, effects on endangered species, impacts on biodiversity, cumulative effects, and sustainability were studied and the results are in Appendix E. The effects of deforestation and forest fragmentation on plants and wildlife are also described in Chapter III.F. This chapter describes in detail the changes to the existing terrestrial environment that occur when large areas of forest community are disturbed or removed [Chapter IV.C]. These changes may be temporary until the forest recovers, or permanent if the site is developed. For a number of years to come, the forest ecosystem is replaced by a grassland and/or herbaceous/shrub vegetative community with different topographic and hydrologic conditions than the pre-mining forest. The wildlife species occupying the pre-mining environmental niches are replaced by a different type of wildlife community adapted to the newly-established environment of the reclaimed mine site.

The consequences of MTM/VF also may impact aquatic resources, including fish. The aquatic impacts were discussed above in Chapter IV.B. The results of technical studies provide insight into aquatic and impacts to fish (USEPA 2000; Stauffer and Ferreri 2002). The studies conclude that valley fills within a watershed may result in impacts to the downstream biotic community structure. A similar project undertaken under the Powell River Project in Virginia may determine whether or not impacts observed can be expected to occur on a larger regional scale [http://als.cses.vt.edu/PRP/].

1. Consequences Common to the No Action Alternative and Alternatives 1, 2 and 3

The Landscape Scale Cumulative Impact Study modeled terrestrial impacts based on ten years (1992-2002) of surface mine permit data (EPA, 2002). Tables IV.C-1 through IV.C-4 were developed from data presented in the Cumulative Impact Study [Appendix I]. The cumulative impacts to terrestrial wildlife species endemic to the MTM/VF portions of the study area would be in direct proportion to the impacts to their forest habitat. As forest habitat is impacted, the wildlife species utilizing that habitat would subsequently be impacted. In a cumulative sense, the greater the forest impact, the more widespread the impacts to terrestrial wildlife species. A description of the cumulative impacts to forest is in Chapter IV.C.

a. Terrestrial Habitat

The study area is rich in avian fauna and a number of species exist that require interior forest for successful breeding. While large tracts of intact forest are rare in the eastern United States due to a number of land use change associated reasons, the EIS study area is comprised of 92% forest. Deforestation and forest fragmentation may locally affect interior forest species such as migratory neo-tropical songbirds and other species that do not range but short distances, such as salamanders. On a regional basis though, if past practice from 1992-2002 occurs over the next decade, MTM/VF could account for 6.8% deforestation of the study area. This 6.8% represents 380,547 acres of forest directly impacted in the last 10 years, and a liberal, worst case projection of an additional 380,547 acres of forest impacted in the next 10 years, with no action. These impacts do not reflect any natural succession or reforestation efforts, that have occurred and will occur. Nonetheless, MTM/VF would result in fragmentation of the forests. The remaining forest patches may provide proper habitat to maintain the population of most of the states avian fauna; however, a few species may be put into peril because their core breeding area is within the heart of the future mountaintop mining area. Some scientists may make the value judgement that loss of these species may have more ecological importance than providing habitat for grassland species considered rare in the state.

Habitat changes will occur in the study area and these changes involve a shift from a forest dominated landscape to a fragmented landscape with more grassland habitat. This shift leads to a shift in the plants and animals of the ecosystem. For example, dry grassland species will dominate the once post-mined and forest harvested sites. This results in an overall reduction in the native woody flora, as well as a reduction in the spring herbs and other vegetative components characteristic to the study area. [Appendix E (Wood, et al, 2001; Handel, 2001)]

Wood and Edwards provide evidence that mine sites that were converted to grasslands after mountaintop mining provide habitat for a number of grassland bird species that are listed as rare in West Virginia [Appendix D]. These species are rare in West Virginia because grasslands are historically rare in the state [Strausbaugh and Core, 1997]. Providing habitat for species listed as rare may not be ecologically significant because these grassland species have substantial breeding habitat in other parts of the United States. The Dicksissel, Horned Lark, Eastern Meadow Lark, and Grasshopper Sparrow are grassland birds with breeding ranges outside of the study area.

As indicated in Chapter IV.C., Soils and Vegetation, the timely re-establishment of a quality forest community on reclaimed mine sites would not prevent the previously described impacts to terrestrial wildlife species. However, with the improvements in the ability to re-establish forests of similar species to those which existed prior to mining, the ability to re-establish wildlife communities similar to those which existed prior to mining would be enhanced. The cove-hardwood forest community is one exception that would not likely re-establish on mine sites, and it is equally unlikely that wildlife communities endemic to this type environment would return. In short, just as the time periods to re-establish similar forests are reduced, the time periods to re-establish similar wildlife communities would also diminish.

b. Wildlife Populations

Wildlife population is a measure for evolutionary change and functioning of ecosystems. However, population numbers alone do not adequately reflect the prospects for species or the continued

performance of their ecological role. Information about life history and population dynamics, such as dispersion, fertility, recruitment, and mortality rates, is critical to identifying potential effects on population persistence and ecological processes. When populations are lost, the local adaptations of these populations are lost, the ecosystem functions performed by these populations cease, and ultimately species may go extinct. In general, the risk of losing populations (and with them ecological integrity) is greatest when populations are small, but even large populations may have critical components of their life histories of population cycles that make them especially vulnerable. (EPA, 1999)

Direct and indirect impacts of population dynamics affect headwater stream systems in the EIS study area. These biotic systems are characteristically in locations with high numbers of endemic macro invertebrates, amphibians and fish. Populations tend to be small and highly specialized in the headwaters environment. Species with these traits tend to be sensitive to relatively small changes in their environment (Stein et al., 2000). Some species in headwater streams may have distributions limited to only one or several watersheds. With such a small geographic range, fill activities from one mine may impact the entire population.

MTM/VF activities may impact population dynamics through indirect as well as direct impacts. For instance, changes in contaminants or in thermal regime may affect survivorship and reproduction and impact the number of individuals available for recruitment. An increase in base flow may eliminate intermittent flow areas serving as refuge for amphibians from fish predators. The loss of autochthonous input from timber harvesting may decrease the habitat types available and may impact reproductive success for some species. Finally, egg mortality may be affected by changes in flow and/or sedimentation. Many other impact producing factors in the study area may cause environmental changes that might result in altered population dynamics, including potential extirpation of some species. Although data are lacking on the magnitude of mining impacts compared to other alterations in land use, such as forestry, the MTM/VF impacts to complex population dynamics in headwater stream systems requires additional study to detail the impacts to this system in the study area.

Preservation of genetic diversity is critical to maintaining a reservoir of evolutionary potential for adaptation to future stresses. The genetic diversity of a species is a resource that cannot be replaced (Solbrig, 1991). Genetic diversity enables a population to respond to natural selection, helping it adapt to changes in selective regimes. Evidence indicates that a reduction of genetic diversity may increase the probability of extinction in populations. Many of the factors that affect genetic diversity have been discussed for population dynamics. Extirpating populations as well as species would result in decreases in genetic diversity in the study area. Direct filling of streams may reduce the numbers of individuals of rare and endemic species, thereby reducing its genetic diversity possibly to the point of extinct. Indirect impacts from mining through alterations in water chemistry, stream flow or the aquatic thermal regime may also negatively impact populations reducing genetic diversity.

However, determinations of this type of impact is highly site-specific and, as such, are beyond the ability of this document to evaluate. Identification of these endemic populations, and as appropriate, protection measures, would be developed on a case-by-case basis as MTM/VF proposals are submitted.

While all of these factors affecting wildlife populations were not studied, other studies for the EIS evaluated the abundance of wildlife on MTM/VF sites. Grassland birds will likely increase, while many forest interior, neo-tropical migrant species will suffer losses in numbers as a result of MTM/VF. Some also believe there may be an increase in game species such as whitetail deer and turkey due to an increase in the diversification of habitats.

The Potential Ecological Condition (PEC) is an index intended to assess the ecological integrity of watersheds based primarily on the extent of large scale human disturbance and forest cover. This index was developed under the premise that songbird community composition reflects ecosystem properties of concern such as structural complexity and landscape configuration. The results of the PEC metric calculated in the Cumulative Impact Study suggest that mountaintop mining may not have a significant impact on the biologic integrity of the terrestrial ecosystems in the study area [Appendix I (USEPA, 2002)].

Although, the Cumulative Impact Study suggests that ample forest will remain in the study area under the future conditions of the No Action Alternative and Alternatives 1, 2, and 3 to maintain relatively high PEC scores, adverse impacts from MTM/VF and logging to many forest interior bird species, such as those species with breeding ranges that are restricted to or confined mostly within the study area are still possible. Portions of core breeding ranges for the Louisiana waterthrush, worm-eating warbler, and cerulean warbler are within the the study area [http://www.mbr-pwrc.usgs.gov/bbs]. Disturbances associated with mountaintop mining could potentially adversely impact each of these species breeding ranges. Researchers have demonstrated that habitat loss does not have to be total to reduce wildlife populations. Many species are "area-sensitive" and require large blocks of habitat or have other special habitat requirements that maybe affected by MTM/VF operations. Although fragments of forest may remain after mining is complete in a previously forested area, certain area-sensitive forest birds (forest interior species) may be absent or their populations reduced.

The herpetofauna will likely undergo a shift from mesic favoring salamander dominated communities along the riparian corridors of the small headwater streams and in the litter of the forest floor to a snake-dominated grassland fauna. [Appendix D; Chapter III.F.7; Wood and Edwards, 2001]. Salamanders are an important ecological component in the mesic forests of the study area and are often the most abundant group of vertebrates in both biomass and number (Burton and Lykens, 1975; Hairston, 1987). Ecologically, salamanders are intimately associated with forest ecosystems, acting as predators of small invertebrates and serving as prey to larger predators (Pough, et al., 1987). Petranka (1993) presented a conservative estimate that there are about 10,000 salamanders per hectare (about 4,050 per acre) of mature forest floor in Eastern forests. A reduction in salamander populations may have negative impacts on the species that depend upon them in the food web.

c. Aquatic/Terrestrial Interface

Chapters III.C. and III.D. of this EIS describes biotic interactions common in headwater streams and various vertebrate species including birds, salamanders (including newts), and mammals which require interactions with the aquatic environment in order to maintain their life cycle. Biotic communities have been demonstrated to occur in the uppermost reaches of watersheds, even in ephemeral stream zones which flow only as a result of rain or snow melt. Under all alternatives, the

biota in these reaches are at risk from valley fills. Filling would eliminate all aquatic and aquatic-dependant interactions that would formerly have occurred in the filled area. In areas downstream from fills, changes in the macroinvertebrate and fish communities have been observed (USEPA, 2000; Stauffer and Ferreri, 2002). Any change in community composition may impact the biotic interactions but these interactions were not studied as part of this EIS because they are often difficult to demonstrate.

Other human activities and development in the study area may cause environmental changes that would result in alterations or simplifications in biotic communities and associated biotic interactions. Although data are lacking on the magnitude of mining impacts compared to other alterations in land use such as forestry, the permanent nature of filling would suggest that MTM/VF impacts to biotic interactions in headwater stream systems, including interactions linking terrestrial biota to the aquatic environment, may constitute a irreversible impact to this system in the study area.

d. Fish Populations

According to Stauffer and Ferreri (2002), the EIS study area is unique and important in the evolution and speciation of North American freshwater fishes [Appendix D; Chapter III.]. Fifty-six species of fish, including two hybrid sunfishes, were collected within several watersheds in the EIS study area. The study determined that small headwater streams harbor populations with unique genetic diversity. These headwater stream populations have the greatest potential for natural selection processes that may result in development of new species/subspecies.

Comparison of the numbers of total species and benthic species on unmined sites and filled sites in Kentucky and in the New River Drainage indicate that MTM/VF has had an effect on the number and composition of the fish communities in these streams. Streams classified as filled had lower numbers of total species and benthic species than unmined streams in both areas.

e. Threatened and Endangered Species

Endangered, threatened, candidate, and special concern species known to inhabit the study area were identified through correspondence with the appropriate Kentucky, Tennessee, Virginia, and West Virginia state agencies and the FWS. Letters requesting T&E terrestrial species information were sent to the Kentucky Natural Resources and Environmental Protection Cabinet, the Tennessee Department of Environment and Conservation, Virginia Department of Conservation and Recreation, and the West Virginia Division of Natural Resources. Responses to these letters included lists of Federal and state listed threatened, endangered, and sensitive species broken down by county. These responses and habitat information are summarized in Appendix F of this EIS.

On September 24, 1996, the FWS concluded formal consultation with OSM pursuant to Section 7 of the ESA on MTM/VF operations conducted under state and Federal regulatory programs adopted under SMCRA and its implementing regulations. This programmatic consultation lead to the issuance by the FWS of a Biological Opinion (BO) and conference report that found surface coal mining and reclamation operations conducted in accordance with properly implemented state and Federal regulatory programs under SMCRA would not be likely to jeopardize the continued existence of listed or proposed species, or result in the destruction or adverse modification of designated or proposed critical habitats.

In addition to the SMCRA program coordination with FWS to implement the 1996 BO and ensure ESA compliance, the COE must consult with FWS on issuance of CWA Section 404 permits. FWS and OSM have also developed an endangered species training course to inform State regulatory agencies and OSM staff about the requirements of the ESA and the 1996 BO, and foster a cooperative working relationship. Implementing these ESA program controls serve to assure appropriate dealings T&E species and their critical habitat.

Currently, the Federal agencies are conducting informal consultation with FWS to determine the extent to which the proposed actions included in the preferred alternative may affect federally listed species or critical habitats that are in the EIS study area. EPA is in the process of writing a Biological Assessment (BA) that will identify Federally listed T&E species which are likely to be adversely affected by actions included in the preferred alternative. The BA under development for this EIS will consider the consequences of several of the Federally-listed T&E species cited in Appendix F that are found in some parts of the study area and that may be affected by MTM/VF. The initial list of species to be considered include the following:

Applachian monkeyface pearly mussel (*Quadrula sparsa*)
Birdwing pearly mussel (*Conradilla caelata*)
Blackside dace (*Phoxinus cumberlandensis*)
Clubshell (*Pleurobema clava*)
Cumberland bean pearly mussel (*Villosa trabalis*)
Cumberland combshell (*Epioblasma brevidens*)
Cumberland monkeyface pearly mussel (*Quadrula intermedia*)
Cumberland elktoe (*Alasmidonta atropurpurea)*
Dromedary pearly mussel (*Dromus dromus*)
Indiana bat (*Myotis sodalis*)
Little-wing pearly mussel (*Pegias fabula*)
Northern riffleshell (*Epioblasma torulosa rangiana*)
Oyster mussel (*Epioblasma capsaeformis*)
Pink mucket pearly mussel (*Toxolasma cylindrella*)
Purple bean (*Villosa perpurpurea*)
Rough rabbitsfoot (*Quadrula cylindrica strigillata*)
Shiney pigtoe (*Fusconaia cor (=edgariana)*)
Tan riffleshell (*Epioblasma florentina walkeri*)
Virginia Northern flying squirrel (*Glaucomys sabrinus fuscus*)

Although all of the listed T&E species in Appendix F will be considered in the BA, special attention will be given to the species listed above. Measures to avoid adversely affecting the Federally-listed species will be considered in the BA. Information about the findings of the BA and the informal consultation will be provided in the final EIS.

2. Consequences Common to Alternatives 1, 2, and 3

All three action alternatives provide for mitigation of functions lost by valley fills covering headwater streams. Mitigation provides opportunities to maintain and improve watershed health, provide for continued or renewed genetic diversity, and restoration of crucial aquatic/terrestrial interface.

The forest loss under the alternatives may be less because of the increased focus to reclaim post mined lands with trees [Chapter II.C.8; Actions 13 and 14]. Such future conditions under Alternatives 1, 2, and 3 would provide opportunity for maintaining the diverse avian fauna of the study area, while at the same time providing substantial breeding habitat for disjunct populations of the rare grassland species. Reforestation or creation of riparian zones as part of mitigation will also aid in restoring contributions of woody materials and leaves for macro invertebrates and downstream energy transport.

There are no significant differences among the No Action Alternative and Alternatives 1, 2, and 3 in terms of their ability to protect T&E species. However, the EIS contains provisional Action 17, should the BA, described above, identify particular measures are needed to fulfill ESA provisions [Chapter II.C.11; Action 17].

E. AIR QUALITY

As described in the Chapter III.V, potential air quality issues of airborne dust and fumes generally result from inhalation of particulate matter, fugitive dust, and re-entrained dust emanating from the mining operations and hauling. Direct impacts to air quality are localized within the immediate area of the mining site and are temporary in nature. Increased awareness of the dust emitted from hauling operations in recent years has improved air quality problems associated with hauling in the vicinity of the mining operations. Air quality programs are described in Chapter II.C.9 and Appendix B.

1. Consequences of the No Action and Action Alternatives

The environmental consequences of MTM/VF to air quality can be considered locally, regionally, and nationally. From the perspective of local consequences, fugitive dust and particulates, fumes released during blasting, and emissions from vehicles and machinery were considered. From a regional perspective, the cumulative effects of these impacts from nearby sources were considered. No irreversible and irretrievable impacts occur with this issue. The forty-two monitoring stations within the study area reported acceptable air quality for all criteria air pollutants in recent years, with the exception of ozone in Boyd and Greenup Counties, Kentucky.

EPA and the states are responsible for Clean Air Act (CAA) implementation regarding air quality [Chapter II.C.9.a.1]. The CAA is the comprehensive Federal law that regulates air emissions from area, stationary, and mobile sources. This law authorizes EPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment. The development of state implementation plans (SIP's) applicable to appropriate industrial sources in the state are designed to attain and maintain applicable NAAQS.

The Federal government generally does not have the authority to regulate fugitive emissions that are not associated with a *permanent stationary source* [42 U.S.C. 7479]. Mountaintop mines are not permanent stationary sources; and, thus far, have not been considered to meet the criteria for *major source* air quality permits, i.e., defined for particulate matter as sources which emit at least 250 tons/year [42 U.S.C. 7661]. However, because the SIPs also were required to contain a permitting program for major and minor sources, fugitive emissions can be regulated under the state SIPs, state permitting programs, and select state regulations, depending upon the facility composition.

a. Fugitive Dust

Fugitive dust usually refers to the dust put into the atmosphere by the wind blowing over bare soil, plowed fields, dirt roads or desert or sandy areas with little or no vegetation. In the case of MTM/VF, re-entrained dust is temporarily put into the air by activities such as vehicles driving over dirt roads and dusty areas, excavation of overburden, and blasting. The emission rates of fugitive dusts are highly variable and dependent on the prevailing atmospheric conditions, including wind speed and direction.

Previous EPA studies have found that mining activities such as drilling, blasting, coal removal, haul trucks, material handling and storage, truck loading and unloading, and bulldozer activities cause dust. Both drilling and blasting emissions are considered to be small contributors to particulate matter emissions, in comparison with other sources of emissions in this category. The most

significant sources of emissions for these types of activities are overburden removal and haul trucks. According to the EPA report, haulage can account for over 50% of the particulate emissions at surface mining sites. Bulldozer activities can also account for significant particulate emissions at levels (about 4% of the total emissions). Truck loading and unloading are considered to be minor contributors to overall emissions. (USEPA, 1991)

b. Respirable Dust

Particulate matter (PM) of concern for protection of lung health are the fine particles. PM in the form of respirable dust are particles with aerodynamic diameters less than 10 microns. This size of airborne dust is capable of entering the lungs if inhaled. According to the American Lung Association, particles of special concern are less than 2.5 microns in diameter. These particles are more easily inhaled than larger sized particles and can either become embedded deeply into the lungs or absorbed into the bloodstream. Inhalation of particulate matter air pollution is particularly harmful to sensitive members of the population who have pre-existing conditions such as asthma and chronic obstructive pulmonary disease. These particle sizes are typically of concern for workers on the mine site and regulated by the Occupational Health and Safety Administration and MSHA. Most particulates from surface coal mining and reclamation operations exceed 10 microns.

Emissions from blasting and drilling are minor contributors and are mostly a concern for the workforce. This is particularly true for drilling when the rock has significant crystalline silica content and the drill operators and helpers may be exposed to large amounts of respirable crystalline silica. Such exposure places these workers at high risk of silicosis. However, the high particulate concentrations associated with drilling affect a limited area and are generally not a concern for surrounding communities. In considering the impact upon communities, the major sources of emissions at surface mines involve scraper travel (not commonly used in Appalachia), overburden and coal removal (by drag lines, shovels, and loaders), truck haulage, and vehicle traffic. Vehicle traffic from and to mines may be a particular concern due to dispersal from the mine haulage roads and entrainment of the load due to improper or no load covering during travel from the mine to the preparation plant or loading terminal and return.

A limited study of the dust from surface mines is in Appendix G. The study found that dust transport following blasting occurred only over short distances. However, SMCRA regulatory agencies in the EIS study area have dealt with several citizens' complaints regarding dust from surface mining. In some cases, dust complaints may be beyond the scope of regulatory authority and present a nuisance. Citizens were recently successful in a West Virginia civil action regarding dust nuisance from a coal storage area on a surface mine.

c. Blasting Fumes

Potential health effects associated with surface mining operations include the potential inhalation of toxic fumes generated from the blasting operations. Blasting operations may involve the release of fumes including carbon monoxide, nitrogen dioxide, nitric oxide and ammonia. The type and amount of fumes released is dependent on the frequency and type of blasting operation conducted for the particular mining operation. According to research published by the National Institute for Occupational Safety and Health (NIOSH), over the past 30 years, blasters have switched to using less expensive blasting agents such as ammonium nitrate/fuel oil (ANFO) mixtures. Ammonia is

released during this combustion process. Exposure to ammonia may cause eye and respiratory irritation. A study of blasting fumes performed in conjunction with the EIS found that fume transport did not extend beyond the permit boundary.

2. Consequences Common to Alternatives 1, 2, and 3

Each of the action alternatives includes an action proposal to evaluate current programs for controlling fugitive dust and blasting fumes from mountaintop mining/valley fill operations, and develop BMPs and/or additional regulatory controls to minimize adverse effects, as appropriate. Under this action, meteorological and physical conditions which can exacerbate dust or blasting fumes, state-of-the-art techniques currently used in the mining industry to control dust and fumes, and appropriate regulatory improvements that can be implemented to monitor and control emissions would be identified.

Under the action alternatives, surface coal mining operators would have access to a central source for state-of-the-art information on techniques to control air quality problems that may not be available under the No Action Alternative. This information, if utilized in the day-to-day operations, could reduce the potential for or, in some cases, eliminate citizen complaints regarding dust and blasting fumes. The action also considers the development of additional regulatory controls, as appropriate to minimize adverse effects. While operators may not embrace the BMPs in the action alternatives, the presence of information, coupled with encouragement to utilize the practices by the regulatory authorities when air quality issues arise, have greater potential to minimize adverse effects.

F. ENERGY, NATURAL, OR DEPLETABLE RESOURCE REQUIREMENTS

The surface mining of coal involves an irreversible commitment of resources. As the coal is mined and placed into commerce for energy or metallurgical production, this resource is not renewable and the remaining coal reserves are finite. On the other hand, surface mining is a temporary use of the land and, with proper mining and reclamation techniques, the land is not irretrievable for a variety of future land uses.

The three action alternatives and the No Action Alternative may also provide significant environmental benefit, if mitigation proves infeasible in certain locations, causing no mining to occur. If fill minimization/mitigation is difficult or impossible because of the application of the CWA 404(b)(1) Guidelines some coal reserves may not be minable. If coal resources in the study area are rendered economically unrecoverable, they may never be mined or not be mined until coal market conditions or mining/reclamation technology provides means to develop the resource in compliance with applicable state and Federal regulatory requirements. Some limited number of reserves may be recoverable by underground mining or a combination of contour and auger/highwall mining. Such types of underground or surface coal mining techniques do not recover as much of the resource a larger-scale surface area or mountaintop removal mining methods.

Coal mining provides over 50% of the electrical generation capacity for the nation, and, in states within the EIS study area, more than 90% of electricity comes from Appalachian coal. Nevertheless, resources in U.S. coal basins within or outside of Appalachia and in other countries exist to offset lost reserves from the study area, if market conditions change for regulatory or other reasons. However, economic impacts resulting from decreased coal mining, could be locally significant [Chapter IV.I.].

Precise estimates of the magnitude of change anticipated from regulatory actions impacting mineral economics are difficult to calculate. The difficulty occurs because the decision of when and where remaining coal reserves may be mined is controlled by numerous complicated factors, such as mineral and surface ownership, market demands for particular coal quality, and the availability of investment capital, equipment, labor, etc. Also, the amount and location of remaining reserves presents various alternatives for future mining and the impact of regulatory costs are highly site specific. To perform such an analysis would require detailed analysis of all remaining minable properties. It is not practical to analyze on that scale and creation of reliable resource maps on any scale is cost prohibitive.

G. CULTURAL, HISTORIC, AND VISUAL RESOURCES

Cultural, historic, and visual resources are discussed in Chapter III.P, R, S, T, and U. Cultural resources are the fragile and non-renewable remains of human activity. They are found in sites, districts, buildings, and artifacts that are important in past and present human events. Cultural resources are arbitrarily divided into historic and prehistoric cultural properties and traditional "way of life" (lifeway) values, although they are part of a continuum of human use and occupation of the land.

A traditional lifeway value is important for maintaining a traditional system of cultural practice, religious belief, or social interaction for a contemporary ethnic or cultural community. Shared traditional lifeway values are abstract, nonmaterial, ascribed ideas that cannot be discovered except through discussions with members of the particular group. Lifeway values may or may not be closely associated with narrowly-defined locations. The Library of Congress provides an online collection for West Virginia which includes extensive interviews on native forest species and the seasonal round of traditional harvesting (including spring greens; summer berries and fish; and fall nuts, roots such as ginseng, fruits, and game). The information documents community cultural events, such as storytelling, baptisms in the river, cemetery customs, and the spring "ramp" feasts using the wild leek native to the region. Interpretive texts outline the social, historical, economic, environmental, and cultural contexts of community life, while a series of maps and a diagram depicting the seasonal round of community activities provide special access to collection materials [http://memory.loc.gov/ammem/cmnshtml/cmnshome.html]

Forests provide the basis for a multi-billion dollar timber industry and are a vital part of the cultural heritage of the region. Many plants found in the forest have contributed to the region's remarkable culture. Herbs such as ginseng are used globally for medicinal purposes, and are harvested to support a local non-timber forest industry. As isolated mountain hollows fostered the evolution of rich species diversity, they helped to preserve cultural heritage and create a sense of self-reliance and independence within the people. [CVI, 2002]

This EIS study area is part of the Mid-Atlantic Highlands region that features some of the most historic landscapes in the country. Native American populations existed 15,000 years prior to arrival of ancestors of the citizens living in the study area today. Indian artifacts, burial mounds, camp sites, and related archaeological sites are scattered in the study area, most significantly in the larger floodplain valleys. Many battles of the Civil War were fought in the Appalachian countryside and pre- and post-Civil War structures and encampments may occur in some locations within the study area.

Following the crossing of the mountains by early settlers, towns and cities formed along the river valleys and became significant centers for trade and industry. Before the discovery of coal, salt brines, oil and gas, timber, glass making and other farming and trading developed the local economies. Settlers began dispersing to other ridge tops and stream valleys surrounding the towns and cities. With the discovery of coal, large land holdings were purchased for rich mineral rights (coal, oil, gas, etc.). During the industrial revolution, the demand for coal for coke and steam began to draw mining employees into coal camps. These coal camps formed the cultural and social hubs for Appalachian residents up through the first half of the twentieth century and are still the roots for

many of the inhabitants today. These coal camps and the large land holdings have tended to control the cultural and historical resources in the region.

Coal mining practices have profoundly affected the communities and residents of the Appalachian coalfields since coal mining first commenced in the region. Sections III.U.1. through III.U.4. provide an overview of the past and current interaction between the coal mining industry and the residents of Appalachia. A decline in the physical state of the community may affect the economic status of local residents. Coal companies frequently built and maintained local infrastructure, from housing to plumbing and even churches, in the coal towns of Appalachia in varying degrees of quality. Today, many coalfield communities not only receive revenue from taxes on coal property and employment, but also donations of money, land, and company equipment to support civic organizations.

Appalachian coalfield residents have a unique social and cultural connection to the natural environment. For coalfield residents, the quality of the natural environment is important both as a source of income and an integral element of Appalachian culture. Sections III.U.5. and III. U.6. present an overview of the relationship between the natural environment, Appalachian culture, and coal mining. Mining effects may compound and ultimately affect the human environment in ways such as land use and potential development, as described in Chapter III.S.; historic and archaeological resources, as described in Chapter III.T.; and the cultural, social, and economic importance of existing landscape and environmental quality, as described in Chapter III.U.

The value of prehistoric and historic properties is intrinsic and may be protected or documented under the National Historic Preservation Act (NHPA). Their preservation may stabilize neighborhoods, stimulate private investment, provide affordable housing, revitalize downtown activities, attract tourists and enhance community pride. If MTM/VF projects may impact historic properties, the projects are coordinated with the State Historic Preservation Office (SHPO). The mission of the SHPO is to encourage, inform, support, and participate in the efforts of people of the state to identify, recognize, preserve and protect prehistoric and historic structures, objects and sites.

The aesthetic quality of a community is composed of visual resources; i.e., those physical characteristics that make up the visible landscape, including land, water, vegetation and manmade features. Visual impacts affect communities from two perspectives: 1) the view from the site, and 2) the view of the site. The view from the site is from the public perspective and leaves a lasting impression of the community, are or regional on the visitor as well as residents. The view of the site by the residents contributes to the feeling of community value and pride. Visual impacts of an area are ascertained by defining the visual environment, identifying key views, analyzing the resources and community responses, depicting the project appearance, assessing the visual impacts, and then developing mitigation measures.

1. Consequences Common to the No Action and Alternatives 1, 2 and 3

Under all four alternatives, local setting for cultural, historic, and visual resources continue to be at risk from MTM/VF activities that may result in a potential impact to those resources. Coordination with the SHPO on impacts to prehistoric and historic properties will provide mitigation in the form of permanent documentation. However, existing controls are judged adequate to protect cultural and

historic resources. No distinction can be made between the No Action Alternative and the three action alternatives as they affect cultural, historic, and visual resources in the EIS study area.

All alternatives may continue to displace local communities in essentially equal amounts, since the alternatives are based on process differences and not directly on measures that restrict the area of mining. However as review processes are improved and enhanced, there should be a greater level of consideration of cultural, historic and visual resources.

Visual impacts will continue to occur, both from MTM/VF, as well as other activities such as roads, and residential/commercial development. These impacts occur to residents and visitors in the form of changes to the viewscape as seen from highways and impacts seen from air travel. Mitigation for these impacts may occur in the form of reforestation in some instances, however, some visual impacts may be permanent due to post-mining development.

As communities are displaced for whatever reason, including MTM/VF, local crafts, skills, and folk lore may be diminished and may be lost. However, all alternatives will produce indistinguishable indirect impacts in this regard.

H. SOCIAL CONDITIONS

From 1980 to 1990, the total population of the counties in the study area fell by over 140,000, from 2.11 million to 1.97 million, a 6.7% decrease. In contrast, the population of each of the states, with the exception of West Virginia, grew over this period. Regarding West Virginia, the study area counties lost population at a substantially greater rate than the state overall, 1.4 percent per year compared to 0.7% per year for the state. Census estimates for 1998 indicate that the study area's population levels have slightly rebounded to total 2,014,466. Tennessee is the only State in which the study area counties have regained their 1980 population. Total population in the West Virginia study area has declined from 1990-1998, although at a slower rate than the previous decade. [Chapter III.P]

Income statistics from the 1980 and 1990 Censuses indicate that the study area, as a whole, has a starkly lower income than the individual states. Just 4 of the 69 study area counties had a per capita income exceeding its state average per capita income in 1990. Another measure of economic well-being is the estimated percentage of the population with an income below the poverty level. Census statistics for 1980 and 1990 depict a poverty problem throughout most of the EIS study area. Over the entire study area, only four of the counties had a lower poverty rate than their respective state and only ten had a poverty rate below twenty percent in 1990. In twenty-four of the study area counties, over one in every three residents was estimated to live below the poverty level. The demographics in the EIS study area are discussed in detail in Chapter III.P.

Traditionally, many employment opportunities in the EIS study area have been in mining, forestry, and agriculture sectors; and industries requiring neither major urban centers nor knowledge in areas such as advanced computer technology. These industries have now declined, or have phased out workers through increased mechanization and operational efficient. [CVI, 2002] The study area counties nearly all show decreases in unemployment rates from 1990 to 1998, and many of the counties show greater improvements than their state average for the period. On the other hand, many study area counties had increases in unemployment rates for the preceding period (1980-1990), or had slower improvements than the state average. Taken together, the changes for the two periods suggest that the study area counties lagged the states in the 1980's in employment improvements and have begun "catching up" in the 1990's. [Chapter III.Q.] The persistence of high employment in the more isolated areas suggested that new and growing industries are not being attracted to take advantage of the available labor force [CVI, 2002].

Coal mining practices have profoundly affected the communities and residents of the Appalachian coalfields since coal mining first commenced in the region. Chapters III.U.1. through III.U.4. provide an overview of the past and current interaction between the coal mining industry and the residents of Appalachia. Appalachian coalfield residents have a unique social and cultural connection to the natural environment. For coalfield residents, the quality of the natural environment is important both as a source of income and an integral element of Appalachian culture. Chapters III.U.5. and III. U.6. present an overview of the relationship between the natural environment, Appalachian culture, and coal mining. Activities directly related to coal mining other than employment, such as increased traffic, air and water quality impacts, flooding and changes in the natural environment, affect the socio-economic conditions in the EIS study area. Because of the topography and terrain in steep slope Appalachia, flooding occurs in severe weather conditions. The

environmental affects of flooding are described in Chapter III.G., and the air quality impacts can be found in Chapters III.V. and III.W. and Appendix G.

While company towns existed in many parts of the United States in the first half of the 20th century, the effects of coal company towns in the Appalachian Mountains were more far reaching. The mining company controlled nearly every essential aspect of community life, from work, to shopping, education, retail merchandising, and medical care.

The social structure of these company towns was impacted by the paternalistic nature of the relationship between the company and the residents, resulting in a highly dependent relationship for the residents. Research indicates that this typical company town relationship has both psychological and physical manifestations. The nature of company towns has been documented across numerous industries; however, the relative isolation of the communities, the predominance of the coal industry and the relative poverty of the region prior to industrialization all arguably contribute to a more pronounced community structure based on company paternalism.

The economic dependence of the region on its exhaustible coal resources, its need to diversify, and its need to further develop the human resources and infrastructure to support economic development are widely recognized. Most leaders are also keenly aware that its coal resources are its best source of leverage for investments needed to build an economy that can continue to flourish after the inevitable decline of coal mining [Chapter III.R.].

Two of the factors most often cited as hindering economic development in Central Appalachia are the rugged terrain and the poor access. The steep slopes and the narrow, flood-prone river valleys severely constrain the available supply of developable land. The use of land after coal mining has been completed may include residential and/or commercial development. Building on and use of this relatively rare flat land could provide jobs from construction, service and commercial industries, and tourism. Changes in land uses not only affect the local social climate and tax base, but affect private property rights as lands are developed and sold.

Changes in terrestrial and aquatic habitats will affect activities such as hunting, fishing, and bird watching. The recreation use of the area by residents and tourists is discussed in Chapter IV.J.

1. Impacts Common to the No Action and Alternatives 1, 2 and 3

The environmental consequences discussed throughout Chapter IV would have an effect on the social conditions of the area. Impacts to aquatic resources affect drinking water and fisheries, impacts to terrestrial resources affects land use and development, viewsheds, wildlife use and recreation which all have a bearing on social and cultural impacts. Requiring avoidance of high quality aquatic habitats and adequate mitigation, will improve water quality in the watersheds. Mining practices affect the local culture and directly impact the economy through employment opportunities. The number of mining jobs is related to the amount of coal produced. Coal-related jobs will likely be lost as the existing coal reserves are depleted and/or if coal mining productivity increases. [Appendix G; Chapter III.P-Q]

The agencies recognize that, in spite of enforcement of the existing regulations and implementation of the recent program improvements, blasting concerns/complaints will continue. Concerns and

subsequent complaints are likely to decrease as a result of the identified recent program improvements. However, when mountaintop mining operations are near residences and populated areas, complaints, particularly those related to noise and vibration of homes (nuisance impacts), may still occur in relatively high numbers. Although regulations provide a limited ability to control nuisance impacts (for example blasting may typically occur only between sunrise and sunset), these nuisance-type concerns will continue to have periodic adverse effects on the quality of life of residents living in close proximity to the mine sites. The regulations were designed to minimize damage potential and only indirectly address nuisance; however, citizens may exercise their right to take civil action against a mining operation for nuisance-related concerns. There have been court cases in the coalfields where mining activities have been ordered to adjust operational procedures (i.e., above-and-beyond existing regulatory program controls) to reduce nuisance.

2. Impacts Common to Alternatives 1, 2, and 3

The actions in the three action alternatives are projected to have positive social benefits through the improved regulatory processes and coordinated public participation. All three action alternatives would facilitate a better understanding by the public of the regulatory process and therefore facilitate their input regarding social concerns that should be factored in permit decision making. This improved efficiency would result in mining companies having more predictability in their planning processes, resulting in reduced costs and time. The No Action Alternative would continue the existing regulatory framework.

Additional water quality data collection and analysis may result in new water quality standards, if necessary. Development of BMPs to centralize the best technical information for aquatic mitigation and reforestation [Chapters II.C.6 and II.C.8.], as well as the two actions discussed below, will provide predictability and better understanding for residents in the area of the effects of MTM/VF.

Implementation of Action 15 [Chapter II.C.9.] to evaluate and coordinate current programs for controlling fugitive dust and blasting fumes from MTM/VF operations, and develop BMPs and/or additional regulatory controls to minimize adverse effects, as appropriate. Under this action, EPA, OSM, state air quality agencies, and state mining agencies would identify 1) meteorological and physical conditions which can exacerbate dust or blasting fumes; 2) state-of-the-art techniques currently used in the mining industry to control dust and fumes; and 3) appropriate regulatory improvements to minimize adverse affects, as appropriate. This action could result in positive changes in operations to control air quality impacts near MTM/VF that may address social concerns.

Implementation of Action 16 [Chapter II.C.10.b.] would result in the identification of guidelines and methodologies for calculating peak discharges and evaluating downstream flooding risk. Modeling and other recommended approaches for peak runoff determinations could be discussed and the proper design storm event for evaluation could be suggested. This action would result in improved designs to reduce the risk of flooding to homes and businesses downstream of MTM/VF operations.

Since all of these actions would be implemented in Alternatives 1, 2, or 3, no distinction can be made between and among these alternatives as they affect social impacts.

I. ECONOMIC CONDITIONS

1. The Role of Coal in the Economy

The interaction of coal in the economy is driven directly by the energy market of the nation. Reliable, inexpensive energy is a crucial component to local, regional, national, and world economies. Setting public policy to balance environmental protection and energy needs is not a simple matter for Congress, the agencies implementing Federal law, state legislatures, or state agencies implementing state or Federal law. Normal supply and demand principles govern the energy market. For instance, the type of coal needed to comply with the Clean Air Act also influences demand. If a certain type of coal is required to meet clean air requirements and is more expensive to mine, then the cost of electricity to consumers will go up.

As long as coal is required to supply a dominant portion of local and national energy needs, the ability to extract low sulfur coal reserves efficiently and cost-effectively will occur somewhere in the nation (or the world) to meet energy demands and clean air standards. Higher mining costs due, in part, to environmental compliance (e.g., material handling, costs of mitigation, less-efficient mining methods to minimize impacts, inaccessibility of large reserves due to impact avoidance, etc.), will result in coal supplies originating from coal basins outside this EIS study area where compliance can occur. If mining costs increase too greatly within the EIS study area, mining employment would drop and tax revenue from coal would decline. Commensurate school closings, diminished state and local government services, etc. would occur. A shift to other industries (such as services, tourism, outdoor recreation, etc.) and some exodus of job-seekers to other regions of the country would occur if lower-salaried jobs are the dominant source of employment. The remaining population in the coalfields may be older and poorer as this long-term transition from coal occurs until or if other sources of employment, revenue, etc. supplant coal economic influences. This process is similar to what has occurred in other parts of the country as the steel industry declined due to foreign competition. These economic shifts have been repeated locally in numerous instances when employers or a primary industry sector decline, go out of business, or move.

If the reliance of the U.S. on coal for electricity is not supplanted by other fuel sources (gas, wind, solar, nuclear, fuel cells, other new technologies), the demand for central Appalachian coal will likely increase at some point in the future. This demand will occur as other low sulfur coal resources in the country diminish and/or more cost-effective and/or "environmentally-friendly" mining techniques are developed. Renewed demand might require more costly mining and more costly electricity with subsequent ripples in the economy as the loss of inexpensive energy influences other industrial sectors.

Central Appalachian coal currently meets air quality standards but cannot compete very effectively with Powder River Basin coal due to mining costs, reserve size, and economies of scale. Productivity increases in central Appalachia spurred by competitive pressure leaves thin profit margins and little attraction of investment capital. Additional costs of environmental compliance will undoubtedly shift some portion of production demands for compliance coal outside of the EIS study area.

Increased environmental costs due to avoidance, fill minimization, and compensatory mitigation to offset unavoidable aquatic impacts have not been a consistent factor in environmental compliance in the EIS study area until the 2002 renewal of NWP 21. These increased costs, discussed in the next section, will push mining companies, if possible, to try and avoid streams and find other places to place excess spoil—or, to "high-grade" already dwindling reserves in order to meet demand. However, even this shift in approach will be difficult, because some segment of the coal industry

has capital tied up in larger equipment that cannot economically mine with smaller fills or longer haulage distances. New capital will be required to "re-tool" in order to conduct more contour/auger mining to reduce valley fill sizes, lower mitigation costs, and still meet coal market demand. These requirements could be difficult for some companies to fulfill and these companies may not be able to secure capital for new equipment, open new mines, or exploit existing reserves.

The influence of coal mining on the central Appalachian economy, including income, employment, and tax base, is discussed briefly below and in more detail in Chapter III.Q. Coal mining earnings within West Virginia are 5 % of total state income (3% of employment); just over 1% of total earnings and employment in Kentucky, and less than 1% of employment and income in Virginia and Tennessee [Chapter III.Q.2.a-b.]. While the coal mining influence state-wide is a relatively low percent of employment and income, it is a considerable influence in certain study area counties. For instance, coal-related earnings have the highest influence in Boone County, West Virginia, Buchanan County, Virginia, and Knott County, Kentucky, where coal-related earning comprise 60, 33, and 42% of county earnings, respectively. Surface mining employment study area wide represents 25% of mining employment, but declines in surface mining production typically result in some amount of commensurate increases in underground production and employment. Shifts in coal mining employment or production in counties with higher percentages of mining earnings can have proportionate effects on the county tax base [Chapter III.Q.2.c]. In West Virginia, for example, 34% of property taxes collected come from coal. Schools rely on these property taxes to supply around 30% of district budgets.

2. Economic Effects of Smaller Valley Fills or Alternatives to Fills

Excess spoil disposal is most cost-effective for a MTM/VF operation at a point as close to overburden removal as possible. Valley fill site selection reflects this factor. Abandoned mine benches, reclaimed mine sites, or active mining areas may accommodate some volume of excess spoil, reducing the size of valley fill sites. However, haulage and material handling costs somewhat limit the practicality of using these storage alternatives to valley fills. As required by the CWA Section 404(b)(1) Guidelines, an applicant must demonstrate that alternatives to valley fills and minimized valley fills have been considered in order to properly balance practicality with project purposes.

It is noted that costs of compliance with statutory performance standards and regulatory requirements are not a basis for relaxing the standards to accomplish any particular MTM/VF project. These types of costs were projected in documents prepared as part of other CWA and SMCRA regulatory implementation and are not restated in detail here. Such costs are only generally relevant to this EIS because the alternatives look at different ways to coordinate decision making, not different ways to meet existing regulatory requirements. Implementation of any future agency action proposed by the EIS, upon filing of a record of decision following the final EIS, will include independent NEPA, legal, and regulatory analysis of the relevant economic consequences of the action. Studies related to the impacts of restricting valley fill size on production, employment, and electricity costs are in Appendix G. Avoidance and fill minimization requirements of the existing CWA Section 404 program may present the most cost-sensitive economic influence to mining costs. Therefore, generalized or relative costs associated with the compliance are illustrated in this section for consideration by the decision makers in light of other costs that could be associated with actions considered in the EIS.

While the economic studies on the projected effects of valley fill restriction in Appendix G are subject to some limitations and do not directly relate to the alternatives analyzed as part of this EIS, they indicate that valley fill size is an important determinant of mining feasibility. The existing program and the alternatives proposed in this EIS contain the common requirement that an applicant must avoid headwater streams and minimize valley fills where avoidance is not possible. Therefore, the studies in Appendix G provide indirect indications of the roll that avoidance and fill minimization may play in selection of mining methods, equipment, and the exploitation of the remaining surface coal reserves.

These studies are based on the mining engineering consideration of the number of cubic yards (cy) of overburden material removed per ton of coal recovered to determine mining feasibility (overburden ratio). Larger equipment can move more cubic yards of overburden less expensively than can smaller equipment. Accordingly, drag lines can reach deeper coal reserves than can truck-and-shovel equipment, which can reach deeper coal reserves than truck-and-loader equipment. Similarly, higher overburden ratios may create proportionately greater amounts of excess spoil. Therefore, operations mining larger or deeper reserves may require larger fills to accommodate the excess spoil. Reduction of available fill space may entail use of different equipment, alternative backfilling and grading plans, and/or result in incomplete recovery. Such differences in available excess spoil storage can adversely affect mining costs and production. Information relative to these differences and discussions on mining methods, planning/feasibility, excess spoil disposal, and reclamation are provided in Chapter III.I, J., K., and L. Economic influences due to available valley fill storage are briefly discussed below.

It is reasonable to presume that required mitigation costs (i.e., to offset valley fills) will result in future MTM designs with reduced valley fill sizes. The economic studies in Appendix G evaluated absolute fill restrictions to specific watershed sizes. While some of the studies have limitations, explained in the cover sheet for Appendix G, they still provide a logical and parallel inference for potential general economic effects of fill minimization. That is, since some of the economic studies show that absolute fill restrictions increase mining costs due to additional material handling and use of different equipment, it can be inferred that minimizing fills will to some degree also affect mining costs.

The economics studies show a direct correlation between fill size and shifts in production due to increased mining costs. The Mining Technical Team Study projected, with fills limited to ephemeral streams, that 91% of reserves that were feasible for mining with larger fills could not be mined with smaller fills. The Hill & Associates sensitivity analysis projected reserve reductions of 22 and 45% as well as mining cost increases of around 8 and 14%, when all fills were restricted to 250- and 75-acre watersheds, respectively. The Hill & Associates studies generally concluded that smaller fills necessitate less complete extraction but more rapid depletion of the surface minable reserve base with different equipment types and a shift to underground coal production. The shift to underground production does not generally involve extraction of coal rendered unminable by surface mining fill restrictions.

For the same reason that the EIS supports case-by-case determination of fill number, size, and location for MTM/VF proposals, the actual mining cost increases and reserve reductions for any given mineral property could vary from these ranges. However, these studies clearly confirm the

intuitive relationships among inexpensive excess spoil disposal, mining costs, minable reserve reductions and mining viability.

Where mitigation presents significant costs to the applicant, the economic effect will likely be similar, but possibly less pronounced, to the results of the absolute fill restriction studies, inasmuch as mining methods that reduce the amount of excess spoil (and consequently reduce the size of fills and the amount of mitigation) will be selected. The effects on individual MTM/VF projects may be less pronounced than the study results because of the following:

- Projects may result in fills larger than the restrictions analyzed
- Site-specific costs, such as the following, may differ from the generalized study assumptions:
  - Varying combinations of equipment may be used
  - Material handling or haulage may be markedly different.

Mining methods resulting in smaller fills can cost more than mining methods supported by larger fills. As described above, this occurs due to a lower coal recovery per volume of overburden removed as smaller equipment types are utilized. Also, resource recovery at operations with smaller fills may be less complete than operations necessitating larger fills. This effect occurs when portions of coal seams that were economically minable by larger equipment cannot be mined (and may never be extracted) by operations using smaller surface equipment or underground equipment.

Mining decisions are also strongly influenced by market demand for particular coal quality. Many mines rely on blending the products of different surface mines or a combination of surface and underground coal to conform with supply contracts for particular coal quality. Also, transportation and coal preparation costs associated with smaller and underground mines are sometimes related to the proximity of larger mines with this existing infrastructure. If the infrastructure is not available, a new, smaller mine may not be practical. Therefore, the types and qualities of coal reserves available in various seams, transportation, and coal cleaning facilities may determine mining viability.

The alternatives proposed in this EIS also include other actions that could increase costs of MTM/VF application preparation and operation. The alternatives propose actions that would increase data collection and analysis costs to the applicant as well as application scrutiny and intra-agency coordination costs to the agency. These costs are discussed below.

3. Economic Consequences of the No Action Alternative

a. Government Efficiency and Coordinated Decision Making

Under the No Action Alternative, the SMCRA agency permit application review process and decision typically start and conclude prior to decisions by the COE and state CWA Section 401 certification. Therefore, the SMCRA review and surface mine design is finalized without early input from COE experts on protecting aquatic values within waters of the U.S., or by state experts on protecting water quality. This type of input at the conclusion of the process often requires modification of the issued SMCRA permit and/or re-design of the mine to accommodate the decision of the COE. This occurrence can add substantially to the time and resources already expended by

the applicant in fulfilling added SMCRA and NPDES reviews. In Virginia and West Virginia, the SMCRA and CWA Section 402 authority rest within the same governmental department and coordination regarding water quality protection in these states would continue.

The COE begins its CWA Section 404 review only after issuance of the SMCRA permit under the No Action Alternative. Because the surface mining operation has been designed to reflect comprehensive SMCRA review, there is pressure on the COE to work within the existing design so as to not significantly alter the mine plan--unless egregious adverse environmental effects would occur. However, there could likely be instances under the No Action alternative where SMCRA-approved projects would require redesign and reprocessing due to COE reviews. This causes increased permitting costs for the applicant and additional SMCRA agency resources to process modifications, revisions, or amendment of previously-issued permits.

b. Data Collection and Analysis

The No Action Alternative could result in increased costs to applicants as the new NWP 21 requirements are implemented. Increased stream characteristic information, impact projections, and demonstrations that impacts to waters of the United States have been avoided and minimized to the maximum extent practicable, and that compensatory mitigation is offered to offset unavoidable aquatic impacts will add field work, laboratory analysis, engineering computations, and likely more elaborate project designs. In the COE Draft Nationwide Permits Programmatic EIS (July 2001), the COE estimated that the cost to the applicant for CWA Section 404 permit is approximately $12,500 higher for an IP than for a NWP [2001 COE DEIS, Table D.4.2-4]. If the level of permitting remains constant in the No Action alternative, the overall increased cost to applicants would range from $1.6 to $1.9 million per year. There was recently an increase of permit applications for renewal of NWP 21 projects following renewal of NWPs in January 2001. These applications occurred for MTM/VF operations not yet initiated since their earlier authorizations expired in February 2003. Thus, the projected costs to applicants may initially be greater until the permit renewals are processed.

c. Consistent Definitions

Without common application of regulatory terms regarding streams [Chapter II.C., Action 2], there is the potential for less effective environmental protection and confusing regulatory responses to citizen concerns. This alternative could ultimately result in increased costs to the public and the regulatory agencies in the form of litigation.

The No Action Alternative is also likely to be more costly to the regulated community due to increased permitting costs associated with resolving conflicting requirements, time delays associated with obtaining the necessary permits to legally conduct mining activities, and potential litigation costs. These delays could occur, for example, when a project is planned in areas where stream characteristics are at issue. Costs of obtaining additional field data to resolve the issues could also accrue.

d. Mitigation

Action 10 is common to Alternatives 1, 2, and 3 and proposes to assure compensatory mitigation through coordination of SMCRA and CWA bonding and inspection. Mitigation under the No Action and action alternatives are discussed in Chapter II.D.6. The No Action Alternative provides no coordination regarding who monitors implementation of mitigation requirements and how mitigation projects are bonded and insured to assure successful completion. Under the No Action Alternative, any disturbances that might occur within the SMCRA permit boundaries would be inspected and bonded by the SMCRA regulatory agency to assure completion of required activities. SMCRA also requires the applicant/permittee to maintain liability insurance during the life of the permit and bond liability period in order to assure that anyone who might be harmed by the proposed activities has a viable opportunity to be made whole through civil court action.

CWA mitigation actions that may be required off-site (beyond the SMCRA permit boundaries) are under the regulatory control of the COE. The COE can, on a case-by-case basis, require performance bonding for mitigation activities. However, COE has no authority to require that permittee or contractors performing such mitigation activities have liability insurance coverage. Under Section 401 of the CWA some states, such as West Virginia, have established mitigation authorities to offset impacts to waters of the state. The COE considers these mitigation plans when evaluating mitigation proposals to satisfy requirements under CWA Section 404.

Since there are no defined, established procedures between COE and SMCRA authorities for coordinating on-site and off-site mitigation requirements such as bonding and inspection, there are both inefficiencies and risk in the current system. The risk is that in maintaining separate, uncoordinated systems, some aspects of a mitigation project may not be completed as required. The inefficiencies are present as the current system now requires separate permitting, separate monitoring/inspection, and separate bonds for what is essentially a single project (reclamation/mitigation). The environment may be impacted should any aspect of a mitigation project not occur. Duplication of permitting, inspection and bonding requirements result in increased costs to both the taxpayer (duplicate permitting and inspection staffs) and to the applicant (duplicate permitting and bonding costs).

e. Flooding

Flooding can adversely impact people, property, public transportation, and utilities. Flooding exacts considerable costs to individuals, insurance companies, as well as local, state and Federal governments. The causes of flooding may be a combination of the rainfall event and the man made alterations to land use, topography, ground cover, and stream channels. Human alterations to the landscape can also prevent or minimize flooding impacts [Chapter III.G]. Technical studies for this EIS indicate that peak runoff will typically increase during and shortly after mining on most sites. This may not be true of all mine sites and reclaimed sites may reduce peak flows compared to pre-mining conditions [Appendix H]. Alternatives 1, 2, and 3 contain an action to develop guidelines for calculating peak discharges for design precipitation events and evaluating flood risk [Chapter II.C.10]. In addition, the guidelines would recommend engineering techniques useful in minimizing the risk of flooding [Action 16].

With regards to the No Action Alternative, the study findings generally support a conclusion that downstream flooding potential is not significantly increased by existing mining practices so long as approved drainage control plans are properly applied [Appendix H]. However, variability in the

results suggests that this assumption cannot be universally applied, and that only site-specific quantitative modeling can determine whether potential for flooding is present for a given mine plan. Absent selection of an action alternative, permit reviews would continue to be evaluated in differing fashion from state to state by SMCRA agencies and COE Districts.

West Virginia currently uses the Surface Water Runoff Analysis (SWROA) guidelines, developed jointly with the COE and OSM [http://www.dep.state.wv.us/docs/28surfacewater.doc]. Kentucky advises permitting staff on general considerations for flooding potential assessments through a policy memo. The COE Huntington District evaluates flooding potential for each applicant based on a 100-year storm, while SMCRA evaluations may use a 25-year storm for some designs and 100-year storms for others. The COE Louisville District reported that no flooding evaluations occurred as part of their NWP 21 reviews. Application of these flooding analyses imposes increased analytical costs to applicants and administrative costs of review to the regulators. Mitigation measures as part of the mine plan result in added costs to the mining companies. The cost-benefit of these analyses should likely exceed the necessity of repairing flood damage absent the measures.

Recent flooding in West Virginia during 2001 and 2002, and the types of flooding analyses described above, resulted in the West Virginia Governor commissioning a study and OSM conducting oversight. Recommendations from OSM reviews could bring consistency to SMCRA programs under the No Action Alternative. However, the No Action Alternative would not necessarily resolve the differing approaches to flooding potential reviews by OSM and the COE. If quantitative analyses continued to be omitted in some states under the No Action Alternative, the risk would continue that some mine plans with increased potential for downstream flooding would be overlooked during the permit review process. If contributions to flooding from surface coal mining occur, flooding recovery costs could be imposed on operators, residents, state, local, or Federal governments.

4. Economic Consequences Common to the No Action and Alternatives 1, 2, and 3

a. Fill Minimization

The alternatives analyzed as part of this EIS, including the No Action Alternative, include the requirement for avoidance and fill minimization. This EIS does not provide a detailed discussion or quantified costs about compliance with the current CWA or future SMCRA fill minimization performance standards. This type of analysis is not required because the purpose of this draft EIS does not include evaluation of the costs of meeting fill minimization. Those requirements were subject to public scrutiny during the administrative process at the time the CWA Section 404(b)(1) regulations were promulgated.

Costs of compliance are not a factor in enforcement of SMCRA or the CWA that can override environmental protection standards set by law. An applicant may find that costs of compliance with the SMCRA and CWA performance standards are prohibitive to profitable mining of some coal deposits. Decisions as to whether company can internalize costs for avoidance and minimization are part of the many factors considered in making a business decision as to mining viability that should occur prior to application. However it is the purpose of this EIS to generally inform the

public and decision makers of the consequences of implementing measures for fill minimization on the economy.

Implementation of any quantified fill minimization evaluation methods under the action alternatives would increase the informational reporting requirements for permit applicants on sites that generate excess spoil. Overall review periods and amount of corrective correspondence between applicants and reviewing agencies would increase. This would have the effect of increasing mine permitting costs due to the greater level of effort required in application preparation.

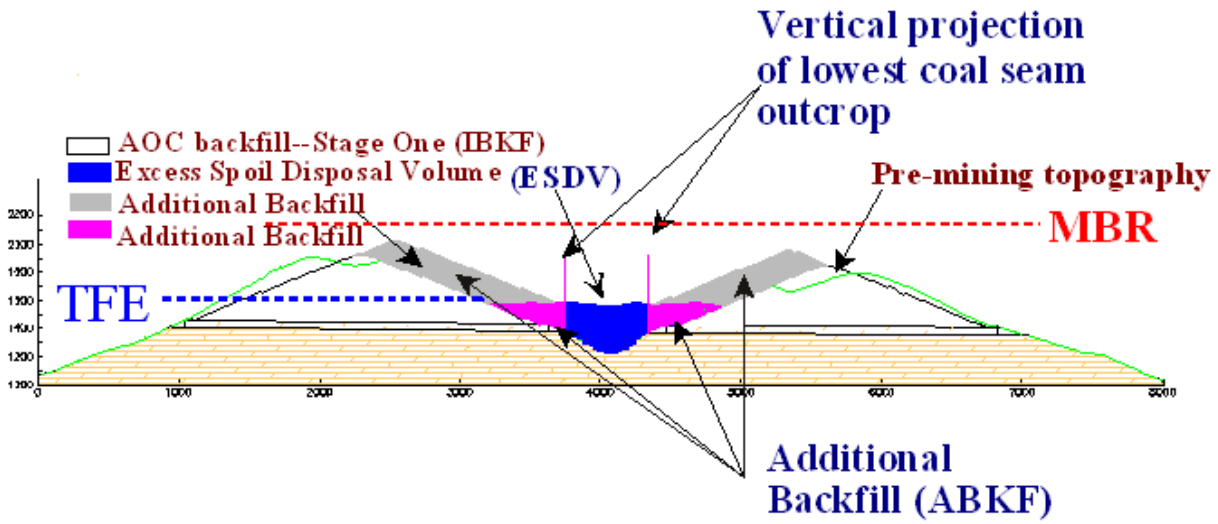
In some instances an operator may have to expand the permit area for upland disposal alternatives with consequent increased transportation costs and attendant costs for purchase or rights of access. Fill minimization may increase operational costs to the mining operator because spoil that must be returned to the mine site has higher handling costs than the current practice of end-dump valley fill construction. In many cases, backfilling on the mined-out area is performed by the same end-dumping techniques as excess spoil placement in durable rock fills. However, unlike durable rock fill construction, backfilling may increase haulage costs, which may be more expensive because of distance, or because loaded trucks must haul uphill (more maintenance costs to engines, brakes, suspension, greater fuel costs, haulage vehicles require replacement sooner, etc.) to back stack to higher elevations to minimize the amount of excess spoil. Backfilling in some areas may necessitate extra handling (grading and compaction costs) to assure stability. This can greatly increase material handling costs for the operator.

While not a direct comparison, and somewhat dated, the regulatory analysis by OSM for the permanent program regulations indicated that placing spoil in lifts versus end-dumping to build valley fills added 17 cents/ton to the cost of mining coal in central Appalachia [p. 98, Table 27, "Permanent Regulatory Program of the Surface Mining Control and Reclamation Act of 1977, Final Regulatory Analysis" OSM-RA-1 March 1979]. This cost would be a portion of other expenses to an operator that affect the cost per ton to mine.

The following case study exemplifies the impacts of minimizing fills by applying WVDEP's AOC+ policy. A proposed surface mine will create 65 million cubic yards (mcy) of mine spoil. Initial analysis indicates that 38 mcy of spoil will be returned to the mined out area and 27 mcy placed in adjacent valley as in excess spoil fills. After applying the iterative fill minimization analysis required by AOC+, more than 26 of the 27 mcy of excess spoil could be returned to the mining area, therefore minimizing the volume of spoil needed to be placed in excess spoil fills. [Figure IV.I-1]

By applying AOC+, 1690 feet less of valley fill length (than in the original mine plan) were avoided. Although the results of AOC+ are site specific, the overall effect of reducing the amount of excess spoil, the resultant size of the excess spoil fill, and direct impacts to streams may be greatly lessened when compared to the past fills before 1999 for mountaintop removal or large area mines. Similar minimization analyses would be developed and applied to contour mining. Illustrations of the results of AOC+ for the case study mine site are shown in Figures IV.I.-2 and 3.

Figure IV.I-1
AOC+ Results in Additional Spoil Returned to the Mined Area and Not in Streams



(Source: WVDEP AOC Guidance Document, 2000).

Figure IV.I-2
Illustration of General Results of AOC+ on Length of Stream Impact

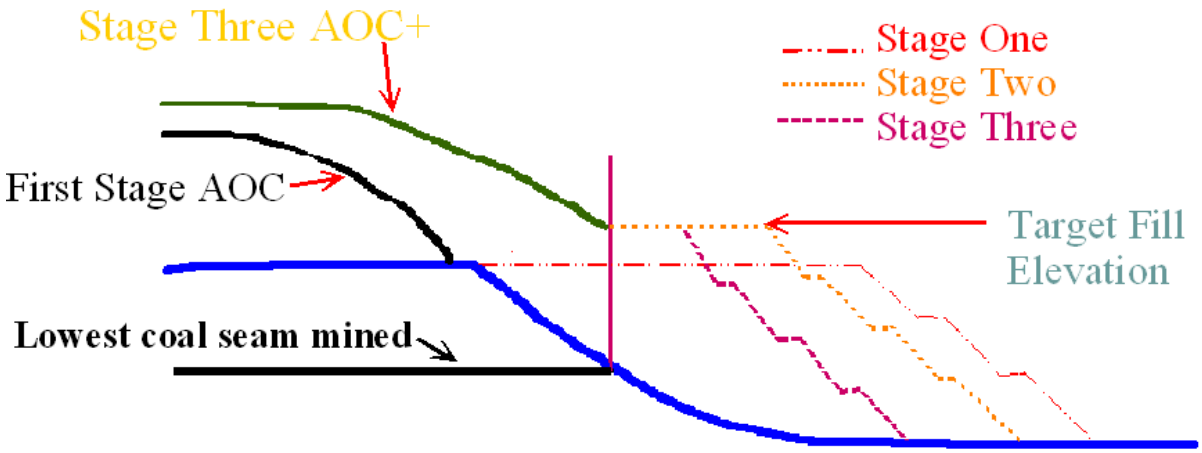
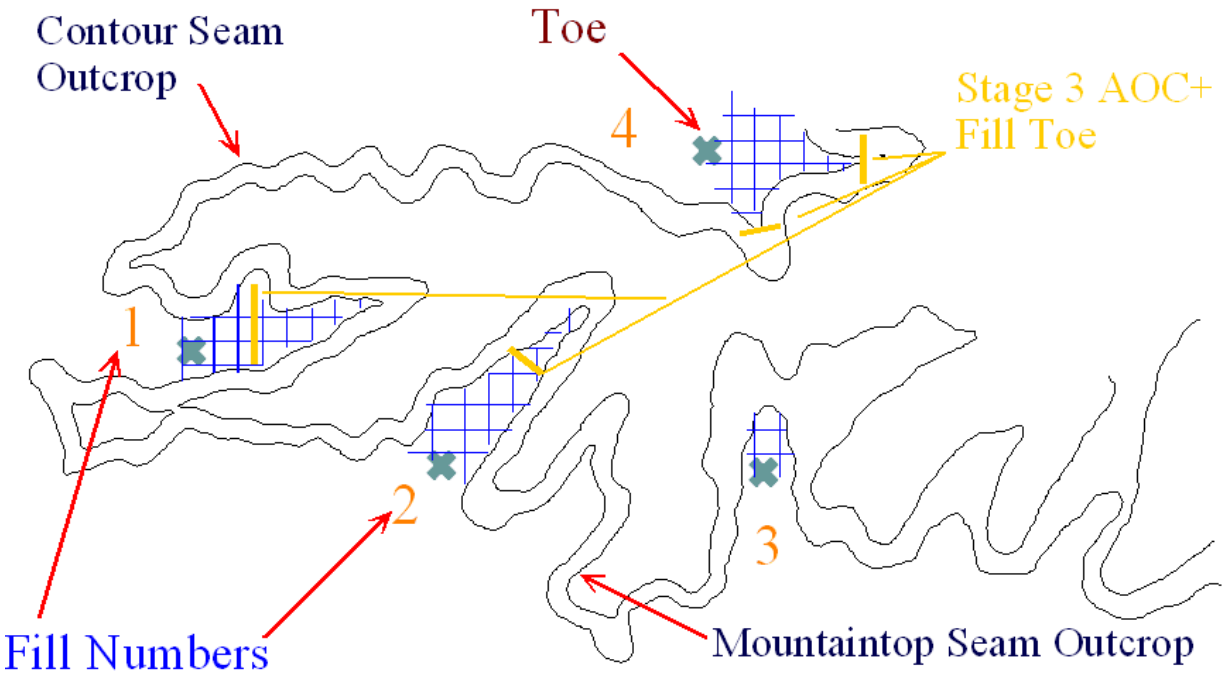


Figure IV.I-3
Illustration of Original Fill Toe Location (At Teal Colored "Xs"); and After AOC + Process (At Gold Lines)



Fill minimization costs for the operator under the example above would be dependent upon the additional logistics and haulage costs. The operator may have initially assumed that the 27 mcy could be hauled a short distance and end-dumped into a fill at relatively low costs. Upon applying AOC+, the operator must now haul 26 of the 27 mcy to the backfill area for grading and reclamation. If this additional hauling and handling adds $0.50-1.00/cubic yard, the operator must absorb $13-26 million additional operating costs from profit margins, if possible. While these increased costs will undoubtably reduce mitigation costs from affecting about 1700 feet of less stream reaches, some operations will likely become infeasible due to reduced return on investment. The only other alternative to mining the coal reserve and avoiding/minimizing valley fills may be to conduct contour mining and auger/highwall mining, consequently reducing reserve recovery considerably.

b. Data Collection and Analysis

The requirement to conduct stream functional assessments to determine size, number and location of valley fills, as well as the aquatic resource impacts and mitigation, will require additional biologists and ecologists in COE Districts under all alternatives, including the No Action Alternative. The data must be reviewed relative to extent of waters of the U.S., the completeness of the alternatives analysis, and the scoring of the biological, chemical, and physical conditions of the stream segments planned to be affected or analyzed as alternatives. These types of analyses are central to determining compliance the CWA Section 404(b)(1) Guidelines and setting adequate mitigation levels. The COE must evaluate the same type of data for adequacy of the proposed mitigation projects, to establish baseline stream characteristics, and review the stream

improvements. The COE must also perform site visits to determine if the projects are in compliance with permit conditions.

c. Mitigation

Under all alternatives, including the No Action Alternative, reclamation and mitigation practices are required by the CWA Section 404 program to restore stream habitat and aquatic functions impacted by MTM/VF through on-site reclamation and on-site and off-site mitigation [Chapter II.C.6]. These practices may include stream construction or enhancement, the construction of other aquatic systems, such as wetlands, and the restoration or enhancement of riparian habitat to compensate for the loss of aquatic functions. Preservation of high quality streams through creation of conservation easements or land trusts and the payment of in lieu mitigation fees for stream protection and restoration measure would also be considered. The costs for in-kind mitigation and in-lieu fee agreements may be considerable but are not presented in detail here. Presenting costs for complying with the COE regulations is not required, inasmuch as the purpose of this NEPA analysis is not to present alternatives to mitigation requirements.

Both on-site and off-site mitigation are likely necessary to insure that only minimal individual and cumulative impacts occur under all of the alternatives considered, including the No Action Alternative. The utilization of a stream assessment protocol provides a more accurate characterization of the loss of aquatic functions and the ability to more accurately predict the opportunity to restore aquatic functions loss at the reclamation or mitigation site. The protocol will also play a substantial role in identifying high quality streams, which may be avoided to reduce the impacts and associated mitigation costs.

Actions associated with Alternatives 1, 2, and 3 would require that a data collection program be implemented as part of utilizing a stream assessment protocol and a water quality and mitigation monitoring program [Chapter II.C.]. A more complete evaluation of the aquatic resources would occur before impacts to headwater streams would be allowed. The data and protocol would also be useful in designing future mitigation projects. There are many aspects regarding impacts of headwater streams and possible mitigation efforts for functions lost that can be better addressed through additional data collection. These actions would provide a venue to achieve this goal. Costs associated with the data collection were previously discussed in Chapter IV.I.3.b and 4.b. While mitigation costs occur under all alternatives considered, the costs to an operator are increased over mitigation costs required by the COE and/or the states prior to 1999.

A case example of alternative analysis and mitigation considerations was provided in Chapter IV.B.1.e. In the example, the Louisville COE District assisted a coal company in evaluating intermittent and ephemeral stream reaches for construction of valley fills and sediment ponds (with sediment transport channels intervening). Through use of the functional stream assessment protocol, the applicant was able to completely avoid intermittent streams, reducing 4,694 feet of originally planned stream impacts from 3 valley fills to a re-designed mine plan with only one fill in 950 feet of an ephemeral stream segment. In addition to decreasing linear feet of stream impacted, this re-design also avoided higher quality streams. The applicant satisfied this mitigation, in part, with on-site, in-kind restoration of the sediment transport channel between the fill and pond. The plan change reduced the mitigation costs from an original assessment of $300,000 to a $128,000 in lieu fee arrangement under the new plan.

Using only the COE case study as an estimate of cost per stream length impacted, mitigating the 724 miles of stream impacts from the Fill Inventory would assess in lieu fees over $516 billion. To avoid these costs carries other costs of material handling. The case-specific decision to construct fills or haul spoil will be integral to a mining financial plan.

d. Deforestation

Through efforts by states, the OSM forestry initiative, and other technology transfer and regulatory incentive methods, landowners and the regulated community are becoming increasingly more apt to implement forestry post-mining land uses and on-the-ground results are meeting with some success. Recent research shows that forestry post-mining land use is less expensive than typical grassland reclamation. Mine sites in Virginia indicate regrading costs for reforestation were reduced by $200-500/acre (Burger and Zipper, 2002). Research by Dr. Donald Graves at the University of Kentucky shows that, when compared to typical grading costs for establishing a hay land/pasture land use, an estimated $1,650-2,640/acre in reduced grading costs occurs when the research recommendations for forestry are followed (personal communication, 2003).

In Virginia, the majority of recorded post-mining land uses proposed on coal mine sites are forestry (VADMLR, 2002). A recent study of the proposed post-mining land uses on current mountaintop mine sites in West Virginia revealed that 68% of the sites were to be reclaimed to forestry-related land uses [Appendix G; (Yuill, 2002)]. There is not complete certainty that these reforestation efforts will resolve all the problems inhibiting the successful establishment of forest communities on reclaimed mine sites. However, recent research indicates quality forest communities equaling or exceeding growth rates existing prior to mining can be successfully and economically established on these mined sites. Improvements in the ability to re-establish a forest community on reclaimed mines sites comprised of highly-marketable species equal or exceed growth rates prior to mining.

As the number of years to re-establish forest decreases, economic benefits for the permittee, the landowner, and society in general are realized. The need of our nation for products derived from the forests (such as housing, paper products, furniture, etc.) places certain demands on the forest resource. This demand would be met more effectively through improvements in reclamation proposed in the action alternatives [Chapter II.C.8, Action 15]. Landowners will benefit as high quality forest follows mining. This provides greater opportunity to derive economic gain from the property, should the landowner choose to implement forestry post-mining land uses.

Timely re-establishment of quality forest communities on undisturbed natural sites or reclaimed mine sites do not prevent terrestrial impacts of deforestation described in Chapter III.F. But, with implementation of the latest research recommendations, long-term environmental effects are minimized and economic benefits of greater forest yields could be realized. Without an OSM effort to develop a BMP manual for the state-of-the-science in terrestrial reclamation, as described in Action 13, the rate of embrace of effective techniques may be slowed.

5. Economic Consequences Common to Alternatives 1, 2, and 3

a. Government Efficiency and Coordinated Decision Making

The basic and common tenets of surface coal mining regulatory programs (e.g., CWA Sections 401, 402 and 404, SMCRA, ESA, FWCA, CAA, NEPA, and other related state and Federal programs) are environmental protection and enhancement. State and Federal agencies responsible for implementing these programs strive to manage their respective programs to effectively accomplish the environmental protection goals, while minimizing duplication with other programs and avoiding the wasteful expenditure of human resources and public funds.

Three alternative approaches are proposed in this EIS to enhance the coordination among the state and Federal agencies in order to make each program more efficient and effective in minimizing the adverse environmental effects from mountaintop mining and valley fill construction. Only limited coordination among the various state and Federal agencies would occur with selection of the No Action Alternative. That is, a consecutive, rather than concurrent, MTM/VF application review process would likely continue without implementing actions described in Alternatives 1, 2 and 3.

Alternative 1 suggests that the COE make an initial determination of the size, number, and location of valley fills. Alternative 2 proposes a coordinated decision process among the COE and SMCRA regulatory authority to determine the size, number, and location of valley fills. Alternative 3 envisions the SMCRA regulatory authority initially determining the size, number, and location of valley fills. Increased coordination and determinations relative to siting valley fills carry administrative costs for the regulatory agencies as well as data collection, analysis, and application development costs for the mining industry.

Pertinent information regarding the SMCRA agencies and COE District Offices within the EIS study area follow. These data are relevant to regulatory and administrative costs under all alternatives.

Table IV.I-1
Comparison of SMCRA Agency and COE District Permitting Programs

State	Staff [1,2]	Payroll (millions)	New Surface Permits [3] (2001)	Other 2001 Permitting Actions [4]	Permit Acreage New/Other [4] (1,000s)
KY DSMRE	88	$3.0	58	234	13.2/31.1
TN OSM	11	$.9	3	38	1.1/0.6[6]
VA DMLR	22	$1.0	23	597	7.7/3.9
WV DEP	86	$2.4	30	314	10.2/0.8
SMCRA TOTALS	**207**	**$7.3**	**117**	**1145**	**35.8/33.1**
COE Huntington	9.6[5]	$0.57[5]	80 to 100		N/A
COE Louisville	3.0	$0.21	~35		N/A
COE Norfolk	1.3	$0.10	6 to 12		N/A
COE Nashville	0.9	$0.07	<5		N/A
COE TOTALS	**14.8**	**$0.95**	**126 to 152**		**N/A**

[1] SMCRA Agency staff working on permits of any type (surface, underground, preparation plant, etc.)
[2] COE District staff represent those staff working on NWP 21 authorizations and Individual Permits
[3] New permits issued for surface mining; does include all applications received.
[4] "Other" represents surface mining permitting actions involving renewals, modifications (revisions and incidental boundary revision); does not include underground mines and preparation plants.
[5] Does not reflect plans to hire two additional staff for coal mining-related work (~$115K/year)
[6] Includes acres from incidental permit revisions but not revisions

The staff organizational structure and budget represents those currently administering the permitting process under the No Action Alternative. To effectively administer the new procedures and reviews required by the revised NWP 21 for coal mining activities (i.e., case-by-case reviews of avoidance, minimization, and mitigation proposals for all unavoidable impacts to waters of the U.S.), additional COE staff would likely be required. For instance, the COE Huntington District anticipates hiring two additional people to process coal mining-related CWA Section 404 permits. The current workload is approximately 200 new permits per year with more than 1,000 other coal mining revisions typical in the EIS study region. To conduct the necessary fill minimization and flooding reviews reflected in proposed actions in this EIS, the estimated cost for additional engineers is $2+ million.

These staffing issues are closely related to actions described in other sections of this chapter, however they are generalized here because the level of staffing is critical to successful coordinated decision making and government efficiency. If any regulatory agency involved does not have adequate resources to provide thorough environmental compliance reviews of MTM/VF proposals,

the impact on other agency reviews and approvals affects the entire permitting process and project implementation. The design of a project with sufficient agency input, when properly inspected and enforced, has direct relevance to the quality of environmental protection and enhancement results on the ground.

As outlined below, Alternative 1 will result in the highest administrative cost to the state and Federal governments; Alternative 3, the lowest administrative cost; and Alternative 2, intermediate costs with a mix of Federal and state engineers performing reviews. Alternative 2 is more practical and realistic, since there are likely to be mining project applications that must be reviewed as IPs, and the COE would require engineers to complete both IPs and NWP processing.

b. Consistent Definitions

Action 2 is proposed for implementation under Alternatives 1, 2, and 3 [Chapter II.C.2]. Terms and stream characteristics with particular significance in the regulatory programs would be consistently applied through guidance, policy, or codified under common definitions through rule-making for CWA and SMCRA. Acceptable field methods and protocols for identifying streams and stream characteristics would be developed for the CWA and SMCRA programs. The Federal and state regulatory authorities propose to jointly prepare technical guidance to facilitate implementation of the use of these defined terms and delineation protocols by both the regulatory agency and the regulated community.

Implementation of Action 2 should result in impacts that are essentially the opposite of those outlined in the No Action Alternative. Less conflict and confusion over defined stream characteristics would result in better and more consistent environmental protections, lower costs to the industry and the ability to make business decisions prior to project application, and less likelihood of litigation-related costs to the local citizens, the regulatory programs, and the regulated community.

c. Data Collection and Analysis

The 2001 COE NWP EIS may understate anticipated applicant costs for NWP 21 submissions based on a more current and thorough consideration of the scope and effect of these requirements on MTM/VF proposals. While no detailed cost estimates are required or available for this EIS, the COE estimates are likely to be low by at least an order of magnitude. For example, some coal industry members asserted that the EPA biological/chemical monitoring stream protocol implemented in 2000 and 2001 in Appalachian steep-slope coal producing states would increase permitting costs by several hundred thousand dollars for larger permit applications due to the cost of additional benthic sampling and identification, testing for additional chemical species, and synthesis and analysis of data. This EPA stream protocol contains some of the components of the COE functional stream assessment protocol, however other data collection and analysis are required. Therefore, if performed by the applicant, the COE protocol may be more expensive than the 2000 EPA stream protocol.

The state or Federal permitting agencies would require additional staff with engineering expertise to conduct reviews of the upland alternatives/fill minimization analysis. This is particularly true of the COE in the No Action Alternative or Alternative 1, when COE reviews govern those permits

processed as IPs. The COE does not currently have staff with mining engineering background in the District regulatory branches. The CWA Section 404 minimization and alternative analyses involve a knowledge of mine planning theory and practice, as well as operational feasibility to determine if all practicable alternatives have been considered. While SMCRA agencies have these types of qualified staff on hand, the added analyses and review may exceed existing permitting staff capacity due to the large workload from permitting actions currently processed.

Discussions with a WVDEP engineer and permitting manager provided an estimate that fill minimization, through application of AOC+, adds 20% to the total time necessary for an engineer to properly analyze permits for fill minimization [personal communication, 2002]. WVDEP has around 14 engineers on staff. Assuming that all engineers might have to perform AOC+ reviews, three additional engineers (~$100-150K) would be required. This estimate may be liberal, because all engineers may not be involved in AOC+ reviews (i.e., they may specialize and, therefore, some segment of the WVDEP engineers review stability, ponds, hydrology/hydraulics, roads, etc.) and, with time, reviews could become more routine. Both applicants and state reviewers would become more familiar with the process, applications would improve, and review time eventually reduce. However, this estimate may also be too conservative, in that every permit with fills--whether contour mining or mountaintop removal-- will require some sort of more detailed fill minimization review and increase the overall average increased review time above 20%. Applying a 20% additional review time estimate to other states in the study area: Virginia DMLR will require at least one full-time staff and $45-60K in additional funding; OSM's Knoxville Field Office, one half-time staff and $38K additional funding; Kentucky DSMRE 3.5 full time staff and $120-200K in additional funding. Thus, an additional $3-400K in combined state revenues, federal grants, and federal salaries is the minimum estimated need for implementing this more detailed analysis of fill minimization under Alternatives 2 and 3.

COE increased staffing costs would be commensurate with the number of engineers that would be required to process the approximately 200 new surface mining applications and another 1000 permit revisions (e.g., modifications, incidental boundary revisions), renewals, transfers, mid-term reviews and other permit processing activities--many involving valley fills. The Federal government typically pays an experienced engineer, on average, ~50% more than state salaries/benefits. Under Alternative 1, the COE would need as many or more engineers as the state to review, comment, address revisions, and approve around 2-300 mountaintop mining proposals per year. Estimating 25-35 additional federal engineers to do COE AOC, flooding and other reviews translates into around $1.8-2.5M (20 experienced GS-12 engineers at ~$75K = ~$1500K; 15 GS-11 at ~$63K = ~$945K). Under Alternative 2, the COE would need fewer engineers to: 1) do more limited reviews of the state SMCRA authorities alternative/fill minimization analyses in the SMCRA permit, for NWP 21 permitting actions; and, 2) to perform more rigorous evaluations for those applications requiring IP processing. Under Alternative 3, the COE would also need some level of engineers for the approval of state reviews needed to issue NWP 21 authorizations.

c.1. Economic Consequences of Data Collection and Analysis Unique to Alternative 1

Alternative 1 anticipates that the COE would take the lead role in determining the size, number and location of valley fills placed in waters of the U.S. and set the level of compensatory mitigation. All surface coal mines proposing to place fills in waters of the U.S. would initially be processed as IPs. This would be a significant change from the current COE permit process. The COE would

determine whether a project EIS or a EA/ FONSI would be required. Processing permits in this manner would result in a much more rigorous review by the COE.

Alternative 1 involves the COE performing the necessary avoidance, fill minimization, and mitigation assessment of MTM/VF proposals. The COE and EPA affirmed that use of the WVDEP AOC+ policy satisfies the requisite alternative analysis required by the CWA 404 (b)(1) Guidelines. For consistent application across the various COE Districts with jurisdiction over CWA Section 404 coal mining activities in Appalachia, the COE would either evaluate the adequacy of existing state SMCRA authorities AOC policies or, develop other procedures for applicants in Virginia, Kentucky and Tennessee to demonstrate that projects have satisfied the CWA Section 404 (b)(1) Guidelines.

It is certain that the regulatory costs of Alternative 1 would increase for the COE, in that the IP review and preparation of the NEPA compliance documents will require more staff. The COE estimated in its Draft NWP Programmatic EIS that processing permits under the NWPs cost an average of $389 compared to $1492 for processing IPs [2001 COE DEIS, Table D.4.2-1]. Based on the level of scrutiny required to satisfy the CWA 404(b)(1) Guidelines, evidenced through the EIS development process and interim permitting coordination in West Virginia, the COE estimates appear low. However, assuming that the number of permits processed will remain constant with the No Action Alternative (200 permits per year in the EIS study area), and the costs remain consistent with the COE 2001 estimate cited, the COE will experience an increase in administrative cost ranging from $400,000 for IPs, to over $2,000,000 per year for IPs and other revisions under this alternative.

Because of the additional staff resources needed to perform chemistry, biology, ecology, mining, and civil engineering reviews of impact predictions, alternatives, fill minimization, flooding, and mitigation analysis, these estimates may be understated by factors ranging from 10 to 20 times COE 2001NWP EIS figures. The NEPA compliance and public interest reviews result in greater COE processing costs due to the larger documents, more expansive detailed information, and additional opportunities for public participation and wider review and comment potential from local, state, and Federal agencies and organizations. An IP also provides for more EPA and FWS oversight and elevation of issues through the CWA 404(q) process that is not afforded in the NWP 21 process.

Conversely, state SMCRA agency costs for permit processing could decrease based on the reviews performed by the COE. The level of review by the states on the effects to the aquatic ecosystem should be reduced if they rely on the COE assessments. A number of other hydrologic assessments required by SMCRA could assist the COE in NEPA compliance. For instance, the state SMCRA and water quality reviewers would focus more on drainage and sediment control structure design, potential effects on water supplies, maintaining the hydrologic balance, PHC/CHIAs. The SMCRA review of terrestrial, post-mining land use, blasting, roads, embankment and impoundment stability would complement the COE NEPA compliance. The MOA and FOP envisioned under this alternative would detail the sequence and the inter-relation of permit review components by each agency.

An applicant for a CWA Section 404 permit would provide more information to process IPs, increasing costs to the applicant. The data and analysis costs are similar to the description above in the No Action Alternative. To help reduce processing time, the applicant may choose to prepare draft EAs and/or EISs for an IP which would add greater costs. These documents must address not

only the site-specific impacts of the mining proposal, but cumulative impacts of the project as well. EISs undergo multiple iterations of widespread distribution and review, comment, and possibly litigation. These steps could add considerable time to application processing and can affect the cash flow and investment positions of a mining company due to unpredictable time frames for mining operation commencement due to issue resolution, project re-design, litigation, etc.

Despite the increased costs to an applicant, there should also be some offsetting efficiency for the applicant due to better coordination between regulatory agencies. Multiple revisions by the applicant should not be required, as agencies would coordinate review comments and deficiency letters so the applicant could address all issues at the same time. Joint discussions between agencies, and between the agencies and the applicant, should better define compliance targets for the applicant with improved applications for both public and regulatory reviewers.

c.2. Economic Consequences of Data Collection and Analysis Unique to Alternative 2

Alternative 2 anticipates OSM (in TN) or the appropriate state SMCRA agency maximizing coordination and joint processing the SMCRA and CWA Section 404 permits. Unlike Alternative 1, in which the applicant applies separately to SMCRA and CWA agencies, a joint application would be developed containing the permitting requirements for both agencies. Like Alternative 1, more rigorous information and analysis would be required of the applicant; surface mines will be designed in consideration of both programs; and the SMCRA agency and COE would review the information to minimize duplication and maximize the use of each entity's respective expertise and regulatory focus. Also, like Alternative 1, the agencies would enter into an MOA to outline the coordination process and develop FOPs to expand on specific parts of the coordination roles and responsibilities for certain portions of the mining proposals. This coordination would greatly aid the applicant in understanding requirements, clearly address compliance criteria, and provide more comprehensive and comprehensible applications to meet CWA and SMCRA standards as well as better inform public and other interested stakeholders. The consequences of this integrated review alternative would include increased environmental protection, reduced processing times and costs to the permit applicant, and reduced administrative costs.

The COE would make case-by-case decisions on the type of permit process and level of NEPA analysis for MTM/VF projects. Therefore, the consequences of Alternative 2 are dependent on the number of permits requiring IP versus NWP processing. To the extent that a certain percent of permits must undergo IP review, the economic consequences would be similar to those described for Alternative 1. Similarly, those permits authorized under NWP would have consequences similar to those described below in Alternative 3.

Another important element of the coordinated decision making process in Alternative 2 is the revision of SMCRA regulatory program provisions [Actions 3 and 7]. The revision would provide for data collection and minimization/alternative analysis more consistent with the requirements of the CWA Section 404(b)(1) Guidelines.

Increased cost for COE reviews would be less than those costs described in Alternative 1, because all applications would not be initially reviewed as IPs. The SMCRA agencies would take on a greater role in fill minimization and alternative analysis, as well as considering on-site mitigation in SMCRA permit decisions. The COE review for approving NWPs should require less rigorous

evaluation, in order to determine that all CWA considerations were made in the state review. COE reliance on SMCRA reviews should decrease processing costs considerably. SMCRA agencies, on the other hand, would likely require additional biologists, hydrologists, ecologists, and engineers to conduct the necessary analyses. The relative increased staffing costs to the states would be proportionately less than the increases for the COE. States have a full compliment of disciplines in their larger permit review organizations than the COE does and economies of scale should apply. State program costs are generally less than Federal program costs. Table IV.A-1 shows that state program staff levels are more than sixteen time COE permitting staff for coal mining, while the state costs are only eight times the COE payroll and benefits. Thus, from a staffing increase perspective, Alternative 2 presents potential cost savings over Alternative 1.

c.3. Economic Consequences of Data Collection and Analysis Unique to Alternative 3

Alternative 3 anticipates that the SMCRA regulatory authority would promulgate provisions for fill minimization and alternative analysis more consistent with CWA Section 404 requirements and take the lead processing and conducting the initial reviews. The COE and the SMCRA agency would work together to develop a joint application containing SMCRA and CWA Section 404 permitting requirements.

Increased SMCRA staff would be required to conduct the initial reviews due to additional biological/ecological stream chemistry aquatic data, and more mine planning, hydrology, and hydraulic engineering evaluations. The consequences of this action are similar to the No Action Alternative in some ways because the COE would begin processing most permits as NWP 21. The administrative cost of this alternative will be similar to the No Action Alternative, but lower than either Alternatives 1 or 2. COE staffing increases are likely, but less than Alternative 2 and markedly less than Alternative 1. State staffing increases would be similar to Alternative 2 but slightly higher because additional minimization and alternatives analysis review, done by the COE in Alternative 2, would be borne by the state in Alternative 3. Administrative costs to the Federal agencies have the potential to be lowest in Alternative 3 if states ultimately can use the SPGP authority and the majority of permits qualify for the SPGP due to adequately minimized unavoidable aquatic impacts. There are no financial incentives for the states to gain CWA Section 404 authority, and the state costs for this authority have not been factored into this analysis. However, costs associated with SMCRA related to avoidance, minimization, and alternative analysis may be covered by 50% OSM regulatory grants.

The information and analysis submitted by the permit applicant will increase permitting costs, but less than Alternative 1 or 2 if most permits are eligible for NWP 21. The absence of NEPA compliance and a streamlined COE review should reduce applicant costs, although it is unlikely that every permit could qualify for NWP 21.

d. Mitigation

If Action 10 is implemented under Alternatives 1, 2, and 3 as proposed, the agencies would, as a part of the MOU developed under each of the action alternatives (and if necessary with revision of existing SMCRA or CWA regulation, policy, or procedures), clearly define and commit to writing the roles and responsibilities for permitting, monitoring/inspection, and bonding of mitigation projects. This would provide the agencies with the opportunity to coordinate these activities in order

to increase certainty that all mitigation requirements are being implemented and minimize identified inefficiencies associated with duplicate systems. By incorporating all mitigation construction plans/specifications, time lines, and success criteria into each issued permit, inspectors would have all the information needed to ensure the mitigation projects are properly completed. This would also serve to minimize costs to both the taxpayer and the applicant.

e. Flooding

Alternatives 1, 2, and 3 share a common action specifically designed to more effectively evaluate flooding risk during SMCRA or CWA permitting. The action proposes joint development of guidelines for appropriate flood risk evaluations by the COE, OSM, and state SMCRA authorities. The guidelines would discuss suitability of different modeling algorithms for various situations, the proper rainfall frequency/duration and other mining site condition (runoff curve numbers and other values, like time of concentration, travel times, roughness coefficients, etc.) assumptions for assessing flood potential.

The effect of a modeling requirement on the permitting process would be variable depending on the degree of complexity of the modeling, but would generally increase costs to the applicant and permit review agencies. The effects on individual permit applications would depend on the size of the application, complexity of the mining plan, and number of modeling points required for the assessment. Large, complicated permits would require more effort than small, simple mine plans. Except in cases where multiple valleys below a mine would drain to a single pond, the number of modeling runs required for each permit would depend on the number of stream valleys downstream of the proposed mine.

Requirements for site-specific runoff modeling would increase the costs of permitting to mining companies for each permit application; and to regulatory agencies for individual project reviews and for cumulative impact analysis of multiple operations in a cumulative impact area. Coal operators would see increased costs from permitting consultant fees or internal engineering staff reflecting the greater engineering effort required to prepare a permit application. Regulatory agencies would likely need additional skilled staff, either as preparers of the CHIA models, or for model reviews when submitted by permit applicants. The dollar value of such changes cannot be predicted without established modeling guidelines.

The quantitative analysis of the potential for flooding caused by a MTM/VF operation will affect the cost of permit preparation, review, mining and reclamation, and inspection. This effect would be variable depending on the degree of complexity of the mining and reclamation plans. Large, complicated permits would require more effort and cost than small, simple mines. The cost of permit modeling may not be as substantial as implementing the on-the-ground controls to assure mining does not increase flooding risk above what existed pre-mining. For the coal company preparing the permit, this analysis may include the consideration of various mining plans and surface water runoff control scenarios. These scenarios could consider water detention structures, drainage patterns, maximum disturbed areas, soil and overburden handling, reclamation configuration, and ground cover. Each scenario will have its associated costs for construction and implementation during mining and reclamation. Recent application reviews by WVDEP using the SWROA have resulted in considerable application revisions that limit the amount of disturbance open at one time

in particular watersheds, hydraulic control changes to channels, and different runoff routing through a watershed–with attendant costs for construction.

The review by regulatory authorities of quantitative analyses of flooding potential for an application would require additional effort, including additional staff who have had adequate training to evaluate the surface water control plan for each permit. The regulatory authority may also require additional staff and training to inspect the surface water control structures at each permitted operation during mining and reclamation to assure plans are effectively carried out and certified by engineers.

While there are additional costs for application preparation, review, implementation, and inspection, the potential for the mine site to contribute to offsite impacts due to flooding would be decreased by this action. This consequence of better protecting the public and the environment meets the intent of the existing regulatory requirements. Additionally, quantitative analysis may result in denial of permits that are allowed under the No Action Alternative. Denial of or a decision not to proceed with a project proposal could depend on the selected flooding risk threshold, increasing overall costs to the mining industry from unfulfilled plans and potentially placing some reserves off-limits to mining.

Regardless of the actual flood risks, there can be real or perceived consequences when persons down stream of an actual or potential surface mine site believe that surface mining increases their risks from flooding. The perceived flood risk can affect land uses and property values by reducing the willingness to live on and make improvements to properties in such areas. This perceived risk problem can be exacerbated when the residents lack confidence in the veracity and forthrightness of mining operators. Recent actions by mining companies following flood events have ranged from generous temporary housing and re-establishment of residents in new or repaired homes to denial of any liability for flooding results. Both reactions may be warranted based on the findings of runoff studies for this EIS. That is, flooding consequences are very site-specific to conditions above and in any stream valley.

f. Deforestation

Alternatives 1, 2, and 3 share an action for development of BMPs for selecting appropriate growth media, reclamation techniques, revegetation species, and success measurement techniques for accomplishing post-mining land uses involving trees [Chapter II.C.8.; Action 13].

The implementation of this BMP could have economic impacts for the landowner and the regulated community. For instance, some of the BMPs may encourage maximizing forest product recovery. Forest product uses may increase revenues to the landowner, if the market, including transportation costs, provides a viable price for the product. Implementing organic utilization practices in the BMP manual could add cost to the mining operation, when compared to the existing practices for disposal of organic materials remaining following logging. These costs would vary, with windrowing and organic “islands” likely being less costly than mulching.

The implementation of BMPs related to revegetation success standards could have economic impacts for the regulatory agency and possibly for the regulated community as well. Regulatory agency costs would be incurred in applying any BMP guidance in the field (employee training,

additional field measurements or tests to determine success, etc.) If any new BMP guidance resulted in a mine site not meeting revegetation success standards, the extended bond liability period and any supplemental revegetation activities needed to meet the revegetation standard could increase costs. However, if research recommendations for establishing a suitable growth medium for trees are followed, the decreased costs of reclamation may offset any increase cost to the regulated community.

Another proposal common to the action alternatives is the requirement, if established by Congress, to require reclamation with trees [Action 14]. The Congressional authority envisioned under this action would require reclamation with trees where trees were the pre-mining condition, unless environmental improvement could be demonstrated by alternative post-mining land uses. From a cumulative impact standpoint, this alternative would result in more widespread use of trees and may be more effective at assuring the values associated with a forest community are re-established following mining. However, this action could also result in increased or decreased costs to the regulated community as operators (who would not otherwise have planted trees) may now be required to use reforestation reclamation and successfully plant trees with a healthy/successful yield. Improving property value by establishing a land use other than forest may not be an option for the landowner under this alternative. The applicant may be unable to demonstrate higher environmental value for non-forestry land uses to receive a variance from such a statutory mandate for reforestation of the property. Administratively, such Congressional action, if implemented, could result in an increase in takings claims. The mere filing of, much less success in, takings claims could have substantial impact to state and federal governments. Litigation, settlement, and judgement costs regarding property rights, could present liability to agencies.

g. Air Quality

The action alternatives propose a common action that would result in BMPs for controlling fugitive dust and blasting fumes or additional regulatory requirements, as appropriate, to minimize these types of adverse air quality effects [Chapter II.C.9; Action 15]. Use of BMPs does not necessarily carry additional costs, depending on the site-specific circumstances. However, requirements to provide dust suppression technology or minimize blasting fumes would likely add considerable costs to monitor and implement additional controls.

J. RECREATION

Tourists are drawn to the visual, cultural, and natural amenities found throughout the study area. Resident and non-resident tourists travel to various outdoor recreational sites throughout the study area for camping, hiking, fishing, swimming, canoeing, hunting, boating, and sight seeing, biking, skiing, off-highway vehicle use, golf, running and festivals. According to Canaan Valley Institute, the Mid-Atlantic Highlands Region offers diverse, economically significant opportunities for recreation and tourism, including hiking, birding, camping, swimming, canoeing, white water rafting, skiing, and other outdoor recreational activities, generating $26 million/year in direct revenue. In addition, hunting and fishing license sales bring in more than $88 million/year to state economies in the Appalachian region. (CVI, 2002) The EIS study area is a part of the Mid-Atlantic Highlands Region. A discussion of Outdoor Recreation and Tourism can be found in Chapter III.T.

Tourism and travel businesses include private and public lands and facilities, such as, campgrounds, hotels, motels, restaurants, gift shops, service stations, amusements, other recreation facilities, and undeveloped real estate. Within the study area in West Virginia alone, there are approximately 15 state parks and forests, in addition to 10 designated wildlife management areas. The Mid-Atlantic Highlands already contains many public lands that are attractive to visitors, but 75% of the forested lands remain in the private sector (CVI, 2002).

Public land needs and demands are very heavily tied to recreation development in the region. There are certainly localized demands for public lands for uses such as schools, community parks, and other public facility developments (West Virginia State Comprehensive Outdoor Recreation Plan, 1997). However, the acreage requirements for most of this development are minimal, and will be linked to existing community locations in most cases. A compilation of the major demands for public lands in the region identified by various federal and state agencies shows significant differences between counties in the region in the need/demand for hunting and fishing, water recreation, and special needs recreation areas–facilities that generally require significant areas. Counties that have a high demand/need for one or more of these activity areas are Kanawha, Lincoln, Logan, Raleigh and Wayne Counties [WVDNR Capital Improvements Plan 1998; WVU Land Use Assessment 2001].

In addition to public lands being available in the study area for recreational activities, private lands are used for recreation by members of the public. It is assumed that, although some of these private lands were affected by MTM/VF operations, the region contains similar lands which are available for recreational experiences outside the locale of a particular MTM/VF operation. Further it is recognized that recreation opportunities related and unrelated to mining are changing in the study area and region. Another limitation to public recreational use of private lands is the fact that landowners who previously tolerated unrestricted access to their land have reacted to increased use and liability concerns by restricting access to private lands.

1. Consequences Common to the No Action and Action Alternatives

Tourists, residents and landowners enjoy the natural environment for outdoor recreational activities including camping, hiking, fishing, swimming, canoeing, hunting, boating, and sight seeing, biking, off-highway vehicle use, golf and festivals. Dramatic topography and generally good air quality

combine to create spectacular vistas. Many of the vistas can be seen from highways back country byways and public lands. Other vistas because of their remote locations can only be seen from the air, private lands or a nearby mountain crest. Tourists are also drawn to the study area for outdoor oriented recreation at the available sites. Available recreational facilities in and around the study area include state parks, national forests, state and federal fish and wildlife management areas as well as privately owned lands open to the public. Most of the lands in the study area are privately-owned and managed.

Public parks, forests, management areas and privately owned lands open to the public, in and around the study area have a growing number and diversity of visitors seeking recreation and access to the visual, cultural and natural amenities of the region. Projections show that the number of visitors to outdoor recreational facilities in the study area and surrounding vicinity will continue to grow, particularly for camping sight seeing, hiking, biking, and off-road vehicle use.

The effects of mining on recreation tend to be localized and depend on a variety of factors. These factors include the size and type of the mine, the mine setting, the recreation activities occurring in the area, the experiences derived from these activities and opportunities for similar activities in other nearby areas. Examples of the types of effects that coal mining development and operations could have on recreation include the following:

- Loss of recreational resources that might lead to displacement of the activity to alternative areas or loss of ability to engage in the activity;
- Modification of recreation settings leading to changes in recreation experiences and types of recreation facilities available due to project related activities or the presence of project related facilities;
- Reduced feelings of solitude and remoteness due to the introduction of visual, sound or other sensory effects from project related activities or the presence of project related facilities that could conflict with recreation use; and
- Changed access to the area, which could open the area to some uses but close it to others. For example mine developments may reduce opportunities for non-motorized outdoor activities while increasing opportunities for motorized recreation.

Residents and visitors to the study area use the natural environment for a range of activities including the harvesting of non-traditional forest products and subsistence gardening. Non-traditional forest products include sassafras, ginseng, goldenseal, mayapple, slippery elm and other botanical products which can be harvested in the Southern Appalachia region. In the Appalachia region specifically, the harvesting of non-traditional forest products contributes to the local economy. Some wild gathering or subsistence gardening locations may be affected by MTM/VF operations. Surface mining operations, by nature, do not allow for concurrent alternate land uses. Another contribution to the decline in lands in the study area being used for wild gathering or gardening is the fact that private landowners have increasingly begun to close off these lands to the public for safety and security reasons. The inherent decline in the ability to engage in gardening or wild gathering by the general public is likely to continue under all the alternatives. However, through improved co-ordination and analysis envisioned under all the alternatives, this decrease in opportunities could lead to alternative areas being created or set aside to be enjoyed as “commons.”

Habitat changes will occur in the study area. Some of the changes will involve a shift from a forest-dominated landscape to a fragmented landscape with, in some instances, considerably more grassland habitat. MTM/VF operations contribute to fragmentation of a forested landscape. The shift from a forest dominated landscape to grasslands and forest edges can lead to a shift in the plant and animal populations from forest to grassland or forest-edge species. The indirect effect of a shift in the plant community is an increase in game species such as whitetail deer and turkey due to an increase in grasslands and the diversification of habitats. The continued habitat changes in the study area are likely to occur with or without MTM/VF operations. A proposed action common to all the alternatives is designed to facilitate reforestation efforts. The direct impacts of MTM/VF operations, in this regard, to recreation dependent upon a forest dominated landscape may be temporary, if the post-mining land use is to restore the pre-mining forest habitat or permanent, if the site is developed for a post mining land use other than forest. The consequences to recreation of such land use shifts under all alternatives are changes in the type of outdoor recreation experiences available. For example, bird-watching for forest interior species will likely be replaced by bird-watching for grassland or edge species while hunting (wild turkey) opportunities could increase. Consequently, the forest recreation activities affected by fragmentation whether due to MTM/VF or other causes would change the recreation experiences available.

Areas that offer more primitive recreation opportunities could decrease because of the vulnerability to mining dominating the local setting by the elimination of the wild land character due to noise, traffic, dust or other mining related condition. Also, development pressures from activities other than MTM/VF operations to primitive settings could decrease the availability of primitive recreational opportunities in the study area. The direct impacts of MTM/VF operations, in this regard, to recreation dependent upon a remote and wild landscape may be temporary, if the post-mining land use is to restore the pre-mining habitat, or permanent, if the site is developed for a post mining land use other than what existed pre-mining. Consequences to recreation of such mining conditions are changes in the type of outdoor recreation experiences available in the local setting of the mine site or those seeking primitive recreation opportunities to look elsewhere in the study area for such recreational opportunities. To the extent MTM/VF would affect the primitive character of recreation in the study area the magnitude of such effects would be the same under all the alternatives.

Lands in the study area provide diverse recreational experiences. All mining permits, including MTM/VF operations include a designated post-mining land use. In some instances, a mine site will be reclaimed to a public recreational use, or after reclamation, be converted by the landowner to a recreational use. An example of where mine sites may be reclaimed to a designated post-mining land use as recreational facility is the development and maintenance of the mine site as a public golf course. An example of a change in recreational use after reclamation is when trails are developed on a former mine site for hiking, biking, camping or other use open to the public. The diversification of recreational opportunities in the study area is likely to be the same under all alternatives.

Added access to local settings in the study area could increase the accessibility of existing recreational opportunities or provide a way to previously isolated land that could be developed for recreation. The building and/or improvement of roads to and on MTM/VF operations have the effect of making previously inaccessible areas attractive for use or development. For example improved public roads and/or new mining roads increase the accessibility to new local settings for

off-highway vehicle use (some times with landowner permission and sometimes without). The increase in access to local settings within the study area is likely to continue an the consequences be similar under all alternatives.

The effects of MTM/VF operations on recreation would vary a great deal based upon the resource setting, the current recreation use of the area, the size and type of mine and opportunities for using alternative areas. Overall, under the alternatives it is anticipated that recreational opportunities in the study area will continue to change and diversify. In addition increased co-ordination in management of lands to be mined in the study area could improve overall recreation experiences at developed, undeveloped and new recreational sites.

A constant in recreational opportunities in and around the study area which will be unchanged under all alternatives is the existence of substantial public parks, forests, wildlife management areas or National Wild and Scenic Rivers. A discussion about these public lands is contained in Chapter III.T. Since these public lands in the study area and similar public lands around the study area are generally off limits to surface mining operations, they will remain available for a broad array of recreational opportunities from primitive to developed facilities (e.g. swimming pools). Mitigation envisioned in all the alternatives could be employed to conserve, preserve or otherwise add lands available for public recreational uses.

Areas adjacent to the study area provide opportunities for additional recreational experiences. These alternative locations have similar visual and natural resources as found in the study area and provide alternate sites for outdoor recreation in the event mining diminishes or displaces sites in the study area currently in use for recreational experiences. The consequences of the No Action and action alternatives are similar and cannot be distinguished from each other.

K. ENVIRONMENTAL JUSTICE

Under the auspices of Presidential Executive Order 12898, "Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations (February 11, 1994)," federal agencies are required to evaluate the impacts of any federal action (e.g., COE 404 permit or OSM permit in Tennessee) to determine if the proposed action will disproportionately affect a minority, low-income, or culturally distinct community or population. This Executive Order, commonly referred to as the environmental justice (EJ) order, is intended to see that no person or group of people should shoulder a disproportionate share of the negative environmental impacts resulting from the execution of this country's domestic and foreign policy programs, and to ensure that those impacted have a meaningful role in the decision-making process. Preparation of this EIS document is also considered to be a federal action subject to the requirements of an environmental justice review.

In implementing the EJ review in this document, each individual action was considered as to the potential impacts of the action and alternatives, including the No Action Alternative, on identified EJ populations. It should be emphasized however, that this executive order applies only to Federal actions. Permitting of an individual proposed mine application by a state agency, when a SMCRA program is delegated to a state, would not be subject to the requirements of EJ. Issuance of a COE individual CWA 404 permit or SMCRA permit in Tennessee would require an EJ review prior to issuance.

To the extent that low-income populations are prevalent in the coalfields, the impacts of mountaintop mining are felt disproportionately by these environmental justice populations. The most notable impacts to be felt by coalfield residents are the operational disturbances, particularly blasting. For example, blasting can be particularly problematic for low-income persons, because they tend to live in substandard or non-traditional housing and may utilize poorly constructed water wells as their drinking water source. As indicated in the blasting studies, such structures may be more vulnerable to damage by blasting vibrations lower than levels that would affect structures built to modern standards [Appendix G.]. However, SMCRA blasting regulations provide for lowering performance standards to account for these circumstances.

Confirming the presence of an environmental justice population is a site-specific exercise that can only be done once an operator submits an application for an individual federally-issued CWA or SMCRA permit. It should be noted that the decision to mine coal is based on a number of factors such as the geologic location of minable coal deposits. Thus, as a review of the mine feasibility evaluation and planning factors described in Chapter III.L. indicates, the ability to mine in a particular location is an economic one and there is no reason to believe the presence or absence of an environmental justice (or any other segment of the) population affects the decision to mine.

In the context of this EIS as a Federal action and compliance with the EJ requirements, the Federal agencies have focused attention on human health and environmental conditions in the communities that may be affected by mountaintop mining activities. Issues or impacts that may disproportionately impact low-income populations in the EIS area are identified as "significant" issues for purposes of NEPA in Chapter II.A. The public participation process associated with this EIS has been quite exhaustive, as described in Chapter I.D. With the preparation and completion

of this document and availability for review and comment by the public, the Federal action agencies have complied with the requirements of the EJ Executive Order.

As for individual mining activities that are proposed under either SMCRA and/or CWA regulatory authorities, residents and communities located near proposed mine sites may feel that efforts to make them aware of a proposed mine are insufficient; that they are not provided adequate opportunity to participate in the permit process; or that if aggrieved by a mining operation, the complaint process is too challenging and intimidating. However, both SMCRA and the CWA have established numerous opportunities to make the public aware of proposed mining and potential impacts to human health and the environment and to solicit input from interested parties. Notices are mailed to local officials, agencies, utilities, etc. when a mine is proposed. The proposed permit application is made available for review by the public at a place accessible to the public. SMCRA requires ads in the local newspaper weekly for four consecutive weeks advising the public of the proposed project, where and when the application is available for review, and where to send comments and/or request a public meeting on the proposed permit. Ads may again be placed in newspapers or other means of public notification when CWA permits are issued under Section 404 (fills) and Section 402 (effluent/basin discharges). An ad is placed in the local newspaper again before any blasting is to occur. Blasting notifications are mailed to everyone living within ½ mile of a mine site if blasting is proposed. If a NEPA document for a federal action is required, the public is advised of the preparation of the document in accordance with established NEPA regulations. The action agencies find that these notifications are more than adequate to notify the public of proposed mining, advise the public of potential impacts, solicit input from those potentially affected, and comply with the both the requirements and the spirit of the environmental justice executive order.

Although no statutory basis exists in either SMCRA or the CWA to base permitting decisions (i.e., approvals or denials) on EJ issues, proposed issuance of a federal permit requires the action agency to comply with the goals of the EJ executive order. Under the EO, an agency must: (1) focus federal agency attention on human health and environmental conditions in EJ communities, (2) foster non-discrimination in federal programs and actions that substantially affect these populations/ communities, and (3) give the EJ populations/communities greater participation opportunities and greater access to public information on matters of public health and the environment. Under NEPA, if disproportionate impacts on minority or low-income populations are identified, a proposed action is not precluded from going forward, nor does it compel a conclusion that the action is environmentally unsatisfactory. Rather, identification of such an effect should heighten agency attention to alternatives, mitigation measures, monitoring needs, and preferences expressed by the affected communities or populations (CEQ, 1997).

In December 1, 2000, the EPA Office of General Counsel stated in a memorandum regarding the EO on EJ: "...there are several CWA authorities under which EPA could address environmental justice issues in permitting." EPA Adminstrator Christie Whitman concurred and reinforced this statement in a memorandum dated August 9, 2001: "Environmental statutes provide many opportunities to address environmental risks and hazards in minority communities and/or low-income communities. Application of these existing statutory provisions is an important part of this agency's effort to prevent those communities from being subject to disproportionately high and adverse impacts, and environmental effects."

The federal action agencies comply with the requirements and the spirit of the EJ executive order both in the development of this EIS document and in the implementation of the federal programs to regulate mountaintop mining activities. The processes in place both for the development of this document and for the processing of permit applications by federal agencies provide the mechanisms to identify the concerns of the public, including EJ populations, and provide numerous opportunities for their participation in the decision-making process. As such, none of the alternatives include any new or revised process-related actions that are specifically directed at the identification and participation of EJ populations in the federal agency decision-making process.

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VI. LIST OF PREPARERS

This document was prepared by the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Office of Surface Mining, U.S. Fish and Wildlife Service, and West Virginia Department of Environmental Protection, with assistance from Gannett Fleming, Inc. The individuals listed below had principal roles in the preparation and content of this document. Many others had significant roles and contributions as well and their efforts were no less important to the development of this EIS. These others include senior managers, administrative support personnel, legal staff, and technical staff.

Steering Committee Members: performed programmatic review of EIS development

Katherine Trott, U.S. Army Corps of Engineers, Headquarters, Washington, D.C.

John Forren, U.S. Environmental Protection Agency, Office of Environmental Programs, Environmental Services Division, Philadelphia, PA

Michael Robinson, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Pittsburgh, PA

Russell Hunter, WV Department of Environmental Protection, Office of Mining and Reclamation, Nitro, WV

Cindy Tibbott, U.S. Fish and Wildlife Service, PA Field Office, State College, PA

Past Steering Committee Members

Rebecca Hanmer, U.S. Environmental Protection Agency, Water Protection Division, Philadelphia, PA

William Hoffman, U.S. Environmental Protection Agency, Office of Environmental Programs, Philadelphia PA

Charles Stark, U.S. Army Corps of Engineers, Headquarters, Washington, D.C.

David Densmore, U.S. Fish and Wildlife Service, PA Field Office, State College, PA

Charles Sturey, WV Department of Environmental Protection, Office of Mining and Reclamation, Nitro, WV

Assisted Steering Committee

David Hartos, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Pittsburgh, PA

Jeffrey Coker, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Knoxville, TN Field Office

Gregory Peck, U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

David Rider, U.S. Environmental Protection Agency, Office of Environmental Programs, Philadelphia, PA

Elaine Suriano, U.S. Environmental Protection Agency, Office of Federal Activities, Washington, D.C.

David Vande Linde, WV Department of Environmental Protection, Office of Mining and Reclamation, Nitro, WV

James Townsend, U.S. Army Corps of Engineers, Regulatory Branch, Louisville, KY

Stream Restoration/Aquatic Ecosystem Enhancement Symposium

Gary Bryant, U.S. Environmental Protection Agency, Wheeling, WV

The Value of Headwater Streams: Results of a Workshop

Cindy Tibbott, U.S. Fish and Wildlife Service, State College, PA; team leader for the symposium

Streams Technical Studies

William Hoffman, U.S. Environmental Protection Agency, Philadelphia, PA; team leader
Jim Green and Maggie Passmore, U.S. Environmental Protection Agency Wheeling, WV (WV Macroinvertebrates)
Hoke S. Howard, Bobbi Berrang and Morris Flexner, U.S. Environmental Protection Agency and Greg Pond and Skip Call of the KY Division of Water (KY Macroinvertebrates)
Gary Bryant, U.S. Environmental Protection Agency, Wheeling, WV (Water Quality)

WV Benthic Survey

H. Vann Weaver, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Pittsburgh, PA; team leader
Fred Kirchner, U.S. Army Corps of Engineers, Huntington District, Huntington, WV
David Rider, U.S. Environmental Protection Agency, Philadelphia, PA
Max Luehrs, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Columbus, OH Area Office
Dr. Ben Stout, Wheeling Jesuit University, Wheeling, WV

Streams Statistical Technical Study

Florence Fulk, U.S. Environmental Protection Agency, Office of Research & Development, Cincinnati, OH

Fisheries Technical Study

Cynthia Tibbott, U.S. Fish and Wildlife Service, State College, PA; team leader
Dr. Jay Stauffer and Dr. Paola Ferreri, Pennsylvania State University, State College, PA

Wetlands Technical Study

William Hoffman, U.S. Environmental Protection Agency, Philadelphia, PA; team leader
David Rider, U.S. Environmental Protection Agency, Philadelphia, PA
Peter Stokely, U.S. Environmental Protection Agency, Philadelphia, PA

Fill Hydrology Technical Study

James Eychaner, K.S. Paybins, T. Messinger, and J.B. Wiley, U.S. Geological Survey
Donald E. Stump Jr.,U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Pittsburgh, PA

Terrestrial Habitats Technical Studies

Cynthia Tibbott, U.S. Fish and Wildlife Service, State College, PA; team leader
Dr. Steven Handel, Rutgers University Center for Restoration Ecology (Revegetation and Succession), NJ
Dr. John Sencindiver, West Virginia University (Soil Health and Organisms), Morgantown, WV
Dr. Petra Wood, West Virginia University (Bird, Small Mammal and Herptile Study), Morgantown, WV
Dr. Ron Canterbury, Concord College (Edge Habitats), WV

Fill Inventory and Chapter III.K.2-5

William Kovacic, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Lexington, KY Field Office; team leader
David E. Beam, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Lexington, KY Field Office
Tom Mastrorocco, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Pittsburgh, PA

Blasting Technical Studies

Blasting Dust and Fumes

Kenneth K. Eltschlager, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Pittsburgh, PA; team leader

Dr. Lloyd English, Department of Mining Engineering, West Virginia University, Morgantown, WV

OSM Citizen Complaint Survey

Kenneth K. Eltschlager, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Pittsburgh, PA

OSM Research: Non-Traditional Structures

Kenneth K. Eltschlager, U.S. Office of Surface Mining, Program Support Division, Appalachian Regional Coordinating Center, Pittsburgh, PA; Contracting Officer's Technical Representative

Contractor: Amone-Martin Associates

OSM Research: Wells

Dennis Clark, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Knoxville, TN, Field Office; Contracting Officer's Technical Representative

Contractor: Daniel B. Stevens & Associates

Mining and Reclamation Technology Study

Charles E. Sandberg, U.S. Office of Surface Mining, Mid-Continent Regional Coordinating Center, Alton, IL
Michael J. Superfesky, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Morgantown, WV Area Office
Joe Ross, WV Department of Environmental Protection, Office of Mining and Reclamation, Nitro, WV
Barry Doss, AEI Resources, Charleston, WV
Erkan Esmer, Esmer & Associates, Boomer, WV
John Morgan, Morgan Worldwide Mining Consultants, Lexington, KY

Mining and Reclamation Technology Symposium

Kenneth K. Eltschlager, U.S. Office of Surface Mining, Program Support Division, Appalachian Regional Coordinating Center, Pittsburgh, PA; team leader
Jan Wachter and Heino Beckert, U.S. Department of Energy, National Energy Technology Center
Meikle & Fincham

Soil and Forest Productivity Review and Section III.B.4

William Kovacic, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Lexington, KY Field Office; team leader

Dr. Milton Allen, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Pittsburgh, PA
Patrick N. Angel, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, London, KY Area Office
Dr. J. Scott Boyce, U.S. Office of Surface Mining, Program Support, Washington, D.C.
Mike Vaughn, U.S. Office of Surface Mining, , Appalachian Regional Coordinating Center, Madisonville, KY Area Office

Fill Stability Technical Study and Section III.K.1.c

Peter Michael, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Pittsburgh, PA; team leader
Joseph L. Blackburn, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Lexington, KY Field Office
Jim Elder, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Knoxville, TN Field Office
Steffan Koratich, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Columbus, OH Area Office

Staff Consultants

Michael J. Superfesky, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Morgantown, WV Area Office
David Lane, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Knoxville, TN Field Office
Danny Rahnema, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Knoxville, TN Field Office
Steve Cassel, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Lexington, KY, Field Office
Bill Arthur, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Lexington, KY, Field Office

The Extent of Potential Surface Minable Coal and Chapter III. O

Michael Robinson, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Pittsburgh, PA; team leader
Nick Fedorko, WV Geologic & Economic Survey
Dr. Eric Westman, Virginia Polytechnic and State University, Blacksburg, VA
Dr. Jerry Weisenfluh, KY Geologic Survey
Tom Mastrorocco, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Pittsburgh, PA
Doug Brown, WV Department of Environmental Protection, (Island Creek & Spruce Creek Studies), Information Technology Office, Nitro, WV

Flooding Technical Studies and Chapter III.G

Donald E. Stump Jr.,U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Pittsburgh, PA; team leader

"Modeling Analysis of Potential Downstream Flooding as a Result of Valley Fills and Large Scale Surface Mining Operations in Appalachia"

Mark Zaitsoff, U.S. Army Corps of Engineers, Pittsburgh District, Pittsburgh, PA
Danny Rahnema, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Knoxville, TN Field Office, (SEDCAD Modeling)

"Comparison of Peak Discharges Among Sites With and Without Valley Fills for the July 8-9, 2001 Flood in the Headwaters of Clear Fork, Coal River Basin, Mountaintop Coal-Mining Region, Southern West Virginia"

Jeff Wiley, U.S. Geological Survey, Water Resources Division, WV District Office

"Comparison of Storm Response of Streams in Small, Unmined and Mountaintop Removal Mined Watersheds, 1999-2001, Ballard Fork, West Virginia"

Terence Messinger, U.S. Geological Survey, Water Resources Division, WV District Office

Land Use Assessment

Dr. C. Yuill. West Virginia University, Morgantown, WV

Biological Assessment

Barbara Okorn, U.S. Environmental Protection Agency, Office of Environmental Programs, Philadelphia, PA
Jim Serfis, U.S. Fish and Wildlife Service, Washington, DC

Economics Study Phase I and II

Michael Robinson, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Pittsburgh, PA; co-team leader
David Hartos, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Pittsburgh, PA; co-team leader
David VandeLinde, WV Department of Environmental Protection, Nitro, WV
John Morgan, Morgan Worldwide, Lexington, KY
Michael Castle, U.S. Environmental Protection Agency, Philadelphia, PA

Contractors' Leads:
Phase I: Dr. Jeff Kern, RTC Inc., State College, PA
Phase II: Lloyd Kelly, Hill & Assoc., Annapolis, MD
Phase III: Dr. Thomas Witt, West Virginia University, Morgantown, WV

Relationship of Mountaintop Mining to Groundwater Quality and Quantity

Workshop

Bob Evans, U.S. Office of Surface Mining, Program Support Division, Appalachian Regional Coordinating Center, Pittsburgh, PA
Jay Hawkins, U.S. Office of Surface Mining, Program Support Division, Appalachian Regional Coordinating Center, Pittsburgh, PA
Tom Galya, WV Department of Environmental Protection, Nitro, WV

Chapter III.H

Bill Winters, U.S. Office of Surface Mining, Program Support Division, Appalachian Regional Coordinating Center, Pittsburgh, PA

Chapter III.E

Eric Perry, U.S. Office of Surface Mining, Appalachian Regional Coordinating Center, Pittsburgh, PA

EIS Document Preparation, Gannett Fleming, Inc (GF) contributors

Richard Koch, AICP, GF NEPA and OFA Contract Program Manager
Jennifer Stump, GF Project Manager, Document Preparation
John (Drew) Ames, Document Preparation
Kevin Hoover, Geologic and Hydrogeologic Analysis, Mine Technology
Wilhelm (Chip) Kogelmann, GIS Analysis
Paula Loht, Health Risks of Airborne Dust and Fumes
Kathy Malarich, Economic Affected Environment,
Troy Truax, AICP, Demographic analysis, Environmental Justice, Quality of Life
Emily Olds, Aquatic Affected Environment, Aquatic Impact Analysis
Joseph J. Wilson, Terrestrial Affected Environment, Terrestrial Impact Analysis
Alexa Viets, Demographic Case Study Report
Kate Ziegenfuss, Community and Economic Affected Environment

VII. DISTRIBUTION LIST

The following is a list of agencies, organizations, libraries, and individuals who were sent copies of this Draft Programmatic Environmental Impact Statement on Mountaintop Mining/Valley Fills in Appalachia. This document is also available on the World Wide Web at the following internet address: http://www.epa.gov/region3/mtntop/index.htm.

FEDERAL AGENCIES

Council on Environmental Quality
Federal Emergency Management Agency
U.S. Department of Agriculture
    Natural Resources Conservation Service
U.S. Department of Commerce
U.S. Department of Defense
    U.S. Army Corps of Engineers
        HQ, Washington, DC
        Huntington District
        Louisville District
        Nashville District
        Norfolk District
        Pittsburgh District
U.S. Department of Energy
U.S. Department of Homeland Security
U.S. Department of the Interior
    U.S. Fish & Wildlife Service
        PA Field Office, State College, PA
        SW Virginia Field Office, Abingdon, VA
        VA Field Office, Gloucester, MA
        TN Field Office, Cookeville, TN
        KY Field Office, Frankfort, KY
        WV Field Office, Elkins, WV
        Regional Director, Region 4, Atlanta, GA
        Regional Director, Region 5, Hadley, MA
        Branch of Federal Activities, Arlington, VA
    U.S. Geological Survey
        Water Resources Division, WV District Office
    U.S. Office of Surface Mining
        Appalachian Regional Coordinating Center, Pittsburgh, PA
        KY - Lexington; London; Madisonville; Pikeville
        TN - Knoxville
        VA - Big Stone Gap
        WV - Beckley; Charleston; Morgantown
    Office of Environmental Policy and Compliance
    National Park Service

U.S. Department of Justice
U.S. Department of Labor
U.S. Department of State
U.S. Department of Transportation
    Federal Highway Administration
U.S. Environmental Protection Agency
    Headquarters, Washington, DC
    Region III, Philadelphia, PA
    Region IV, Atlanta, GA

OTHER AGENCIES

Advisory Council on Historic Preservation
Interstate Commerce Commission

STATE AGENCIES

Kentucky
    Department of Surface Mining Reclamation and Enforcement
        Office of the Commissioner
        Pikeville; London; Middlesboro; Prestonsburg
Ohio
    Ohio Environmental Protection Agency
Tennessee
    Department of Environment and Conservation
Virginia
    Department of Mines, Minerals & Energy
        Mined Land Reclamation
            Keen Mountain; Big Stone Gap
West Virginia
    Department of Environmental Protection
        Logan; Nitro; Oak Hill; Philippi; Welch
    Division of Natural Resources
        Charleston; Elkins

LIBRARIES

Kentucky
Middlesborough-Bell County Public Library, Middlesboro, KY
Boyd County Public Library, Ashland, KY
Breathitt County Public Library, Jackson, KY
Clark County Public Library, Winchester, KY
Clay County Public Library, Manchester, KY
Elliott County Public Library, Sandy Hook, KY

Estill County Public Library, Irvine, KY
Floyd County Public Library, Prestonsburg, KY
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Menifee County Public Library, Frenchburg, KY
John F. Kennedy Memorial Public Library, West Liberty, KY
Owsley County Public Library, Booneville, KY
Perry County Public Library, Hazard, KY
Pike County Public Library District, Pikeville, KY
Powell County Public Library, Stanton, KY
Pulaski County Public Library, Somerset, KY
RockCastle County Public Library, Mount Vernon, KY
Wayne County Public Library, Monticello, KY
Whitley County Public Library, Williamsburg, KY
Wolfe County Public Library, Campton, KY

Tennessee
Briceville Public Library, Briceville, TN
Clinton Public Library, Clinton, TN
Clinch-Powell Regional Library Center, Clinton, TN
Lake City Public Library, Lake City, TN
Betty Anne Jolly Norris Community Library, Norris, TN
Oak Ridge Public Library, Oak Ridge, TN
Altamont Public Library, Altamont, TN
Beersheba Springs Public Library, Beersheba Springs, TN
Coalmont Public Library, Coalmont, TN
Monteagle (May Justus Memorial Library), Monteagle, TN
Palmer Public Library, Palmer, TN
Tracy City Public Library, Tracy City, TN
Sequatchie County Public Library, Dunlap, TN
Jasper Public Library, Jasper, TN
Beene-Pearson Public Library, South Pittsburg, TN
Orena Humphreys Public Library, Whitwell, TN
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Barbara Reynolds Carr Memorial Library, Tazewell, TN
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Coalfield Public Library, Coalfield, TN
Deer Lodge Public Library, Deer Lodge, TN
Oakdale Public Library, Oakdale, TN
Petros Public Library, Petros, TN
Sunbright Public Library, Sunbright, TN
Wartburg Public Library, Wartburg, TN
Art Circle Public Library, Crossville, TN
Fentress County Public Library, Jamestown, TN

Virginia
Buchanan County Public Library, Grundy, VA
Wise County Public Library, Wise, VA
Russell County Public Library, Lebanon, VA
Tazewell County Public Library, Tazewell, VA
Scott County Public Library, Gate City, VA
Lee County Public Library, Pennington Gap, VA

West Virginia
Ansted Public Library, Ansted, WV
Boone - Madison Public Library, Madison, WV
Bradshaw Public Library , Davy, WV
Clay Co. Public Library, Clay, WV
Fort Gay Public Library, Fort Gay, WV
Gilbert Public Library, Gilbert, WV
Glasgow Public Library, Glasgow, WV
Graigsville Public Library, Graigsville, WV
Fayetteville Public Library, Fayetteville, WV
Fayette County Public Libraries, Oak Hill WV
Hamlin - Lincoln Co., Hamlin WV
Kanawha Co. Public, Charleston, WV
Kermit Public Library, Kermit, WV
Logan Area Public Library, Logan, WV
Mingo County Public Library, Delbarton, WV
McDowell County Public Library, Welch, WV
Oceana Public Library, Oceana, WV
Raleigh Public Library, Beckley, WV

Sutton Public Library, Sutton, WV
Wayne County Public Library, Kenova, WV
Branch of Wayne County Public Library, Wayne, WV
Whitesville Public Library, Whitesville, WV

ORGANIZATIONS

Arch Coal, Inc.
Arch Coal, Inc., WV Operations (CSX)
Bell County Coal Corporation
Buckeye Forest Council
Citizens Coal Council
Citizens & Tourists Against Leveling of WV
Coal Operators and Associates, Inc.
Concerned Citizens Coalition
EcoSource, Inc.
Greystone Environmental Consultants
Howard Engineering & Geology, Inc.
Interstate Mining Compact Commission
Jackson & Kelly, Attorneys at Law
Kentuckians for the Commonwealth
Kentucky Coal Association
Kentucky Resources Council, Inc.
Knott/Letcher/Perry Coal Operators Association
Lone Mountain Processing, Inc.
Massey Coal Services, Inc.
Michael Baker Engineering Consultants
Mountain State Justice, Inc.
National Mining Association
Ohio Valley Environmental Coalition
Pittston Coal Management
Progress Coal Company
Samples Mine Complex
Schmid & Company, Inc.
Small Coal Operators Advisory Council
Summit Engineering, Inc.
Tennessee Coal Association
The West Virginia Highlands Conservancy
The Virginia Coal Association, Inc.
Virginia Mining Association
West Virginia Coal Association
West Virginia Mining & Reclamation Association
West Virginia Environmental Council
WV Rivers Coalition
WV Sierra Club

INDIVIDUALS

Lynn Abbott
Geri Albers
Tina Bailey
Jim Baird
Leslie Elizabeth Barras
Ella Belling
Arthur C. Benke, University of Alabama
Ida Binney
Kathy Birmingham
Julia Bonds
Jeff Bosley
Randy Boyd
Paul Brant
Linda Brock
Megan Brown
Dianne Burnham
Edmund Burrows
Owen Cox
Carol and Don Creager
Ruth H. Creger
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Michael Ferrell
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Carol E. Warren
Matt Webber
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Chuck Wyrostok

VIII. GLOSSARY

Affected Environment: The environment of the area to be affected or created by the alternatives under consideration. (40 CFR 1502.15). Surface or subsurface resources (including social and economic elements) within or adjacent to a geographic area that could potentially be affected by steep slope surface mining and valley fill activities. Any land or water surface area that is used to facilitate, or is physically altered by, surface coal mining and reclamation operations.

Agricultural Land Use: Any land that is used primarily for the production of crops. As used here, this land use classification also includes, but is not limited to, grazing lands, pastures, woodlands, and forests interspersed within croplands.

Aerial Photogrammetric Mapping: Contour maps developed from stereo pairs of air photographs.

Alternative: A combination of management prescriptions applied in specific amounts and locations to achieve a desired management emphasis as expressed in goals and objectives. One of several policies, plans, or projects proposed for decision-making. An alternative need, not substitute, for another in all respects.

Alternative, No-Action: An alternative that maintains established trends or management direction.

Annual Plants: Plants living for only one growing season and then seeding to form the next generation.

Anthracite Coal: A hard, black lustrous coal containing a high percentage of fixed carbon and a low percentage of volatile matter. Commonly referred to as hard coal, it is mined in the United States, mainly in eastern Pennsylvania, although in small quantities in other states.

Anticline: A fold that is convex upward or had such an attitude at some stage of development. In simple anticlines the beds are oppositely inclined, whereas in more complex types the limbs may dip in the same direction. Some anticlines are of such complicated form that no simple definition can be given. Anticlines may also be defined as folds with older rocks toward the center of curvature, providing the structural history has not been unusually complex.

Approximate Original Contour (AOC): The surface configuration achieved by backfilling and grading of the mined area so that the reclaimed area, including any terracing or access roads, closely resembles the general surface configuration of the land prior to mining and blends into and complements the drainage pattern of the surrounding terrain, with all highwalls and spoil piles eliminated. All mined areas are to be returned to AOC, unless they receive a variance from it [Subsection 701(2) of SMCRA].

Approximate Original Contour (AOC) Variance: A regulatory authority may grant a variance or waiver from the requirement to restore a site to AOC if certain specified conditions are satisfied.

Area Mining: A mining operation where, unless the operation is located in a steep-slope area and a steep-slope AOC variance has been granted, all disturbed areas are restored to (1) AOC and (2) the site is capable of supporting the uses that existed prior to mining or an equal or better use.

An area-mining operation may remove multiple seams of coal in the upper reaches of a mountain just like a mountaintop-removal operation; however, this type of operation cannot be classified as a mountaintop-removal operation for two reasons. First, the site may be restored to AOC; second, the entire coal seam or seams may not be removed.

Aquifer: (a) A layer of geologic material that contains water. (b) A zone, stratum, or group of strata that can store and transmit water in sufficient quantities for a specific use.

Augering: A method of mining coal at a cliff or highwall by drilling holes into an exposed coal seam from the highwall and transporting the coal along an auger bit to the surface.

Backfill: The operation of refilling an excavation. Also, the material placed in an excavation in the process of backfilling.

Bank Cubic Yards: The volume of overburden material in the ground before it has been excavated and expanded by swell.

Belt Conveyor: a) A moving endless belt that rides on rollers and on which materials can be carried. The principal parts of a belt conveyor are (1) a belt to carry the load and transmit the pull, (2) a driving unit, (3) a supporting structure and idler rollers between the terminal drums, and (4) accessories, which include devices for maintaining belt tension and loading and unloading the belt, and equipment for cleaning and protecting the belt.

Bench: Specific to surface mining, this refers to the floor(s) of mining excavation areas where backfilling will occur.

Benthic: Relating to or occurring at the bottom of a body of water.

Biological Diversity: The relative abundance of wildlife species, plant species, communities, habitats, or habitat features per unit of area.

Bituminous Coal: (1) Coal that ranks between subbituminous coal and anthracite and that contains more than 14 percent volatile matter (on a dry, ash-free basis) and has a calorific value of more than 11,500 Btu/lb (26.7 MJ/kg) (moist, mineral-matter-free) or more than 10,500 Btu/lb (24.4 MJ/kg) if agglomerating (ASTM). It is dark brown to black in color and burns with a smoky flame. Bituminous coal is the most abundant rank of coal; much is Carboniferous in age.

Syn: soft coal.(2) A coal that is high in carbonaceous matter, having between 15 percent and 50 percent volatile matter. Soft coal. (3) A general term descriptive of coal other than anthracite and low-volatile coal on the one hand and lignite on the other. (4) A coal with a relatively high proportion of gaseous constituents; dark brown to black in color and burns with a smoky luminous flame. The coke yield ranges from 50 percent to 90 percent. The term does not imply that bitumen or mineral pitch is present.

Blanket Drain: Porous zone of large rock formed beneath a valley fill by rolling segregation during wing dumping.

Box Cut: A mining cut excavated into the slope of a hillside, resulting in highwalls on three sides of the cut, or through a mountaintop or ridge crest, resulting in highwalls on two sides of the cut. This type of cut is used to initially open a hillside or mountaintop or ridge crest to all initiation of spoil casting by equipment or explosives.

BTU: British Thermal Unit - a measure of the heat content; the heat required to raise the temperature of one pound of water by one degree (F).

Buffer Zone: An area between two different land uses that is intended to resist, absorb, or otherwise preclude developments or intrusions between the two use areas.

Bulking Factor: The net expansion of overburden material resulting from excavation and subsequent backfilling, usually referred to in the mining industry as the swell factor.

Cage: Elevator car used for carrying personnel in an underground mine shaft hoist.

Cast Blasting: A mining method whereby the force of blasting explosions used to fragment overburden is directed to cast the resulting spoil horizontally into an adjacent open area or mine cut.

Center Ditch: Rock-lined ditch used to carry runoff from the surface of a valley fill down its face to its toe.

CHIA: A CHIA is a cumulative hydrologic impact assessment. Before a SMCRA permit can be approved, an assessment of the cumulative hydrologic impacts of all anticipated mining on the hydrologic balance in the cumulative impact area is performed. Before a SMCRA permit can be approved, the CHIA must find that the proposed operation has been designed to prevent material damage to the hydrologic balance outside the permit area. CHIA preparation is an integrated process which embodies a specific application of hydrologic information management at each step of the process. The scope of a CHIA may initially include all components of the groundwater and surface water systems in the cumulative impact area. This initial scope can be systematically and logically reduced to those concerns of quantity and quality considered significant to maintaining the hydrologic balance of the area. The process focuses on those aspects of the hydrologic balance that are likely to affect designated uses of water. A sample outline is available at the Office of Surface Mining website http://www.osmre.gov//chiaint.htm

Clearing and Grubbing: The process of removing vegetation and large stumps and roots from a site in preparation for topsoil stripping or other excavation.

Coal seam: A layer, vein, or deposit of coal.

Combined Uses Land Use: Any appropriate combination of land uses where one land use is designated as the primary land use and one or more other land uses are designated as secondary land uses.

Commercial Woodland: Land where forest cover is managed for commercial production of timber products.

Continuous Miner: A self-propelled mining machine for excavating coal within underground mines or from beneath surface mine highwalls, usually accompanied by a conveyor to carry the coal to a loading point.

Contour Mining: Surface mining that progresses in a narrow zone following the outcrop of a coal seam in mountainous terrain, and the overburden, removed to gain access to the mineral commodity, is immediately placed in the previously mined area, such that reclamation is carried out contemporaneously with extraction.

Core Drain: Central column of porous large rocks in a valley fill formed by rolling segregation and convergence of materials at the valley fill center during wing dumping.

Council on Environmental Quality (CEQ): An advisory council to the President established by the National Environmental Policy Act of 1969. It reviews federal programs for their effort on the environment, conducts environmental studies, and advises the President on environmental matters.

Cropland Land Use: Land used for the production of adapted crops for harvest, alone or in rotation with grasses and legumes, that include row crops, small grain crops, hay crops, nursery crops, orchard crops, and other similar crops.

Crosscut: Tunnel used to connect two entries in an underground mine.

Cultural Landscape: A cultural landscape is a geographic area, including both cultural and natural resources and the wildlife and domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values. There are four general types of cultural landscapes, not mutually exclusive: historic sites, historic designed landscapes, historic vernacular landscapes, and ethnographic landscapes.

Cultural Resources: (1) In the aims of historic preservation, all of the physical manifestations of archeology and history are cultural resources. (2) Cultural resources includes archeological sites, structures and objects significant to American history and prehistory. May include battlefields, ships, places where treaties were signed, places of significant events. (3) They are important for their representation of cultures, lifestyles, people, architecture, engineering, arts and events, or for the information they contain, or for associations they have with past people or events. (4) Cultural resources are considered fragile and non renewable resources, once they are removed, lost or destroyed, they are gone forever.

Cumulative Impact: The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (40 CFR 1508.7)

Cut: An excavation, generally applied to surface mining; to make an incision in a block of coal; in underground mining, that part of the face of coal that has been undercut.

Daylighting: Excavation of underground mine voids so that they can be backfilled.

dBA: Is the symbol for a sound level measured on an A-weighted scale. The A-weighted scale gives more weight to those frequencies that are audible to the human ear (about 500 Hz to about 8000 Hz) and discounts those frequencies outside the band of frequencies audible by the human ear.

Dendritic: The dendritic drainage pattern is characterized by irregular branching in all directions with the tributaries joining the main stream at all angles. Resembling the vein patterns in a tree leaf.

Development Areas: Areas mined or otherwise excavated in advance of production mining to establish highwalls and drilling benches for production areas.

Development Equipment: Medium to light equipment used for excavation and haulage in development areas, usually hydraulic excavators, loaders, dozers, and haul trucks.

Dip: Inclination in degrees of a planar geologic stratum from the horizontal.

Disturbed Area: An area where vegetation, topsoil, or overburden is removed or upon which topsoil, spoil, coal processing waste, underground development waste, or noncoal waste is placed by surface coal mining operations. Those areas are classified as disturbed until reclamation is complete and the performance bond or other assurance of performance is released.

Dozer: Generic term used for bulldozers, also referred to as tractors; tract-mounted earthmoving equipment with a forward blade for pushing material.

Dragline: A type of excavating equipment that casts a rope-hung bucket a considerable distance; collects the dug material by pulling the bucket toward itself on the ground with a second rope; elevates the bucket; and dumps the material on a spoil bank, in a hopper, or on a pile.

Dump Equipment: One of many conveyances that carry and then dump rock, coal or ore. Generally trucks in surface mining and shuttle cars in underground mining.

Durable Rock: Naturally formed aggregates that will not slake in water or degrade to soil material. Federal law provide that durable-rock fills must consist of at least 80 percent durable rock [30 CFR §§ 816.73 and 817.73].

Effects: Effects include direct effects and indirect effects. Direct effects are caused by the action and occur at the same time and place. Indirect effects are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. Effect and impacts as used in these regulations are synonymous. Effects includes ecological such as the effects on natural resources and on the components, structures and functioning of affected ecosystems, aesthetic, historic, cultural, economic, social or heath, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if in balance the agency believes that the effect will be beneficial.(40 CFR 1508.8)

Elevation: A general term for a topographic feature of any size that rises above the adjacent land or the surrounding ocean bottom; a place or station that is elevated. The vertical distance from a datum (usually mean sea level) to a point or object on the Earth's surface; esp. the height of a ground point above the level of the sea. The term is used synonymously with altitude in referring to distance above sea level, but in modern surveying practice the term elevation is preferred to indicate heights on the Earth's surface, whereas altitude is used to indicate the heights of points in space above the Earth's surface.

Endangered Species: Federally listed: any species of animal or plant in danger of extinction throughout all or a significant portion of its range; state (group I): species whose prospect of survival or recruitment in the state are in jeopardy in the foreseeable future; state (group II): species whose prospect of survival or recruitment within the state may become jeopardized in the near future.

Endemic: Any localized process or pattern, but usually applied to a highly localized or restrictive geographic distribution of a species.

Environmental Assessment (EA): A concise public document prepared to provide sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement or a Finding of No Significant Impact. An EA includes a brief discussion of the need for a proposal, the alternatives considered, the environmental impacts of the proposed action and alternatives, and a list of agencies and individuals consulted.

Environmental Impact Statement (EIS): A document prepared to analyze the impacts on the environment of a proposed project or action and released to the public for comment and review. An EIS must meet the requirements of NEPA, CEQ, and the directives of the agency responsible for the proposed project or action.

Excess Spoil: (1) Spoil in excess of that necessary to backfill and grade affected areas to the approximate original contour. The term may include box-cut spoil where it has been demonstrated for the duration of the mining operation, that the box-cut spoil is not needed to restore the approximate original contour. (2) Overburden material that is disposed of in a location other than the mine pit. [30 CFR § 701.5]

Exotic: Those species that occupy habitats of which they did not evolve and often have no natural enemies to limit their reproduction and spread--frequently at the expense of native plants and animals and, sometimes, of entire ecosystems. The words exotic, invasive, and non-indigenous are often used synonymously.

Face: The working surface of a coal seam where it is being excavated, usually applied to underground mining. Also the front of the downstream end of a valley fill.

Factor of Safety: Engineering term used to evaluate slope stability in valley fills with regards to rotational sliding and failure; greater values for a factor of safety indicate greater slope stability.

Fills: Fill structures that are created by the placement of excess spoil in valleys, on hill sides, or on preexisting benches. Although most excess-spoil fills are commonly referred to as valley fills, most

mountaintop-removal and steep-slope mining operations today involve the construction of durable-rock fills [OSM-30 CFR §§ 816.71 and 817.71].

Fines: Very fine-grained coal materials or dust typically generated as residue from coal processing facilities.

Fish and Wildlife Habitat and Recreation Lands: Wetlands, fish-and-wildlife habitat, and/or areas managed primarily for fish and wildlife and recreation.

Flume: see Core Drain.

Forb: Any herbaceous plant that is not a grass or grass-like in nature; leafy soft-stemmed plants.

Forestland: (1) Land with at least 25 percent tree canopy or that has been stocked with at least 10 percent forest trees of any size, including land that formerly had such tree cover and that will be naturally or artificially reforested. (2) Land bearing a stand of trees of any stature, including seedlings, and of species attaining a minimum of 6 feet average height at maturity or land from which such a stand has been removed but on which no other use has been substituted. The term is commonly limited to land not in farms; forests on farms are commonly called woodland or farm forests.

Fragipan: A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Front End Loader: A rubber-tired piece of earthmoving equipment with a single forward-facing bucket mounted on hydraulic lifting arms, usually abbreviated to “loader.”

Fugitive Dust: The particulate matter not emitted from a duct or stack that becomes airborne due to the forces of wind or surface coal mining and reclamation operations or both. During surface coal mining and reclamation operations it may include emissions from haul roads; wind erosion of exposed surfaces, storage piles, and spoil piles; reclamation operations; and other activities in which material is either removed, stored, transported, or redistributed.

Glaciated: 1. Said of a country which has been scoured and worn down by glacial action, or strewn with ice-laid drift. 2. Covered by and subjected to the action of a glacier.

Glaciation: Alteration of the Earth’s solid surface through erosion and deposition by glacier ice.

Graders: Rubber-tired earthwork equipment with a center-mounted, underslung blade used for fine grading of roads or reclamation surfaces.

Grazing Land Use: As used here, open woodland and desert shrubland that is predominantly used for grazing, browsing, or occasional hay production.

Groin Ditch: Rock-lined ditch used to carry runoff from slopes surrounding a valley fill to the toe of the valley fill.

Groundwater: Subsurface water that fills available openings in rock or soil materials to the extent that they are considered water saturated.

Haul Distance: The distance from the coal face to pit bottom or surface; the distance quarry or opencast products must be moved to the treatment plant or construction site; the distance from the shaft or opencast pit to spoil dump.

Haul Road: (1) A road built to carry heavily loaded trucks at a good speed. The grade is limited on this type of road and usually kept to less than 17 percent of climb in direction of load movement. (2) Road from pit to loading dock, tipple, ramp, or preparation plant used for transporting mined material by truck.

Haul Truck: Any of a variety of wheeled trucks used for haulage of spoil or coal, usually having an open dump bed.

Hayland or Pasture: Land used primarily for the long-term production of adapted, domesticated forage plants to be grazed by livestock or cut and cured for livestock feed.

Head-of-Hollow Fill: A fill structure consisting of any materials, other than a coal processing waste or organic material, placed in the uppermost reaches of a hollow where side slopes of the existing hollow measured at the steepest point are greater than 20 degrees , or the average slope of the profile of the hollow from the toe of the fill to the top of the fill is greater than 10 degrees . In fills with less than 250,000 yd^3 (191,000 m^3) of material, associated with steep slope mining, the top surface of the fill will be at the elevation of the coal seam. In all other head-of-hollow fills, the top surface is the fill, that when completed, is at approx. the same elevation as the adjacent ridge line, and no significant area of natural drainage occurs above the fill draining into the fill areas.

Heading: Term for the entries used in a longwall mine to access coal panels.

Headwater: The source (or sources) and upper part of a stream, including the upper drainage basin.

Headwaters: Non-tidal rivers, streams, and their lakes and impoundments, including adjacent wetlands, that are part of a surface tributary system to an interstate or navigable water of the United States upstream of the point on the river or stream at which the average annual flow is less than five cubic feet per second. The District Engineer may estimate this point from available data by using the mean annual area precipitation, area drainage basin maps, and the average runoff coefficient, or by similar means. For streams that are dry for long periods of the year, District Engineers may establish the point where headwaters begin as that point on the stream where a flow of five cubic feet per second is equaled or exceeded 50 percent of the time. [COE-33 CFR 330.2(d)]

Herbaceous: Term for soft-stemmed grass and forb plant species.

Historic Property or Historic Resource: Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places.

The term "eligible for inclusion in the national Register of Historic Places" includes both properties formally determined as such by the Secretary of the Interior and all other properties that meet the National Register listing criteria.

Highwall: The unexcavated face of exposed overburden and coal or ore in an opencast mine, or the face or bank on the uphill side of a contour strip mine excavation.

Highwall Limits: The maximum economical mining depth for a coal seam as established by its stripping ratio and market value.

Highwall Mining: Removal of coal from beneath a standing highwall without excavation of the overburden, using augers or continuous highwall mining machines.

Horizon: A stratigraphic zone containing a coal seam or other mineral deposit. The horizontal and/or vertical extent of a planar coal seam or mineral deposit.

Hydraulic Excavator: A piece of earthmoving equipment similar to a shovel, but using an articulated hydraulic arm for lifting rather than a fixed boom. Hydraulic excavators are divided into hoes, which dig with a forward-facing bucket, and backhoes, which dig with a back-facing bucket. Both types are mounted on tracks for mobility.

Hydrologic Balance: The relationship between the quality and quantity of water inflow to, water outflow from, and water storage in a hydrologic unit such as a drainage basin, aquifer, soil zone, lake, or reservoir. It encompasses the dynamic relationships among precipitation, runoff, evaporation, and changes in ground and surface water storage.

Hydrology: The science that relates to the water systems of the earth, or the principles of water flow, or the presence of surface or groundwater.

Hydroseeder: Usually a truck-mounted pump arrangement used for spraying a mixture of seed and stabilizing mulch in a fluid medium over a broad surface area for reclamation.

Industrial/Commercial Land Use: Land for: (a) extraction or transformation of materials for fabrication of products, wholesaling of products, or long-term storage of products. This includes all heavy and light manufacturing facilities. (b) Retail or trade of goods or services, including hotels, motels, stores, restaurants, and other commercial establishments.

Interburden: A term applied to rock strata between two coal seams to be mined, similar to overburden, which is rock strata overlying a coal seam to be mined. Both interburden and overburden are often referred to collectively as overburden.

Invasive: Those species that colonize natural or semi-natural ecosystems, are agents of change, and threats to native biodiversity. The words exotic, invasive, and non-indigenous are often used synonymously.

Lentic: Non-flowing aquatic systems such as ponds.

Loose Cubic Yards: The volume of overburden material after it has been excavated.

Longwall Mining: Underground mining method whereby wide panels of coal are mined, with mechanical shields used for roof support.

Lotic: Flowing aquatic systems such as streams.

Material Damage: In the context of Secs. 784.20 and 817.121, means: (a) Any functional impairment of surface lands, features, structures or facilities; (b) Any physical change that has a significant adverse impact on the affected land's capability to support any current or reasonably foreseeable uses or causes significant loss in production or income; or (c) Any significant change in the condition, appearance or utility of any structure or facility from its pre-subsidence condition.

Median: The median is the middle of a distribution: half the scores are above the median and half are below the median. The median is less sensitive to extreme scores than the mean and this makes it a better measure than the mean for highly skewed distributions. For example, the median income is usually more informative than the mean income.

Metallurgical: Bituminous coal used in a beehive coke oven.

Mine Mouth: The entrance to a mine, or the point of shipping of raw coal from a surface or deep mine operation.

Mineral Extraction Area: Portion of a mine permit where coal will actually be extracted.

Mitigation: Mitigation includes: (a) Avoiding the impacts altogether by not taking a certain action or parts of an action. (b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation. (c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environments. (d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action. (e) Compensating for the impact by replacing or providing substitute resources or environments. (40 CFR 1508.20)

Mountaintop Mining/Valley Fill (MTM/VF) Mining: Surface coal mining in the Appalachian coalfield states of Kentucky, Tennessee, Virginia, and West Virginia is conducted by a variety of mining methods and in different topographic settings. Surface coal mining occurring on mountaintops, ridges, and other steep slopes (by definition those of 20 degrees or more) is often referred to as mountaintop mining. Removal of overburden from coal on mountaintop mining sites may result in generation of excess mine spoil in quantities that may not allow regrading of a mine site to its approximate original topographic contours or that must otherwise be disposed of to allow for regrading of a mine site to its approximate original topographic contours or that must otherwise be disposed of to allow for efficient and economical coal extraction. One method of disposing of this excess spoil is to place it the heads of hollows or valleys of streams, a practice often referred to as valley fill. For the purposes of this EIS, steep slope surface coal mining operations that produce excess spoil and dispose of it in heads of hollows or valleys of streams shall be referred to collectively as mountaintop mining/valley fill (MTM/VF) operations, in recognition that repetitive discussion of individual mining methods would be cumbersome.

Mountaintop-Removal Operation: According to SMCRA, a type of surface-mining operation that extracts an entire coal seam or seams running through the upper fraction of a mountain, ridge, or hill. Coal extraction must be accomplished by removing all of the overburden and creating a level plateau or a gently rolling contour that both has no highwalls remaining and is capable of supporting certain postmining land uses.

Multiple Seam Mining: Surface mining in areas where several seams are recovered from the same hillside.

National Pollutant Discharge Elimination System (NPDES): The national program for issuing, modifying, revoking, and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 402, 318, and 40 of the CWA. [EPA-40 CFR 122.2]

Nationwide Permits: Nationwide permits are a type of general permit and represent DA authorizations that have been issued by the regulation (33 CFR Part 330) for certain specified activities nationwide. If certain conditions are met, the specified activities can take place without the need for an individual or regional permit. [33 CFR 325.5(c) (2)]

NEPA, The National Environmental Policy Act of 1969: Declares the national policy to encourage a productive and enjoyable harmony between man and his environment. Section 102 of that Act directs that "to the fullest extent possible: (1) The policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act, and (2) all agencies of the federal government shall insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision-making along with economic and technical considerations ". (See Appendix B of 33 CFR Part 325.) (42 U.S.C. 4321-4347)

Neutralization Potential: A measure of the ability of a material to neutralize acidity, expressed in terms of calcium carbonate equivalents. In overburden analysis, this is usually expressed as tons of calcium carbonate equivalent per 1,000 tons of overburden.

NPK Fertilizer: Nitrogen (N), phosphorus (P), and potassium (K) fertilizer with numeric values of the three nutrients expressed as percentage by weight.

Ordinary High Water Mark: That line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas. [COE-33 CFR 328.3(e)]

Outcrop: (a) The part of a rock formation that appears at the surface of the ground. (b) A term used in connection with a vein or lode as an essential part of the definition of apex. It does not necessarily imply the visible presentation of the mineral on the surface of the earth, but includes those deposits that are so near to the surface as to be found easily by digging. (c) The part of a geologic formation or structure that appears at the surface of the earth; also, bedrock that is

covered only by surficial deposits such as alluvium. (d) To appear exposed and visible at the earth's surface; to crop out.

Outslope: The face of the spoil or embankment sloping downward from the highest elevation to the toe.

Overburden: Designates material of any nature, consolidated or unconsolidated, that overlies a deposit of useful materials, ores, or coal--esp. those deposits that are mined from the surface by open cuts.

Pan Scraper: A piece of earthmoving equipment with a belly opening that is used to scrape a surface layer of loose material for excavation. The pan scraper then carries the material to a dump point and dumps it through a set of belly doors.

Panel: Primary coal extraction area in an underground mine, usually rectangular in shape. Multiple panels may be present in a single underground mine.

Perennial Plants: Plants that live for more that one growing season.

Perimeter Ditch: Ditch or channel used to convey runoff from within a mining area around the outside perimeter of the mining area to a controlled discharge point, such as a sedimentation pond. When sediment trapping basins are included in the ditch design, a perimeter ditch may also be referred to as a sediment ditch.

Phase: Sequenced operational areas to divide the progression of a surface mine.

PHC, **Probable Hydrologic Consequences**: The PHC process consists of the following steps, repeated as many times as necessary to mitigate adverse impacts:
Data collection; Characterization of the premining hydrologic balance; Prediction of mining disturbances; Design of measures to mitigate mining disturbances; and Documentation of residual impacts to the hydrologic balance remaining after implementation of mitigative measures. The remaining unmitigated impacts must be documented in the PHC determination. This iterative PHC process is intended to reduce the predicted adverse impacts to the hydrologic balance to an acceptable level. A sample outline for the PHC determination is available for downloading at http://www.osmre.gov//hyphc.htm.

Pit: In surface mining, the void left after removal of overburden to expose the coal in a cut.

Premining/Postmining Land Use: The primary uses of the land before and after mining. After mining, land is generally required to be returned to its premining use. A site may be returned to an alternative postmining land use if certain requirements are satisfied. Permits involving mountaintop removal or steep-slope mining operations with variances from AOC may be issued by the regulatory authority only if they meet certain specified postmining land use as described in the approved state program. Some examples of postmining land uses include, but are not limited to: combined uses, commercial woodland, fish and wildlife habitat and recreation lands, forestland, residential, rangeland, or pasture.

Preparation Plant: A facility where coal is subjected to chemical or physical processing or cleaning, concentrating, or other processing or preparation. A preparation plant's facilities include, but are not limited to, the following: loading facilities; storage and stockpile facilities; sheds, shops, and other buildings; water-treatment and water-storage facilities; settling basins and impoundments; and coal processing and other waste disposal areas.

Production (Cut) Areas: Main coal producing areas of an MTM/VF mine where mining is conducted using large linear cuts and heavy production equipment.

Production Equipment: Heavy equipment used for primary spoil movement and coal excavation, usually draglines, shovels, hydraulic excavators, or large loaders, the latter three working with haul trucks; also large dozers in the case of cast blasting.

Recovery Rate: The net percentage of the total coal in a reserve that is recovered by mining and not left in the ground. Can be applied either to the total reserve or to working areas within a reserve.

Relief: Difference in elevation between the highest mountaintop, ridge, or hill and the lowest valley within a permit area.

Reserve: That portion of the demonstrated coal reserve base that is estimated to be recoverable at the time of determination. The reserve is derived by applying a recovery factor to that component of the identified coal resource designated as the demonstrated reserve base.

Reserve Evaluation: Process of assessing the extent and value of coal reserves on a prospective mine site.

Revegetation: Plants or growth that replaces original ground cover following land disturbance.

Required Findings: Specific findings that a regulatory authority must make prior to granting a mountaintop-removal or steep-slope AOC variance [Subsections 515(c) and (e) of SMCRA].

Runoff: That portion of the rainfall that is not absorbed by the deep strata, is used by vegetation or lost by evaporation, or that may find its way into streams as surface flow.

Scope: Scope (as defined in 40 CFR 1508.25) consists of the range of actions, alternatives, and impacts to be considered in an environmental impact statement. The scope of an individual statement may depend on its relationships to other statements (NEPA §§ 1502.20 and 1508.28). To determine the scope of environmental impact statements, agencies shall consider three types of action, three types of alternatives, and three types of impacts. They include: (a) Actions, other than unconnected single actions, which may be: 1) connected actions, which means that they are closely related and therefore should be discussed in the same impact statement. Actions are connected if they automatically trigger other actions which may require environmental impact statements, cannot or will not proceed unless other actions are taken previously or simultaneously, or are interdependent parts of a larger action and depend on the larger action for their justification. 2) cumulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement.

3) similar action, which when viewed with other reasonably foreseeable or propsed agency actions, have similarities that provide a basis for evaluating their environmental consequences together, such as common timing or geography. An agency may wish to analyze these actions in the same impact statement. It should do so when the best way to assess adequately the combined impacts of similar actions or reasonable alternatives to such actions is to treat them in a single impact statement. (b) Alternatives, which include: 1) No action alternative; 2) Other reasonable courses of actions; 3) Mitigation measures, not in the proposed action. (c) Impacts, which may be: 1) Direct; 2) Indirect; 3) Cumulative.

Secondary Extraction: Removal of residual coal after primary extraction methods have been completed, such as highwall mining in surface mined or pillar recovery in underground mines.

Sediment: Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the Earth's surface either above or below sea level.

Sediment Channel/Ditch: see Perimeter Ditch.

Sedimentation: The process of depositing sediments carried by water.

Sedimentation Pond: A reservoir for the confinement and retention of silt, gravel, rock, or other debris from a sediment-producing area.

Severance Tax: A tax levied against coal as it is mined, based either on the value of the coal or at a flat rate per ton, used to compensate federal, state, and sometimes local governments for the value of the portion of the reserve that is extracted.

Shovel (Electric): (a) Any bucket-equipped machine used for digging and loading earthy or fragmented rock materials. (b) There are two types of shovels, the square-point and the round-point. These are available with either long or short handles. The round-point shovel is used for general digging since its forward edge, curved to a point, most readily penetrates moist clays and sands. The square-point shovel is used for shoveling against hard surfaces or for trimming.

Shrinkage Factor: Percent decrease in loose material volume resulting from backfilling and subsequent compression by overlying material.

Significant: "Significant" as used in NEPA (40 CFR 1508.27), requires consideration of both context and intensity:

- **Context.** This means that the significance of an action must be analyzed in several contexts, such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.

- **Intensity.** This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:

  1. Impacts that may be both beneficial and adverse. A significant effect may exit even if the federal agency believes that on balance the effect will be beneficial.

  2. The degree to which the proposed action affects public health or safety.

  3. Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, and wild and scenic rivers, or ecologically critical areas.

  4. The degree to which the effects on the quality of the human environment are likely to be highly controversial.

  5. The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.

  6. The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.

  7. Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.

  8. The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for the listing in the National Register of Historic Places, or may cause loss or destruction of significant scientific, cultural, or historic resources.

  9. The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.

  10. Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment.

Slake Durability: The ability of rock or spoil materials to resist dissolution or breakdown in water; used for assessing the suitability of spoil material for use in valley fill construction.

Special Handling: General term for methods of blending, isolation, or encapsulation of toxic materials within the backfill to prevent adverse impacts to chemical water quality.

Spread: Colloquial mining industry term for a working piece of production equipment (shovel, hydraulic excavator, loader, etc.) and its attendant group of haul trucks that carry away spoil as it is excavated.

Spoil: Overburden, non-mineral or other material removed in mining.

Spoil Bank: A term common in surface mining to designate the accumulation of overburden. Also, underground mine refuse piled outside.

Soil Horizons: Means contrasting layers of soil parallel or nearly parallel to the land surface. Soil horizons are differentiated on the basis of field characteristics and laboratory data. The four master soil horizons are : (a) A horizon. The uppermost mineral layer, often called the surface soil. It is the part of the soil in which organic matter is most abundant, and leaching of soluble or suspended particles is typically the greatest; (b) E horizon. The layer commonly near the surface below an A horizon and above a B horizon. An E horizon is most commonly differentiated from an overlying A horizon by lighter color and generally has measurably less organic matter than the A horizon. An E horizon is most commonly differentiated from an underlying B horizon in the same sequum by color or higher value or lower chroma, by coarser texture, or by a combination of these properties; (c) B horizon. The layer that typically is immediately beneath the E horizon and often called the subsoil. This middle layer commonly contains more clay, iron, or aluminum than the A, E, or C horizons; and (d) C horizon. The deepest layer of soil profile. It consists of loose material or weathered rock that is relatively unaffected by biologic activity.

Steep Slope: Any slope of more than 20 degrees or such lesser slope as may be designated by the regulatory authority after consideration of soil, climate, and other characteristics of a region or state [30 CFR § 701.5].

Steep-Slope Mining: Type of surface-mining operation where the natural slope of the land within the proposed permit area exceeds an average of 20 degrees.

Storage Capacity: The amount of water that can be store in a specific volume of rock.

Stratum: Geologic term for a sedimentary rock bed, plural strata.

Stripping Ratio: The unit amount of spoil or overburden that must be removed to gain access to a unit amount of coal. Generally expressed in cubic yards of overburden to raw tons of mineral material.

Sub-Bituminous Coal: Coal of rank intermediate between lignite and bituminous. In the specifications adopted jointly by the American Society for Testing and Materials (D388-38) and the American Standards Association (M20 .1-1938), *subbituminous* coals are those with calorific values in the range 8,300 to 13,000 Btu (19.3 to 30.2 MJ/kg), calculated on a moist, mineral-mater-free basis, which are both weathering and nonagglomerating according to criteria in the classification.

Subsidence: Lowering of the ground surface resulting from collapse of underground mine voids.

Support Areas: Portions of a mine permit that are maintained to support the production and development areas, such as haul roads, building facilities, and erosion and sedimentation control facilities.

Swell: The tendency of soils and bedrock, on being removed from their natural, compacted beds, to increase or swell owing to the creation of voids or spaces between soil or rock particles. The volumetric increase, normally expressed as a percentage, that occurs as the consequence of changing undisturbed overburden (bank) into loose (excavated) material.

Swell Factor: The percentage increase in the volume of rock material as it is broken to form spoil, resulting from the creation of voids between the broken rock fragments that were not present in the original unbroken rock. Also used in industry as the equivalent to the term "bulking factor," or the net percentage increase between the volume of rock material and its resultant spoil after compaction in backfill.

Syncline: A fold in rocks in which the strata dip inward from both sides towards the axis.

Terrace: A level or nearly level plain, generally narrow in comparison with its length, from which the surface slopes upward on one side and downward on the other side. Terraces and their bounding slopes are formed in a variety of ways, some being aggradational and others degradational.

Topsoil: The A, O, and E soil horizon layers of the four master soil horizons.

Toxic Material: Specific to coal mining, this includes overburden strata or coal materials that have been identified as containing materials that may result in adverse impacts to chemical water quality if exposed to air and water.

Underground Mining: Also known as *deep mining*, a process by which coal is extracted by excavating within the horizon of a coal seam and without removing the overlying overburden for reasons other than primary seam access.

Valley Fill: A fill structure consisting of any material other than coal waste and organic material that is placed in a valley where side slopes of the existing valley measured at the deepest point are greater than 20 degrees, or the average slope of the profile of the valley from the toe of the fill to the top of the fill is greater than 10 degrees.

Waters of the United States:

1. All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
2. All interstate waters including interstate wetlands;
3. All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters:

   i. Which are or could be used by interstate or foreign travelers for recreational or other purposes; or
   ii. From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or
   iii. Which are used or could be used for industrial purpose by industries in interstate commerce;
4. All impoundments of waters otherwise defined as waters of the United States under the definition;
5. Tributaries of waters identified in paragraphs (a)(1)-(4) of this section;
6. The territorial seas;
7. Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (a)(1)-(6) of this section.
   Waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of CWA (other than cooling ponds as defined in 40 CFR 123.11(m) which also meet the criteria of this definition) are not waters of the United States.
8. Waters of the United States do not include prior converted cropland. Notwithstanding the determination of an area's status as prior converted cropland by any other federal agency, for the purposes of the Clean Water Act, the final authority regarding Clean Water Act jurisdiction remains with the EPA. [COE-33 CFR 328.3 (a)]

Wetland: Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. (Section 404 of the Clean Water Act). For resource mapping purposes, the FWS (Cowardin et al. 1979) has also defined wetlands as follows. Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification, wetlands must have one or more of the following three attributes: 1. At least periodically, the land supports predominantly hydrophytes; 2. The substrate is predominantly undrained hydric soils; and 3. The substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

Wing Dumping: End dumping of spoil from haul trucks on opposite sides of a valley fill area to create blanket and core drains beneath the fill.

IX. INDEX OF KEY TERMS

Air Quality	I.G, II.A, II.C, III.V, IV.E, IV.H, I.V.I, I.V.J, Appendix B, Appendix G
Approximate Original Contour (AOC)	I.F, I.G, II.A, II.B, II.C, III.G, III.K, IV.B, IV.I, Appendix A, Appendix B, Appendix D, Appendix J, Appendix K
Archaeological Resources	III.S, IV.G
B	
Benthic (Macroinvertebrate)	II.A, II.B, II.C, III.C, III.D, III.E, IV.B, IV.C, IV.D, Appendix B, Appendix D, Appendix E
Biological Diversity (Biodiversity)	I.G, II.C, III.F, IV.A, IV.B, IV.D, Appendix D, Appendix L
Blasting	I.G, II.A, II.B, II.C, III.G, III.H, III.I, III.J, III.L, III.V, III.W, IV.E, IV.I, IV.K, Appendix A, Appendix B, Appendix G, Appendix J, Appendix K
C	
Clean Air Act (CAA)	II.C, III.V, IV.E, IV.I, Appendix B, Appendix G,
Clean Water Act (CWA)	I.A, I.B, I.D, I.F, I.G, II.A, II.B, II.C, II.D, III.C, III.E, IV.K, Appendix B, Appendix D, Appendix L
Cultural	I.G, II.A, II.B, II.C, III.A, III.B, III.C, III.E, III.F, III.J, III.L, III.S, III.U, IV.A, IV.C, IV.G, IV.H, IV.J, IV.K, Appendix A, Appendix B, Appendix C, Appendix G
Cumulative Hydrologic Impact Assessment (CHIA)	I.F, II.B, II.C, III.H, IV.I, Appendix A, Appendix B, Appendix H, Appendix K
Cumulative Impact	I.C, I.F, I.G, IIA, II.B, II.C, II.D, III.D, III.G, III.T, III.U, IV.A, IV.B, IV.C, IV.D, IV.E, IV.F, IV.G, IV.H, Appendix A, Appendix B, Appendix G, Appendix L
D	
Demographics	II.A, II.C, III.P, IV.A, Appendix G
Dust	I.G, II.A, II.B, II.C, III.H, III.J, III.L, III.V, III.W, IV.E, IV.I, Appendix A, Appendix B, Appendix G, Appendix J, Appendix K

Effluent Limits	II.B, II.C, III.E, Appendix B
Endangered Species	I.A, I.G, II.A, II.B, II.C, III.A, III.F, IV.A, IV.D, Appendix A, Appendix B, Appendix F
Endangered Species Act (ESA)	I.A, I.G, II.B, II.C, IV.A, IV.D, Appendix A, Appendix B
Environmental Justice	I.G, II.A, III.P, IV.K, Appendix B
Ephemeral	I.G, II.A, II.C, II.D, III.C, III.D, IV.B, IV.D, IV.I, Appendix B, Appendix D, Appendix H, Appendix K
Excess Spoil	I.A, I.B, I.C, I.D, I.E, I.F, II.A, II.B, II.C, III.A, III.B, III.D, III.E, III.H, III.I, III.J, III.K, III.L, IV.A, IV.B, IV.D, IV.I Appendix A, Appendix B, Appendix D, Appendix H, Appendix J, Appendix K
F	
Fill Inventory	I.F, II.A, II.B, II.C, II.D, III.K, IV.B
Fill Material	I.A, I.F, II.C, II.D, III.A, III.H, III.K, IV.B, IV.I, Appendix A, Appendix B, Appendix D
Fish	I.A, I.C, I.F, II.A, II.B, II.C, III.A, III.C, III.D, III.E, IV.B, IV.C, IV.D, IV.J, IV.K, Appendix A, Appendix B, Appendix D, Appendix F, Appendix I
Forest	I.F, I.G, II.A, II.B, II.C III.A, III.B, III.C, III.D, III.F, III.G, III.L, IV.A, IV.B, IV.C, IV.D, IV.G, IV.H, IV.I, IV.J, IV.K, Appendix A, Appendix B, Appendix D, Appendix E, Appendix F, Appendix H, Appendix K, Appendix L
Fugitive Dust	II.C, III.V, IV.E, Appendix A, Appendix B, Appendix G
G	
General Permit (Nationwide Permit)	I.A, I.F, II.B, II.C, IV.A, IV.I, Appendix B
Groundwater	I.G, II.C, III.A, III.B, III.C, III.E, III.H, III.K, III.L, III.W, IV.B, Appendix A, Appendix B, Appendix C, Appendix G, Appendix K
H	
Headwater Stream	I.A, I.D, I.G, II.A, II.C, II.D, III.A, III.C, III.D, III.E, IV.B, IV.D, IV.I, Appendix A, Appendix B, Appendix D
Historic	I.F, I.G, II.A, II.B, II.C, III.B, III.C, III.D, III.E, III.F, III.S, III.U, IV.A, IV.G, IV.H, IV.J, IV.K, Appendix B, Appendix F

Hydrologic Balance	I.G, II.B, II.C, III.B, III.E, III.G, IV.I, Appendix B, Appendix H
I	
Impact Threshold	I.B, I.F, II.B, II.C, II.D, IV.B, Appendix A
Individual Permit (IP)	I.A, I.F, II.B, II.C, II.D, III.K, IV.A, IV.D, IV.I, Appendix B
Intermittent	I.D, I.F, II.A, II.C, II.D, III.C, III.D, IV.B, IV.D, IV.I, Appendix B, Appendix C, Appendix D, Appendix H, Appendix K
Invertebrate	II.A, II.B, II.C, III.A, III.C, III.D, III.E, III.F, IV.B, IV.D, Appendix A, Appendix D, Appendix E, Appendix F
L	
Land use	I.F, I.G, II.A, II.C, III.A, III.B, III.C, III.D, III.E, III.F, III.K, III.L, III.R, IV.A, IV.B, IV.C, IV.D, IV.F, IV.G, IV.H, IV.I, IV.J, Appendix A, Appendix B, Appendix G
Land cover	III.A, III.B, III.F, III.R, IV.G, Appendix L
M	
Mitigation	I.B, I.C, I.D, I.F, I.G, II.A, II.B, II.D, III.D, III.L, IV.A, IV.B, IV.D, IV.E, IV.F, IV.I, IV.J, Appendix A, Appendix B, Appendix G
N	
Nationwide Permit (General Permit)	I.A, I.F, II.B, II.C, IV.A, IV.I, Appendix B
National Pollutant Discharge Elimination System (NPDES)	I.A, II.B, II.C, IV.I, Appendix B
Natural Resources	II.C, III.A, III.C, IV.A, IV.D, IV.J, Appendix B
Noise	I.G, II.C, III.U, III.W, Appendix B, Appendix G
Non-traditional Forest Products	III.A, III.T, IV.H, IV.J
P	
Performance Standards	II.B, II.C, III.K, III.U, IV.B, IV.I, IV.J, Appendix A, Appendix B
Perennial	I.D, I.F, I.G, II.A, II.C, II.D, III C, III D, III K, Appendix A, Appendix B, Appendix C, Appendix F, Appendix H

Population	I.G, II.A, II.B, II.C, III.C, III.F, III.H, III P, III.U, III.V, IV.A, IV.D, IV.E, IV.I, IV.J, IV.K, Appendix A, Appendix B, Appendix F, Appendix G
Post Mining	I.G, II.A, II.B, II.C, III.B, III.E, III.H, III.I, III.J, III.K, III.L, IV.A, IV.B, IV.C, IV.D, IV.I, IV.J, Appendix B, Appendix K,
Prime Farmland	III.B, Appendix B
Probable Hydrologic Consequences (PHC)	I.F, II.B, II.C, Appendix B, Appendix H, Appendix K
Public Involvement	I.G, II.A, II.C, IV.A, IV.B, IV.C, IV.D, Appendix B, Appendix G
R	
Reclamation	I.A, I.B, I.C, I.D, I.F, I.G, II.A, II.B, II.C, III.B, III.D, III.E, III.H, III.I, III.J, III.K, III.L, IV.A, IV.B, IV.C, IV.D, IV.F, IV.I, Appendix A, Appendix B, Appendix C, Appendix H, Appendix K
S	
Severance Tax	I.G, II.C, III.L, III.P, III.Q
Socioeconomic	II.C, III.P, IV.A, Appendix G
Stream Buffer Zone (SBZ)	I.D, I.F, II.B, II.C, II.D, Appendix B
Surface Mining Control and Reclamation Act (SMCRA)	I.A, I.B, I.D, I.F, I.G, II.A, II.B, II.C, II.D, III.E, III.V, IV.A, IV.B, IV.C, IV.D, IV.I, IV.J, Appendix A, Appendix B
T	
Total Maximum Daily Load (TMDL)	II.B, II.C, Appendix A, Appendix B
Tourism	I.G, III.T, IV.H, IV.I, IV.J, Appendix A, Appendix G
U	
Unemployment (employment)	I.G, II.A, II.C, III.P, III.Q, III.U, III.V, IV.A, IV.H, IV.I, IV.J, IV.K

Variance	I.F, III.E, III.N, IV.C, IV.I, Appendix A, Appendix B
Visual Resource	I.G, IV.G, IV.H, Appendix B, Appendix F
W	
Watershed	I.D, I.E, I.F, I.G, II.B, II.C, II.D, III.A, III.C, III.D, III.E, III.F, III.G, III.H, IV.A, IV.B, IV.D, IV.E, Appendix A, Appendix B, Appendix D, Appendix E, Appendix F, Appendix H, Appendix I
Water Supply	II.C, III.E, Appendix A, Appendix B, Appendix G
Water Quality	I.A, I.C, I.D, I.F, I.G, II.B, II.C, III.A, III.B, III.C, III.D, III.E, III.H, III.L, IV.B, IV.C, IV.E, IV.G, IV.H, Appendix A, Appendix B, Appendix C, Appendix D, Appendix F, Appendix G
Well Water	Appendix B, Appendix G
Wetland	I.G, II.A, II.C, II.D, III.A, III.C, III.D, III.F, IV.B, IV.I, Appendix A, Appendix B, Appendix D, Appendix F
Wildlife	I.A, I.C, I.F, I.G, II.A, II.B, II.C, III.A, III.B, III.C, III.D, III.F, IV,A, IV.B, IV.C, IV.D, IV.E, IV.G, IV.H, IV.J, IV.K, Appendix A, Appendix B, Appendix F, Appendix I, Appendix L