U.S. Department of the Interior
Office of Surface Mining
Reclamation and Enforcement

North Cumberland Wildlife Management Area

Tennessee Lands Unsuitable for Mining
Draft Petition Evaluation Document / Environmental Impact Statement
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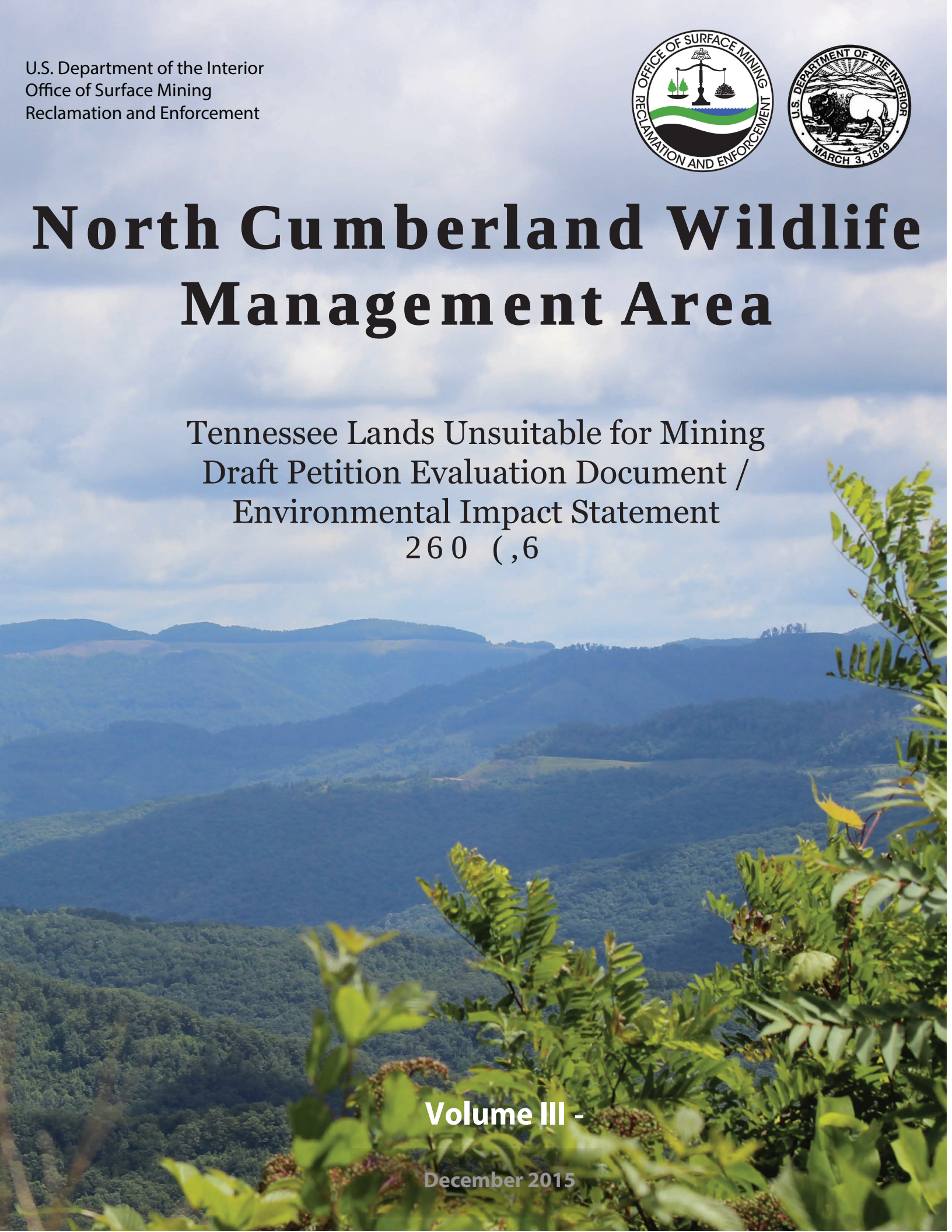

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APPENDIX A: SCOPING REPORT: PETITION EVALUATION DOCUMENT/ENVIRONMENTAL IMPACT STATEMENT NORTH CUMBERLAND WILDLIFE MANAGEMENT AREA AND EMORY TRACT CONSERVATION EASEMENT

DEPARTMENT OF INTERIOR

OFFICE OF SURFACE MINING

SCOPING REPORT : PETITION EVALUATION DOCUMENT/ENVIRONMENTAL IMPACT STATEMENT NORTH CUMBERLAND WILDLIFE MANAGEMENT AREA AND EMORY TRACT CONSERVATION EASEMENT

SCOPING REPORT

Introduction:

The Office of Surface Mining Reclamation and Enforcement (OSM) is the regulatory authority in the State of Tennessee responsible for implementing the Surface Mining Control and Reclamation Act (SMCRA). Pursuant to § 522(c) of SMCRA, any person having an interest which is or may be adversely affected shall have the right to petition the applicable regulatory authority to have an area designated as unsuitable for surface coal mining operations. The regulatory authority is mandated to designate an area unsuitable for all or certain types of surface coal mining operations if it determines that reclamation according to the requirements of SMCRA is not technologically and economically feasible pursuant to § 522(a)(2). Under the following subsections of § 522(a)(3), a surface area may be designated unsuitable for certain types of surface coal mining operations if such operations will:

(A) be incompatible with existing State or local land use plans or programs; or,

(B) affect fragile or historic lands in which such operation could result in sufficient damage to important historic, cultural, scientific and esthetic values and natural systems; or,

(C) affect renewable resource lands in which such operations could result in a substantial loss or reduction of long range productivity of water supply or of food or fiber products, and such lands to include aquifer recharge areas; or,

(D) affect natural hazard lands in which such operations could substantially endanger life and property, such lands to include areas subject to frequent flooding and areas of unstable geology.

By letter dated September 30, 2010, the State of Tennessee filed with OSM a petition to designate certain lands in the North Cumberland Wildlife Management Area (WMA) and the Emory River Tracts Conservation Easement area in Anderson, Campbell, Morgan, and Scott Counties, hereinafter collectively referred to as "the petition area", as unsuitable for surface coal mining operations. The State filed the petition on behalf of the Tennessee Wildlife Resources Agency (TWRA) and Tennessee Department of Environment and Conservation (TDEC) under OSM's Federal program to regulate surface mining operations within Tennessee (30 CFR Part 942). Based on the provisions listed under A and B above, the State of Tennessee alleges that it has an interest which may be adversely affected by surface coal mining operations and the State has asked OSM to designate the petition area as unsuitable for surface coal mining operations.

OSM responded to the petitioners by letter dated October 29, 2010, with a request for additional information in order to finalize the completeness review. The petitioners responded to OSM's

request on November 8, 2010. OSM reviewed the additional information and the petition was deemed administratively complete and accepted for processing on November 23, 2010.

OSM proceeded to process the petition by mailing notices on January 14, 2011, to the petitioners, interested State and Federal agencies, landowners and other interested parties that the petition has been accepted for processing. The parties were also notified that the action on the petition is a major Federal action and would require OSM to prepare a combined Petition Evaluation Document /Environmental Impact Statement (PED/EIS). OSM announced the acceptance of the petition to the public through legal notices in the local newspapers. In addition, the petition was made available for review at the OSM Knoxville Field Office; the Anderson County Planning and Zoning Office in Clinton, TN; the Morgan County Clerk's Office in Wartburg, TN; the Campbell County Mayor's Office in Jacksboro, TN; and, the Scott County Assessor of Property Office in Huntsville, TN.

The Scope of the PED/ EIS:

The North Cumberland WMA comprises the Royal Blue, Sundquist, and New River WMAs, in addition to the Emory River Tracts Conservation Easement. The total acreage for the North Cumberland WMA is approximately 167,075 acres. The petition area as submitted by the State consists of approximately 67,326 acres, which is defined by the ridgelines that lie within the North Cumberland WMA. The lands unsuitable designation would prevent surface coal mining activities within 600 feet on each side of the ridgelines; thus, creating a 1,200 foot ridge-top buffer zone for all ridge lines within the petition area. The scope of the PED/EIS proposes to evaluate the environmental impacts of each of the alternatives (see Alternatives below) on the existing environment for the entire petition area and not just the ridgelines located within the WMA boundaries. The table below represents the acreage for the four tracts that defines the petition area and the area that will be evaluated in the PED/EIS.

Petition Area Units	Acreage[1]
Sundquist Unit	75,000
New River Unit	23,200
Royal Blue Unit	50,000
Conservation Easement on Emory River Tracts	18,875
Total Acreage: North Cumberland WMA including the Emory River Tracts Conservation Easement	167,075

[1] Stan Stooksbury, Area Manager TWRA; Gina Hancock, State Director Nature Conservancy in Tennessee

Alternatives:

OSM proposed three primary alternatives in the public notice for the scoping meetings for consideration by the public as part of the evaluation for the PED/EIS. The alternatives are listed in the following table:

Alternative #	Alternative Description
1	Designate the entire petition area as unsuitable for surface coal mining operations.
2	Do not designate any of the area as unsuitable for surface coal mining operations.
3	Designate parts of the petition area as unsuitable for all or certain types of surface coal mining operations.

Scoping Process:

OSM prepared a Notice of Intent in the Federal Register (76 FR 6825) to request public participation in determining the scope, alternatives and other significant issues relating to the preparation of the PED/EIS. A Federal Register was published on February 8, 2011. OSM also provided public notice in the Tennessee Administrative Register, and that announcement was published on February 3, 2011.

On February 23, 2011, OSM mailed 794 notices to the petitioners, interested State and Federal agencies, landowners, intervenors, and other interested parties to announce the date, time and place for the scoping meetings. The general public was notified via legal announcements for the receipt of public comments in accordance with 30 CFR 764.15(b)(2) of the federal regulations. The newspaper advertisements were placed once a week for two consecutive weeks in the local newspaper of the petition area. Scoping meetings were held in three of the four counties of the petition area.

Notices of the scoping meetings were advertised by other media outlets. Several special interest groups and organizations published announcements in their newsletters, websites, and through social networking services. Statewide newspapers in Nashville, Knoxville and Chattanooga provided articles related to the meetings in addition to coverage on local news, WVLT Channel 8, in Knoxville.

The following table contains information regarding the newspapers and publishing dates for the meetings:

Newspaper	Date Published
Clinton Courier News	February 27, 2011 March 6, 2011
Lafollette News	February 24, 2011 March 3, 2011
Morgan County News	February 23, 2011 March 2, 2011
Scott County News	February 24, 2011 March 3, 2011
Knoxville News Sentinel	February 27, 2011 March 6, 2011

The public meetings were held in Scott, Campbell and Anderson Counties. The meeting locations, number of attendees and speakers are listed in the following table:

MEETING LOCATIONS	DATE	SPEAKERS	ATTENDEES
Huntsville Middle School	March 8 , 2011	17	66
Lafollette Middle School	March 10, 2011	40	164
Oak Ridge High School	March 15, 2011	24	81

Many of the speakers at the meetings identified their preferred alternative and the majority expressed the need for an EIS to evaluate the petition area. In addition to the oral comments presented at the meetings, written comments were received and evaluated. Permanent records for each meeting were prepared using a court stenographer.

Public Comments Submitted:

In addition to requesting that written comments be submitted during the open comment period from February 3, 2011 to April 14, 2011, we accepted written comments at each of the scoping meetings as well as by mail and by e-mail.

A total of 25,675 comments were received from the following sources:

Type of Comments Submitted	Number of Comments Submitted
E-mail	25,639
Mail	27
Hand Delivered	9

As listed above, a large number of comments were received via e-mail at the TNLUM@osmre.gov account.

These comments were characterized as follows:

1) 25,116 messages submitted as a duplicate form letter;
2) 333 messages submitted via excel spreadsheets by the Statewide Organization for Community eMpowerment (SOCM); the spreadsheets listed each individual's comments and,
3) 226 messages submitted by other interested individuals and other concerned entities/organizations that appeared unique in origin.

The following procedure was used to process the comments from the public and government contributors:

1) All comments were tracked and logged into the administrative files.

2) All written and oral comments (from transcripts) were reviewed by OSM technical specialists in the Knoxville Field Office.

3) Comments were grouped into topical categories according to the subject matter for consideration in the analysis of the PED/EIS.

4) The comments within each of the topical categories were then summarized. This collective summary is included as Attachment A.

All comments will be considered in the scoping process for the preparation of the PED/EIS. All comments including a representation of duplicative comments will be filed in the administrative record for this petition.

Attachment A: Categories for Scoping Comments

Category	Major Themes of Scoping Comments
Acquired Property	• Verify the number of acres owned by the State (127,000 acres) and, verify the number of acres given under easement rights for the conservation initiative. What is the acreage for the petition area? • The State and Federal Government should purchase the area and the coal they seek to lock up, preventing the production of energy to our country. • The Nature Conservancy (TNC) believes its current financial investment of $10 million and its ability to raise the necessary public capital to retire the debt would be protected by implementing the State's petition to classify the petition area as Unsuitable for Surface Mining. • OSM should consider reviewing all legal agreements made between the State and the mineral owners.
Air Quality Including Visibility	• Evaluate the impacts of mine dust pollutants from blasting, coal truck traffic, mining equipment, etc. • Determine the need to assess air impacts.

Biology	• OSM needs to do an EIS because the petition is sufficiently significant and covers a significant portion of a biologically valuable part of Tennessee. The lands subject to the State's petition have been identified by the State of Tennessee's Comprehensive Wildlife Strategy and TNC's Cumberland/Southern Ridge & Valley eco-regional planning effort as a priority action area, ranking high or very high for both aquatic and terrestrial biological diversity. • The wildlife management areas are rich in biodiversity; mining would destroy this important habitat and make the protection and preservation of the area impossible. • OSM should analyze long-term benefits of intact ridge lines versus the fragmentation of habitat on biological communities. • Consider the findings of the previous Flat Fork Creek unsuitability petition regarding the impacts to a biologically important reference creek in a heavily-mined area. • There is recent evidence to suggest that biodiversity declines in aquatic animals are related to increases in specific conductivity in streams draining coal mine areas.

Ecology	• Evaluate the potential impacts of mining on stream biology, the biodiversity and other organisms that may exist within the wildlife management area (WMA). Evaluate ecologically significant or critical areas under Federal ownership/jurisdiction. • Review all reputable, peer-review studies, other than those funded by the coal industry, show that considerable ecological, economic and public health damage is prox*i*mately caused by coal mining activities. • The lands included in the petition area constitute an ecological treasure and ecological treasures offer great potential for tourism, which when actualized will result in substantial renewable revenues as opposed to finite revenues that are terminated when the natural resources are depleted. • If you protect the habitat of the Cerulean Warbler in the petition area, you will also protect the habitats of many other species that are ecologically important.

Economics	• Mining over the years has created jobs for the local people. Unemployment in the Huntsville area is one of worst situations in the State and Nation. • Tennessee's watersheds are becoming just as much an economic importance as energy resources to the State. • The Tennessee economy depends on a healthy water supply and water resources from surrounding watersheds for future economic growth and job creation in rural communities in the Tennessee coal fields. • It is a shame to waste or avoid using the coal energy resources in our back yard when our whole country needs energy at a reasonable cost to the consumer. • Coal provides approximately 60% of our electricity. • The coal industry has always created taxes, both for our local government and the State government. • The citizens of Morgan County believe that lack of property control by the State is one of the factors that contribute to their county's lack of economic development and growth. • Scott County unemployment at the end of 2010 was 20.4 percent, the highest in the State. Responsible mining can reduce that rate. • Evaluate the impact to privately-held lands adjacent to any lands designated unsuitable for mining • Review the following documents "U. S. Energy Information Administration; Independent Statistic and Analysis – Domestic and Foreign Distribution of U.S. Coal by State of Origin, 2009" and "The impacts of Coal on the Tennessee State Budget."

Ecosystem	• Evaluate the natural environment between the habitats, living resources, and the residents in the petition area. • Evaluate the value of mature hardwood forest in the ecosystem.
Environmental Justice	• Environmental Justice is a NEPA requirement and must be evaluated. • Evaluate the potential impacts that surface mining will have on low income communities in the vicinity of the petition area; community and regional growth and; current population trends of the local communities.

Esthetics and Viewsheds	• Evaluate the impacts of surface coal mining on pristine areas, breath taking vistas, and analyze long-term benefits of intact ridge lines and viewsheds including the Cumberland Mountain State Park. • While a reclaimed mountain is certainly better than one laid bare and abandoned, a reclaimed mountain looks like an interstate median with sediment ponds and rock gullies. It's not even remotely simi*l*ar to a God-made moun*t*ain. • The petition claims that mining would distract from the recreational value of the Interstate 75 corridor described as a popular scenic drive for tourists as it bisects Royal Blue WMA. In fact, the views from I-75 depict prelaw orphan mining high walls that can be corrected if re-mining permits are continued. • Runners in an annual organized trail race on the Cumberland Trail through the North Cumberland WMA appreciate the sense of remoteness that can't be found in many places. They prefer running through mature forests and not through clear cut areas where new highwalls can be seen. They have been thrilled to see elk and bobcat. The race couldn't be done without the nice viewsheds. • I rarely climb all the way to Frozen Head Tower on a clear day because the views of the nearby ridges mangled by mining are depressing.

Forestland	• Evaluate how mining encourages clear cutting and destroys forestlands and the existing diversity. • Consider placing restrictions on tree cutting. • Evaluate the negative impacts of forest fragmentation. • Evaluate the forest composition, the age classes and the succession stages of the trees in the WMA. • Deforestation and blowing off the tops of mountains is not appropriate use of the land. The process leaves behind a barren wasteland that will never be useful again. • The petitioner assumes that surface mining "destroys the forest" but, does not take into account successful efforts by OSM to address this concern through use of the forest reclamation approach. • Reclamation of mined land leaves the land in better condition than logging. • Analyze the connectivity of the forest at edges; forest composition, age classes, and successional stages; and the impacts of invasive plants and insects, particularly on mine sites. • Assess the impact on non-timber forest resources such as roots and herbs. • Consider the loss of marketable timber and high-quality timber growing on ridge tops. • Miners in Tennessee are the number one planters of hardwood forests.

Fragile Lands	• Evaluate the impacts of surface coal mining on pristine areas seen from viewsheds and potential impacts to the Cumberland Trail State Park. • The petitioner lists the Cu*m*berland Trail State Park as a fragile land, but surface coal mining operations are already prohibited in public parks by virtue of SMCRA section 522(e)(3). • The petitioner fails to demonstrate that the petition area contains fragile lands that will be significantly damaged by mining.
Geology	• There is need to assess the geologic data collection and analysis for acid and toxic forming materials found in the petition area. • Conduct o extensive geological studies because of numerous landslides in post-law surface mines, including Smoky Creek and Lawson Mountain, which are right along the Cumberland Trail. • From a slope stability standpoint, assess the risks and benefits of leaving ridge lines intact both in the petition area and in downstream areas. • Analyze the geologic and tenable character of soil, rocks, and minerals in the petition area, including the potential for creation of acid-mine drainage and toxic pollutants such as selenium and other known constituents of coal and the rock layers above and below the seams. • OSM must evaluate the amount of coal deposits that would be unattainable if the Petition is granted.

Historic and Cultural Resources	• Evaluate the long and short term impacts of mining on any monuments, archaeological sites historic site(s) and land(s) of native Americans national landmarks etc., located within the WMA, and the local community. • Located within the petition area. • There are 9 recorded archaeological sites within the proposed tracts. Seven (7) are prehistoric in nature; one (1) site has both prehistoric and historical remains.

Hydrology	• The need to assess the ability of surface coal mining to protect from "material damage to the hydrologic balance outside the permit area" from long and short term impacts. Section 510(b) (3) demands that the agency make an affirmative finding that the proposed mining will not cause material damage including flooding. As such more extensive baseline hydrology data should be collected for the petition area. • Designating all of the petition area unsuitable for mining would support the Connecting the Cumberland project and help ensure that the 27,000 Tennessee residents who depend on drinking water from the New River and Emory River watersheds (Tennessee and Cumberland River basins and further downstream) will not be threatened by mining pollution by sedimentation and acid mine drainage caused by runoff from surface mine steep slope coal extraction. • There are water bodies within the affected region identified by the State of Tennessee as being impaired and listed on the State's 2008 303(d) list requiring that draft Total Maximum Daily Load (TMDLs) studies be developed. • Permit applications are site specific and require considerable engineering to meet the current OSM regulations. Consider an alternative where re-mining operations can occur. Surface coal mining in compliance with all laws that used contemporary mining methods will not impact water quality but can improve waters impacted by previous mining. • OSM needs to analyze the streams draining the petition area for the potential for acid mine drainage, discharges with selenium, elevated levels of total dissolved solids, and excessive sedimentation to be created from at surface mines. Consider the potential for water percolating through mine sites to bypass the ponds and enter the stream below the mine site. • The EIS should address potential water quality changes with mining within the petition area and the effects on aquatic resources of the Big South Fork and Obed River. • New River and Clear Fork along with other tributaries and the main stem Big South Fork in the National River and Recreational Area (NRRA) are listed as Critical Habitat. • The entire Obed WSR system has been designated as critical habitat for the spotfin chub under the endangered Species Act.

Land Use	• Evaluate the impacts of mining on the existing conservation efforts and the future land use plans. • Evaluate the environmental impacts from oil and gas drillings, forestry operations, and road construction. • Determine if the recreational, scenic and economic values of our property would be diminished by surface mining on the surrounding tracts. • Surface mining of surrounding lands would significantly damage the conservation values of TNC's property. • The EIS should evaluate the impacts on prime farmland in the petition area. The EIS should evaluate the activities that precede or are an integral part to mining such as clear cutting, haul roads, tipples, processing plants, waste impoundments, real estate development, and industrial development. (move to land use)

Mining and Reclamation	• Evaluate the impacts of allowing all or certain types of mining operations in the petition area and compatibility with the State's Conservation Plan including the "Connecting the Cumberlands" conservation project. • Assess mining company's ability to reclaim. • Evaluate the impacts of mining on prime farmland, returning lands to the original elevation and configuration, in steep slopes. • Evaluate the number of previous and existing mining operations in the petition area and identify any significant impacts. • Evaluate the value and impacts of roads and access to most of the WMA which are enjoyed by the public. • Some areas should not be mined near branches and unstable areas, but banning all surface mining will not be in the best interest of the landowner. • Mining is already occurring in the petition area, and is being carried out in accordance with SMCRA. • Designation of lands unsuitable for mining would prevent the re-mining of abandoned mine land and the reclamation of miles of orphan high walls. • Ninety-five percent of the coal mining in Tennessee is re-mining, which results in the reclamation of exposed abandoned highwalls, improves water quality, and provides for reforestation and vegetation for wildlife. • The findings of OSM's 1985 EIS are still valid. Cumulative topographic impacts to the region would be largely beneficial because a large percentage of mining would occur on un-reclaimed benches that would at least partially be restored to pre-mining topography. Re-mining would result in an overall reduction in sediment discharge and acid mine drainage. • Re-mining of abandoned mines results in reclamation of abandoned mine highwall that are safety hazards to hunters and hikers. • Prelaw benches have increased the value of my land because hunters camp on the flat areas; I am considering constructing cabins on the benches that I would rent to hunters.

Mining and Reclamation *cont'd*	• Implementation of the regulations adequately protects the environment. • Mines in Tennessee are under bonded, and as a result areas are not restored when operators walk away. • Impacts of mining the Tennessee Valley Authority (TVA)-owned coal will not likely occur because TVA never issued an EIS on the Kopper's Deposit and because it has announced its intention to retire 4,000 megawatts of coal-fired generation. • OSM must take into consideration that contemporary mining practice does not leave highwall, un-reclaimed surfaces and polluted water. • OSM must consider the amount of coal in the Petition area subject to re-mining. • Considerations should be given to the adverse impacts of the inability to re-mine. • The elimination of mining in the Petition area will stop the post-mining land use planning currently underway in coordination with TWRA and other entities. • Coal mining companies are the only answer for reclaiming abandoned coal mines and highwalls. The State of Tennessee does not have the funds to do so. The SMCRA abandoned mine land fund will not be adequate to reclaim these lands if we're not buying coal because AML money comes from a fee levied on mined coal. • Analyze whether mining practices and available restoration technology are adequate to protect people and watershed ecosystems from potential short- and long-term adverse impacts.

Mountaintop Mining	• The residents of Tennessee do not want mountaintop removal allowed on our sensitive public lands and it is not worth the environmental degradation that will occur. • Until the time when these mined properties are all used for something beneficial, I would support to revoke permits on all mountaintop mining, cross ridge or other mines where the land is permanently destroyed. • Documented literature shows that mountaintop removal causes adverse hydrological effects to streams 1,000 times greater than the model OSM allows coal companies to use for permit applications. • Mountaintop removal mining is destructive not only to land and water but also to people living in coal communities. It destroys upper reaches of streams and causes pollution below. • Mountaintop mining is not occurring in Tennessee. • Valley fills, usually prevailing on mountaintop mining operations, are almost nonexistent here because of the stringent regulations already in place. • OSM must consider that Tennessee law already prohibits mountaintop removal mining.
Noise and Ground Vibration	• Evaluate the impacts of noise and vibrations from blasting; and, evaluate the noise generated from coal truck traffic, mining equipment, etc.

Public Health and Safety	• Evaluate the impacts of blasting, exposed highwalls and mining equipment on public health and safety. • Evaluate the impacts of mining on public/community facilities and services available in the WMA. • The EIS must consider the imminent danger to inhabitants of the urbanized areas, cities, towns, and the communities in the petition area. • Consider all reputable, peer-review studies, other than those funded by the coal industry, show that considerable ecological economic and public health damage is proximately caused by coal mining activities.
Recreation	• Evaluate the impacts of mining in the petition area on recreational activities (hunting, fishing, hiking, biking, sight-seeing, camping, bird-watching, ATVs, and many other sports and activities offered in the wildlife management area.) • Evaluate the impacts of mining with the protection afforded to the Cumberland Trails State Park. • Evaluate the impacts of mining on the existing aquatic resources, commercial and recreational fishing. • Evaluate the restoration of areas used for spiritual values of our Cumberland Mountains. • The analysis must include areas outside the petition area, including the Cumberland Trail State Park, Frozenhead State Park and Recreation Area, and Big South Fork National Park and Recreation Area. • Commenter submitted the following document for review, "State-Level Economics Contribution of Active Outdoor Recreation – Technical Report and Methods of Findings." • The Smokey Mountain Hiking Club, based in Knoxville, TN, has over 600 members. They sponsor outings in the petition area on the Cumberland Trail between Lafollette and Smokey Branch. This hiking club is one of the largest and most active outdoor recreation and conservation groups in the area.

Sedimentology	• There is not a method to adequately control sediment loads into the "waters of the state." • Mining releases both metals and sediment into watersheds. • The petition area is currently subject to heavy logging in which by itself is increasing sedimentation in streams causing loss of habitat and creating unsightly clear cuts. • Sedimentation or water quality impacts related to coal mining runoff could affect the primary elements considered important when delineating the Designated Critical Habitat for aquatic species.
Socioeconomics	• The EIS must consider socioeconomic items. • There is a need to address the different financial cost and environmental cost in the petition area. Consider the long and short term economic impacts that will affect the counties in Tennessee. • TN's watersheds are becoming just as much an economic importance as energy resources to the state. • Hikers on the Cumberland Trail support businesses outside the park that would otherwise not exist. • The coal industry stimulates the economy through its employment of persons and payment of taxes. • Assess the full cost of coal and its threat on other economic activity (tourism, wildlife management, and recreation). • County residents would lose revenue from a reduction in coal severance tax. In Campbell County alone, property tax rates would have to be raised by 7 cents in order to recoup the $4,000 that's currently paid by each coal miner.

Socioeconomics cont'd	• According to a National Park Service 2005 report, recreational activities such as hunting, camping, fishing, and enjoying nature's bounty in the area annually contribute $10 to $16 million to the economy. If the water and land are destroyed by mining, these revenues will be lost. • Ecotourism plays in a sustainable future for the economy of Morgan County. That future will not happen if the designated area does not receive the protections afforded by the OSM approval of this petition. • Tennessee's coal production accounts for about $67 million in direct and indirect economic value. • Consider the "externalized costs" of mining, including road repairs, carbon dioxide levels in the atmosphere, downstream clean up and restoration of streams, filtration systems for affected drinking water, oil and gas drilling, and reduced real estate values. • Surface mining on petition ridge lines makes no economic sense when compared to the potential revenues that can be derived from preserving these lands in a pristine and unspoiled state for tourism and recreation. • For every coal miner you put out of work, you put about 60 other people out of work when you consider supporting industries and businesses • Assess the value of coal in the petition area and the coal severance tax that would be collected if the coal were mined. • Campbell County can't afford to lose any more jobs; in the absence of coal severance tax revenues, county taxes would probably have to be increased. • Outside of government, coal companies are the largest single contributors to rural school systems in east Tennessee. Without them, taxes would have to be increased. • Banning mining in the petition area would cause coal miners to lose their jobs and would cause the nearly 20 percent unemployment rates in surrounding counties to be even higher.

Socioeconomics *cont'd*	• Given the recent ownership transfer of National Coal Company properties and the subsequent termination of 115 or 120 coal miner jobs, the economic impact of designating the petition area unsuitable for mining would not be all that great. • Study the impacts outside the petition boundary, particularly on those municipalities and communities that might eventually be gateway communities for a long-term recreational capability. • Study the long-term economic, social, and cultural impacts of transitioning the area, which is one of the poorest in Tennessee, from the old boom-and-bust cycles of resource extraction to a more sustainable level of economic activity that would be generated by tourism and recreation.
Soil	• Evaluate the need to assess soils impacts in the petition area.
Streams	• OSM must take into consideration that Tennessee prohibits deposition of overburden as fill in valleys and headwater streams. • The Tennessee coal mining laws already prohibits mining through streams and the removal of coal within 100 feet of a stream. • The petition area is currently subjected to heavy logging which by itself is increasing sedimentation in streams causing loss of habitat and creating unsightly clear cuts. • An environmental impact statement should be prepared that analyzes the importance of headwater streams in watersheds.

Threatened and Endangered Species	• Assess the potential impacts of coal mining on are at least 24 animal species listed as endangered or threatened found on lands subject to the State's petition (including the Cerulean Warbler, Gray Bat, Indiana Bat Cumberland Bean, Cumberlandian combshell, Cumberland elktoe, Oyster mussel, purple bean and tan riffleshell endangered fish (Duskytail darter, Blackside Dace, Spotfin Chub and the Cumberland Darter). • Included within the Petition area are several other species (Cumberland Dusky Salamander, Ashy Darter, Cerulean Warbler, Golden-winged Warbler, Eastern Small-footed Bat, Northern Long-eared Bat and Rafinesque's Big-eared Bat).and other sensitive species. • OSM and FWS have signed a biological opinion which clearly states that surface mining operations conducted in accordance with SMCRA are not likely to result in the destruction or adverse mod*if*ication of designated or proposed critical habitat. • Mining has impacted vulnerable species in the Big South Fork, the park with the greatest number of threatened and endangered species of any park in the country. • Investigate the effect of the petition on the integrity of the forest area because it is one of the global hot spots for biological diversity and harbors rare and declining species that are dependent on forest interior habitat. • The Cerulean Warbler has declined about four percent per year for the past 60 years. The Cumberland Mountains are by far the best habitat for this bird on earth. A petition was filed under the Endangered Species act to list the Cerulean Warbler as threatened and endangered. This species was not listed, but it is likely that another petition will be submitted. • The area covered by the Lands Unsuitable for Mining Petition (LUMP) potentially supports one endangered and two threatened plants (Cumberland sandwort, Cumberland rosemary, and the Virginia spiraea). • The area covered by the LUMP potentially supports two endangered bats (Gray Bat and the Indiana Bat).

Tourism	• There is a need to assess how mining will impact tourism and the economy in the State of Tennessee. • The Connecting the Cumberlands project added 50,000 acres of new lands for public access. Visits to Frozen Head State Park increased by more than 20 percent during August 2009 to September 2010. • Assess impacts to recreationalists who enjoy the scenery and also hunting and fishing. • For every dollar spent in a State park, 37 are returned to the economy around the park from tourism. • Tourism will promote a sustainable economy if the vistas and waters are protected, but they might not continue if mountaintop mining occurs. • There are substantial revenue and jobs derived from tourism through the preservation of an intact landscape of the North Cumberland Plateau, including the Big South Fork, Obed Wild and Scenic River, Cumberland Trail State Park, and Frozenhead State Park and Natural Area. • In east Tennessee, the number one employer is tourism. In Campbell County, mining isn't even in the top 30. • Preserving Cerulean Warbler habitat promotes tourism. • Last year, runners from 11 States participated in an annual trail race that starts in Caryville and uses the Cumberland Trail and the North Cumberland Wildlife Management Area and economically benefit this area.
Wetlands	• Any impacts to wetlands or other sensitive aquatic resources should be clearly defined.

Wildlife Protection	• Evaluate the long and short term impacts of surface mining on wildlife habitat (including elk, fish, migratory birds and implementation of the State's wildlife habitat plan. • The petitioner fails to recognize the opportunities that are generated through the reclamation process that result in reclaimed coal mining lands supporting elk.

Wildlife Protection *cont'd*	• Wildlife continues to flourish in the area and is not driven out by mining. Mining creates edge boundaries and cover for most wildlife. • Habituate for species targeted by the conservation effort requires significantly larger tracts of un-fragmented forested habitat. • The Nature Conservancy (TNC) has been engaged in a long-term habitat conservation planning efforts with the Tennessee Wildlife Resources Agency (TWRA) and local government for the Connecting the Cumberlands area. • The EIS must consider evaluating any land use listed as Wildlife Refuge Areas. • Assess impacts on vulnerable resident and migrant species, including the Cerulean Warbler whose numbers have plummeted precipitously and whose core breeding habitat is located in the petition area. The petition area supports the highest nesting density of Cerulean Warblers anywhere in its breeding range. • In the petition, there are no presentations of fact or evidence that surface coal mining in the petition area is incompatible with conservation goals of the State. By its own admission, the State does not have a wildlife plan. • Surface coal mining on Hatfield Knob created elk, turkey, and deer habitat, and people from many States enjoy viewing the elk there. • If the petition area is designated unsuitable for mining, unemployed miners will probably hunt the elk for food and eliminate them.

Width of Petition Area	• Designate as unsuitable for mining an area 1,000 feet wide on each side of the ridge lines. • Designate as unsuitable for mining an area wider than the petition's 600 feet on each side of the ridge lines. • Consider a smaller petition area such as 300 feet which is the minimum buffer zone from a National Park, or 100 feet the distance SMCRA specifies for stream buffer zones. The Petition area is not properly defined. The Petition area not only encompass what appears to be ridge lines, but also streams, valleys, and features that under any contemporary definition of "ridge" would not be included.
Other	• Evaluate the "The New York Times" article "My Polluted Kentucky Home." and Article: "Death of a Mountain" Radical strip mining and the leveling of Appalachia. • Implement a plan to reclaim coal mines or previous disturbances located in the New River watershed. • The State purchased the Northern Cumberland WMA years ago, but did not purchase the mineral rights of that property. Granting the petition without proper compensation is illegal and in violation of existing contracts and must be evaluated. • Consider the physical and psychological health of communities and the spiritual value of mountains. There is no such thing as "clean coal," mining creates as much greenhouse gas.

APPENDIX B: STATE OF TENNESSEE NORTH CUMBERLAND WILDLIFE MANAGEMENT AREA LAND UNSUITABLE FOR MINING PETITION

STATE OF TENNESSEE

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September 30, 2010

RECEIVED
OCT 01 2010
OSM KNOXVILLE
FIELD OFFICE

VIA OVERNIGHT DELIVERY
Earl Bandy, Jr.
Field Office Director
Office of Surface Mining Reclamation and Enforcement
710 Locust Street, 2nd Floor
Knoxville, Tennessee 372902

RE: Petition to Designate Certain Lands Within the North Cumberland Wildlife Management Area and the Emory River Tracts Conservation Easement, Anderson, Campbell, Morgan and Scott Counties, Tennessee as Unsuitable for Surface Coal Mining Operations

Dear Mr. Bandy:

Enclosed please find a petition with exhibit on behalf of the State of Tennessee to designate as unsuitable for surface coal mining operations the area within 600 feet of all ridge lines lying within the North Cumberland Wildlife Management Area - comprised of the Royal Blue WMA, the Sundquist WMA, and the New River WMA – and the Emory River Tracts Conservation Easement, encompassing approximately 67,326 acres in Tennessee.

Sincerely,

Elizabeth P. McCarter
Senior Counsel
(615) 532-2582

Encls.

Reply To: Office of the Attorney General, Environmental Division
P. O. Box 20207, Nashville, Tennessee 37202
FAX: 615-741-8724

BEFORE THE U.S. DEPARTMENT OF THE INTERIOR
OFFICE OF SURFACE MINING

In re Designation of Certain Lands	)
Within the North Cumberland	)
Wildlife Management Area and the	)
Emory River Tracts Conservation	)
Easement, Anderson, Campbell, Morgan	)
and Scott Counties, Tennessee as	)
Unsuitable for Surface Coal Mining	)
Operations.	)

PETITION

Petitioner, the State of Tennessee , in accordance with section 522 of the Surface Mining Control and Reclamation Act of 1977, 30 U.S.C. § 1272 ("SMCRA"), petitions the United States Department of the Interior, Office of Surface Mining ("OSM"), to designate as unsuitable for surface coal mining operations the area within 600 feet of all ridge lines lying within the North Cumberland Wildlife Management Area ("WMA") - comprised of the Royal Blue WMA, the Sundquist WMA, and the New River WMA (also known as the Brimstone Tract Conservation Easement) – and the Emory River Tracts Conservation Easement [hereinafter referred to as the "petition area"], encompassing approximately 67,326 acres. [1]

In 2007, the State of Tennessee completed an ambitious conservation project, referred to as "Connecting the Cumberlands," which resulted in the protection of new public lands that connect to the existing public lands of the Royal Blue WMA, Sundquist WMA, and Frozen Head State Park and Natural Area. The project, located in Scott, Campbell, Anderson, and Morgan Counties, provides public access rights on approximately 127,000 acres and is the largest conservation transaction in the state since the creation of the Great Smoky Mountains National

[1] A map of the petition area is included in Exhibit A.

Park in the 1930s. In Governor Bredesen's words, the project gave the state "a rare, once-in-a-lifetime opportunity to protect ecologically significant woodlands on a large scale and make them available for recreation [and] also help protect our air and water quality and wildlife habitat, as well as the natural beauty and cultural heritage that make our state uniquely Tennessee."[2] He further described the project as an investment that will support tourism and the economies of some of the state's most rural areas, "while at the same time ensuring this land is protected for the benefit of Tennesseans for generations into the future."[3]

SMCRA was enacted, in part, to "establish a nationwide program to protect society and the environment from the adverse effects of surface coal mining operations" and to "assure that the rights of surface landowners and other persons with a legal interest in the land or appurtenances thereto are fully protected from such operations." 30 U.S.C. §1202(a), (b). Congress recognized that all surface mining operations, regardless of the permitting requirements and performance standards in place, inherently have adverse social, economic, and environmental effects.[4] Accordingly, Congress enacted section 522, specifically recognizing that in some circumstances "coal surface mining should give [way] to competing uses of higher benefit."[5] As the petition shows, protecting the conservation values and recreational values of the public lands for the benefit of generations to come is a "higher benefit" that should prevail over surface coal mining.

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[2] Press Release, Tennessee Department of Environment and Conservation, Bredesen Celebrates Historic Land Acquisition for Tennessee (Nov. 8, 2007), *available at* http:/www.state.tn.us/environment/news/release/2007/Nov/cumberlands.shtml.

[3] *Id.*

[4] *See* U.S.C.§ 1201(e) (finding that effective and reasonable regulation of surface coal mining operations will merely minimize "the adverse social, economic, and environmental effects of such mining operations").

[5] U.S. H.R. Rep. No. 95-218, at 94 (1977); *see also* Areas Unsuitable for Surface Coal Mining, 48 Fed. Reg. 41312, 41312 (Oct. 14, 1983).

Section 522(c) of SMCRA allows any person having an interest which is or may be adversely affected by surface coal mining to petition to have an area designated as unsuitable for surface coal mining operations. 30 U.S.C. §1272(c). The SMCRA regulatory program for Tennessee is set out at 30 C.F.R. Part 942. In addition, 30 C.F.R. Parts 942.762 and 942.764 incorporate by reference OSM's criteria and procedures for considering a petition to designate non-federal lands as unsuitable. Under section 522(a)(3), OSM has the discretion to designate an area as unsuitable if such operations will:

> A) be incompatible with existing State or local land use plans or programs;
>
> B) affect fragile or historic lands in which such operations could result in significant damage to important historic, cultural, scientific, and esthetic values and natural systems;
>
> C) affect renewable resource lands in which such operations could result in a substantial loss or reduction of long-range productivity of water supply or of food or fiber products; or
>
> D) affect natural hazard lands in which such operations could substantially endanger life and property.

30 U.S.C. §1272(a)(3)(A)-(D).

Petitioner urges OSM to designate the petition area as unsuitable for surface coal mining operations based on the first two statutory criteria above because:

1) Surface mining operations in the petition area would be incompatible with the conservation goals of Tennessee's "Connecting the Cumberlands" project, as well as with various state land use plans, programs and strategies that govern and set goals for the lands within and downstream of the petition area, including Tennessee's Comprehensive Wildlife Conservation Strategy, the Management Plan for the Royal Blue WMA, the Management Plan for the Sundquist WMA, and the Tennessee State Recreation Plan. These plans have at their

core the preservation and improvement of wildlife habitat and recreational opportunities, and these goals would be seriously compromised by the inherent impacts of surface mining operations in the petition area; and

2) Surface mining operations in the petition area would significantly damage the natural systems and esthetic, recreational, cultural, and historic values of the ridge lines and their viewsheds that exist within these fragile lands, including the Cumberland Trail State Park, which traverses four counties within the petition area. The public is attracted to an intact landscape with the opportunities for hunting and wildlife viewing that such a corridor offers and surface mining in the petition area has the potential to destroy both the viewsheds and vital habitat for numerous sensitive species that exist in the petition area.

Although this petition does not otherwise discuss the criterion relating to the long-range productivity of a water supply, it is important to note that the State of Tennessee expressly recognized the protection of water quality in the New and Emory Rivers as one of the benefits of the "Connecting the Cumberlands" project. These rivers provide water for more than 27,000 Tennesseans in nine communities including Harriman, Kingston and Rockwood. [6]

Petitioner's Contact Information

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   Nashville, Tennessee 37204
   615-687-6577
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[6] *See* TDEC, North Cumberlands Acquisition; Public Benefits, *available at* http://tennessee.gov/environment/northcumb/benefits.shtml (last visited June 1, 2010).

2. Tennessee Department of Environment and Conservation
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Identification of the Petition Area

This petition seeks an unsuitability designation for all ridge lines lying within the North Cumberland WMA and the Emory River Tracts Conservation Easement ("Emory Tracts"). The North Cumberland WMA is the umbrella WMA created as a result of the 2007 "Connecting the Cumberlands" conservation project, consisting of the existing Royal Blue and Sundquist WMAs and the newly created New River WMA (also referred to as the Brimstone Tract). For clarity and ease of reference, this petition refers to the individual land units that comprise the North Cumberland WMA by their original or "unit" names—the Royal Blue WMA, the Sundquist WMA, and the New River WMA. The petition area includes approximately 600 feet on either side of the ridge lines within the North Cumberland WMA and the Emory River Tracts Conservation Easement encompassing approximately 67,326 acres in parts of four counties in Tennessee -- Anderson, Campbell, Morgan and Scott. The petition area is within the South Fork of the Cumberland, the Clear Fork of the Cumberland, and Upper Clinch watersheds, but does not include any areas where there currently is acid mine drainage to waters of the state. A Geographical Information Systems ("GIS") map of the petition area is attached to this petition as Exhibit A.

OSM's public records reveal that since 2005, the agency has issued numerous new mining permits for surface coal mining operations in the petition area. Further, the Tennessee Valley Authority ("TVA") still has under consideration a plan for managing its coal reserves underlying the Royal Blue WMA due to the increase in market demand for high-sulfur coal.[7] In 2003, TVA estimated that approximately 70 million tons of recoverable coal, including 28 million tons from surface mining and 42 million tons from deep mining, exist under the Royal Blue WMA.[8] In 2008, National Coal Corporation estimated the amount of recoverable coal beneath the Sundquist WMA to be at least 30 million tons.[9] These estimates, together with the number of surface mining permits already granted, as well as the mining infrastructure being put in place throughout the petition area, indicate ongoing and continued surface coal mining operations in the petition area for the foreseeable future.

Identification of Petitioner's Interests and Statement of How Surface Mining of the Area May Adversely Affect Those Interests

Petitioner, through the Tennessee Wildlife Resources Agency ("TWRA"), has full jurisdiction over the management, protection, propagation, and conservation of wildlife in Tennessee.[10] Toward these ends, TWRA manages lands and waters suitable for game, birds, fish and fur-bearing animal restoration, propagation, and protection, including the Royal Blue and Sundquist WMAs that comprise a portion of the North Cumberland WMA. Historically, surface mining within the New River watershed has adversely affected the Royal Blue and Sundquist

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[7] Tennessee Valley Authority, Notice of Intent, Environmental Impact Statement: Koppers Coal Reserve Management Plan, 68 Fed. Reg. 26,371 (May 15, 2003).
[8] *Id.* at 26,372.
[9] Dave Flessner, *Legislators debate higher taxes, controls as strip mining rebounds*, Chattanooga Times Free Press (April 7, 2008), *available at* http://www.timesfreepress.com/news/2008/apr/07/legislature-debates-higher-taxes-controls-strip-mi/?print.
[10] *See* Tenn. Code Ann. § 70-1-301.

WMAs through sediment loading, acid mine drainage and other impacts. Based upon recent trends at surface mining operations that have been fully regulated pursuant to the requirements of SMCRA, the impacts that would occur as a result of continued and renewed surface mining within the petition area can be expected to adversely affect the wildlife habitat within the New River watershed and adjacent areas through alterations of the soil and geologic structure, an elevated level of conductivity in surface water, noise, dust and vibration.

The cumulative impacts from past and current mining and, as discussed below, an expected increase in surface mining in the petition area will significantly impair wildlife habitat in the North Cumberland WMA through forest fragmentation, impacting pollution-sensitive species and the natural values of these wildlife corridors. TWRA's interests likewise would be threatened by damage to the recreational uses of the Royal Blue and Sundquist WMAs, both in terms of hunting opportunities and wildlife viewing. Consequently, surface mining in the petition area will adversely affect TWRA's management interests in protecting and propagating wildlife on these lands.

Petitioner, through the Tennessee Department of Environment and Conservation ("TDEC"), manages numerous state parks and state natural areas encompassing 175,000 acres across Tennessee. These include the Justin P. Wilson Cumberland Trail State Park ("CTSP"), the state's only linear park spanning 300 miles and traversing eleven counties in Tennessee, among them Anderson, Campbell, Morgan and Scott Counties, which are within the petition area.[11] TDEC, through its Division of Recreation Educational Services, is also responsible for providing assistance in the acquisition and conservation of land for recreational purposes, including the 2007 "Connecting the Cumberlands" project.

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[11] *See* TDEC , Tennessee State Parks, Justin P. Wilson Cumberland Trail State Park, *available at* http://tennessee.gov/environment/parks/CumberlandTrail.

Surface mining within the ridge lines of the North Cumberland WMA, created as a result of the "Connecting the Cumberlands" project, can be expected to significantly impair opportunities for public access and recreation within this unbroken core of protected land, which includes nearly 130,000 acres of majestic hardwood forests, mountains and streams. Surface coal mining operations in the CTSP, or within its viewscape, and other parts of the petition area could damage important natural systems and the cultural and esthetic values of these fragile lands, including various overlooks, viewsheds and gorges, thereby adversely affecting the public's experience of these important esthetic resources. TDEC's interests would therefore be threatened by damage to the viewscapes and recreational uses of the ridge lines in both the Cumberland Trail State Park and the North Cumberland WMA.

Allegations of Fact and Supporting Evidence

I. THE PETITION AREA SHOULD BE DESIGNATED UNSUITABLE FOR SURFACE COAL MINING OPERATIONS BECAUSE MINING IN THE AREA WOULD BE INCOMPATIBLE WITH EXISTING STATE OR LOCAL LAND USE PLANS OR PROGRAMS WITHIN THE MEANING OF 30 U.S.C. § 1272(a)(3)(A).

A. Surface Mining in the Petition Area is Incompatible with the State's Conservation Plan for this Area as Reflected in the 2007 "Connecting the Cumberlands" Conservation Project.

In 2007, Tennessee, in partnership with The Nature Conservancy and two conservation-oriented timber companies, acquired a mix of fee title and conservation easements to more than 127,000 acres of land.[12] Tennessee describes the acquisition as a "once-in-a-lifetime opportunity

[12] Tennessee Department of Environment and Conservation ("TDEC"), North Cumberlands Acquisition Fact Sheet, *available at* http://tennessee.gov/environment/northcumb/facts.shtml (last visited August 18, 2010). The conservation easements consist of 23,200 acres on the Brimstone tract and 18,875 acres on the Emory River tract. The State also acquired the timber rights to the Sundquist WMA's 75,000 acres of timber. *Id.* The State appropriated

to protect majestic woodlands on the Northern Cumberland Plateau that include some of the most important forests, mountains, streams and wildlife habitat remaining in North America. . . . The 'landscape scale' of this acquisition will . . . help preserve the purity of streams and rivers and provide a natural corridor for wildlife . . . ."[13] Further, "[o]ver the long term, establishing this unbroken core of protected land has the potential to enhance life in Tennessee through increased tourism, protection of unique forms of wildlife and their habitats, and opportunities for public access and recreation."[14] The Tennessee Senate recently passed a resolution extolling the virtues of the Cumberland Plateau and recognizing that its resources "represent valuable tourism assets which can, with proper stewardship, development, and management," contribute to local economies, as well as to the quality of life in the region.[15] Surface mining in the petition area is incompatible with this resolve and with Tennessee's goals for its 2007 "Connecting the Cumberlands" land acquisition.

As the name "Connecting the Cumberlands" reflects, the acquisition connects the newly acquired lands to the existing public lands of Frozen Head State Park and Natural Area, the Royal Blue WMA, and the Sundquist WMA to create a large expanse of unfragmented habitat.[16] The Cumberland Trail also traverses Frozen Head State Park and Natural Area and Royal Blue WMA, so the acquisition of this property provides an unbroken trail of approximately 90 miles through public lands that maintain "the visual esthetics for future generations of trail hikers." [17] The wildlife corridor that was created amounts to "300 square miles of protected forestland for

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$82 million out of a total estimated value of the project of $135 million. *Id.* The State's investment is "the largest of its kind in state history and the largest conservation appropriation by any one state in recent years." *Id.*

[13] TDEC, North Cumberlands Acquisition Fact Sheet, *available at* http://tennessee.gov/environment/northcumb/facts.shtml (last visited August 18, 2010).

[14] *Id.*

[15] Tennessee Senate Joint Resolution No. 980, May 5, 2010.

[16] Paul Kingsbury, *Connecting the Cumberlands*, The Tennessee Conservationist, January/February 2009, at 20 at 19, 22.

[17] Southern Cumberland Mountains: A TWRA Acquisition Priority, 2002, at 2.

black bear, elk, white-tailed deer, turkey and numerous migratory songbirds such as the cerulean warbler and the wood thrush."[18] The Nature Conservancy ranks this biologically rich area as the eighth most important place in the world.[19]

As the conservation easement documents indicate, one of the primary purposes of the easements is to protect the land's "Conservation Values," which include "native flora and fauna and the ecological processes that support them," "threatened and endangered animal species and other animals," "neotropical migrant songbirds," "wetland, riparian, and other aquatic habitats," and "biological diversity."[20] All forest management activities are required to be compatible with these purposes by emphasizing sustainable forestry principles, employing best management practices, and establishing "special management" or "conservation zones."[21] The easements establish these special conservation areas, including approximately 5,000 acres in the Brimstone tract that are predominantly ridge lines, to protect habitats and natural communities that support rare, threatened, or sensitive plant or animal species.[22] The easements also require that the grantor obtain certification of its forest management plan from the Forest Stewardship Council (FSC), or have an alternative program that meets FSC standards and that is mutually agreed upon by the grantor and the State.[23]

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[18] Paul Kingsbury, *Connecting the Cumberlands*, The Tennessee Conservationist, January/February 2009, at 19.
[19] TDEC North Cumberlands Acquisition; Public Benefits, *available at* http://tennessee.gov/environment/northcumb/benefits.shtml (last visited August 18, 2010).
[20] Sustainable Forestry Conservation Easement, "Brimstone Property" at 7; Conservation Easement, Emory Tract at 1-3.
[21] Sustainable Forestry Conservation Easement, "Brimstone Property" at 19, 23 (discussing "Conservation and Economic Objectives" and "Mandatory Forest Management Provisions"); Conservation Easement, Emory Tract at 14, 20 (discussing "Compliance with Forest Management Objectives" and "Special Management Zones" or "Conservation Zones").
[22] Sustainable Forestry Conservation Easement, "Brimstone Property" at 24 (discussing "Forest Management Exclusion Zones"); Conservation Easement, Emory Tract at 6, 20 (discussing "Special Management Zones or Conservation Zones").
[23] Sustainable Forestry Conservation Easement, "Brimstone Property" at 20-21; Conservation Easement, Emory Tract at 20-21.

Thus, the very purpose and vision of the State's "Connecting the Cumberlands" land acquisitions are to ensure the integrity and protection of these public lands on a landscape scale and to ensure that timbering is done on a sustainable basis, lessening forest fragmentation. The Emory River tract consists of approximately 18,800 acres and is the subject of the conservation easement between The Nature Conservancy, which owns the surface rights, and the State of Tennessee. Clearly, the State's policy for these public lands is to preserve them in large blocks in order to protect habitat and diversity and to avoid landscape fragmentation.

While the sustainable timbering practices required by the easements can be carried out consistently with the State's wildlife conservation plans, surface mining in the petition area cannot. Surface mining, together with the clear-cutting of forest that precedes it, directly damages wildlife and wildlife habitat within, surrounding, and downstream from the mined areas. Surface mining also fragments forests, directly conflicting with one of the State's explicit goals for the newly acquired areas. Such impacts occur even when mining is carried out in full compliance with SMCRA's permitting requirements and performance standards.

Surface mining operations in the petition area are also inconsistent with the State's goals of creating and enhancing recreational opportunities. The Commissioner of the Tennessee Department of Environment and Conservation ("TDEC") stressed that the project would "increase recreational opportunities such as hunting and fishing, as well as hiking, biking, horseback riding and wildlife viewing."[24] The State also repeatedly emphasized that all of the more than 127,000 acres involved in the project would be open to the public.[25] The acquisition

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[24] Press Release, Bredesen Celebrates Historic Land Acquisition For Tennessee, 8 Nov. 2007, *available at* http://tn.gov/environment/news/release/2007/Nov/cumberlands.shtml.

[25] *See, e.g.*, *id.* While the conservation easements allow for some closure in areas of active forest management where public safety would be threatened, they ensure that no more than 10% of the protected area will be closed at any time, once again indicating the importance the State places on recreation. Sustainable Forestry Conservation Easement, "Brimstone Property" at 29-30; Conservation Easement, Emory Tract at 26.

also directly advances the State's strategy, set forth in the Tennessee State Recreation Plan and "Tennessee 2020," a ten year plan for the future of Tennessee's parks and landscapes, of creating a Recreation Development Corridor in the Cumberland Plateau.[26] Similarly, TWRA's interests in promoting the recreational uses of the Royal Blue and Sundquist WMAs for hunting and wildlife viewing will be enhanced by this new project. Thus, the impacts of surface mining in the petition area, such as damage to scenic resources and viewscapes, noise, dust, and vibration, would all directly conflict with the State's plans for protecting the area for public recreation.

Finally, surface mining would undermine the State's plans for sustainable economic development. The State made clear that the "Connecting the Cumberlands" acquisition would not only preserve valuable natural lands but would also provide *long-term* support for local economies.[27] The keys to the State's long-term, sustainable economic development plans are preservation of the land's natural and ecological values that attract tourism[28] and management of forests for the permanent provision of valuable products and local jobs.[29] Unlike tourism and sustainable forestry, surface mining provides only short-term benefits, siphons the majority of profits out of the area, and leaves local communities with very few, if any, post-mining economic

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[26] *See* TDEC, The Tennessee State Recreation Plan 2003-2008 at 28-31 (Feb. 2004), *available at* http://tn.gov/environment/recreation/pdf/rec_plan_final.pdf; TDEC, Tennessee 2020; Vision for Parks, People & Landscapes, at 105-06 (31 March 2010), *available at* http://www.state.tn.us/environment/recreation/plan/.

[27] Press Release, Bredesen Celebrates Historic Land Acquisition For Tennessee, November 8, 2007, *available at* http://tn.gov/environment/news/release/2007/Nov/cumberlands.shtml ("We were able to . . . make investment that will support tourism and the economies of some of our most rural areas, while at the same time ensuring this land is protected for the benefit of Tennesseans *for generations into the future*.") (emphasis added).

[28] TDEC North Cumberlands Acquisition; Public Benefits, *available at* http://tennessee.gov/environment/northcumb/benefits.shtml (last visited August 18, 2010) ("the diversity of the Cumberland Mountains" is "a draw for hikers, bikers, camping and wildlife viewing"); TDEC, North Cumberlands Acquisition Fact Sheet, *available at* http://tennessee.gov/environment/northcumb/facts.shtml (last visited August 18, 2010) ("[E]stablishing this unbroken core of protected land has the potential to enhance life in Tennessee through increased tourism...").

[29] TDEC North Cumberlands Acquisition; Public Benefits, *available at* http://tennessee.gov/environment/northcumb/benefits.shtml (last visited August 18, 2010) ("Working lands provide local jobs"); TDEC, North Cumberlands Acquisition Fact Sheet, *available at* http://tennessee.gov/environment/northcumb/facts.shtml (last visited August 18, 2010) ("Conservation easements present an opportunity to protect not only the properties themselves but also the economic benefits they generate for local communities as working forests.").

opportunities.[30] Surface mining damages the natural and scenic values that attract tourism and destroys the forests that would provide a sustainable timber harvest.[31] For all of the above reasons, surface coal mining conflicts with the State's vision and plans for the lands involved in the "Connecting the Cumberlands" project.

B. Surface Mining in the Petition Area is Incompatible with the State Management Plans for Wildlife Management Areas.

Surface mining in the petition area is incompatible with the state's plans for its Wildlife Management Areas. Under Tennessee law, a "wildlife management area" is a specific area established "for the intensive management of both habitat and wildlife species for optimum enhancement and use by both consumptive and nonconsumptive users."[32] Although no comprehensive management plan has yet been developed for the new North Cumberland WMA, the Management Plan for the Royal Blue Wildlife Management Area ("Royal Blue Plan") currently provides guidance for a large portion of the WMA. As adopted in 1992, the Royal Blue Plan provides that "proper wildlife management" is the "highest priority."[33] While the Royal Blue Plan notes that mining has occurred and is envisioned to continue in the future,[34] it

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[30] *See, e.g.,* Mountain Association for Community Economic Development, The Economics of Coal in Kentucky: Current Impacts and Future Prospects, at 6 (25 June 2009) ("The top coal-producing counties have some of the highest poverty rates in the region. . . So while mining employment is extremely important as a source of income for individuals in coal-producing counties, the benefits of these jobs do not translate into prosperity for the region."). A recent study in Kentucky found that the coal industry actually costs the State nearly $115 million per year more than it brings in. Mountain Association for Community Economic Development, The Impact of Coal on the Kentucky State Budget, at 1 (25 June 2009), *available at* http://www.maced.org/coal/.

[31] Recognizing the damage wrought by surface coal mining on forests, both conservation easements prevent such mining by the Grantor. Sustainable Forestry Conservation Easement, "Brimstone Property" at 31. Conservation Easement, Emory Tract at 10.

[32] Tenn. Code Ann. § 70-1-101 (42).

[33] Royal Blue Plan at 32.

[34] *Id.* at 6, 23. Note, however, that at the time of the 1992 Plan there was only limited demand for the area's high-sulfur coal. *Id.* at 8. The development and installation of scrubbers to remove sulfur dioxide from coal-fired power plant emissions regulated under the Clean Air Act has increased the demand for such coal, meaning that mining could potentially occur at levels much higher than could have been envisioned by the Plan. *See, e.g.,* Dave Flessner,

also makes clear that mining must be environmentally sound and compatible with the wildlife-centered uses for which the WMA was created.[35] The Royal Blue Plan notes that mining should be limited to situations in which it can be done so as to ensure that wildlife habitat and water quality are not adversely impacted.[36] For numerous reasons discussed below, mining in the North Cumberland WMA cannot meet these requirements.

Surface mining operations in the petition area will impair human recreational and wildlife-viewing opportunities in the WMA. The Royal Blue Plan's list of goals for the WMA includes providing opportunities for "wildlife enjoyment," "plant and animal restoration," "non-wildlife associated recreation" and protection and management of "threatened and endangered flora and fauna."[37] Similarly, the mission statement for the Sundquist Wildlife Management Area ("Sundquist Plan"), provides that TWRA has a duty to manage and operate the surface area for "Conservation and Recreation," in a way that precludes development, sustains "a natural hardwood forest through time" by prohibiting "conversion to plantations" and conserving "biological diversity," and provides public recreational opportunities. [38] While both the Royal Blue and Sundquist WMAs include timbering in their management plans, it should be noted that neither plan allows clear-cutting on the massive scale that occurs with surface mining. Both plans seek to protect habitat through controlled timber harvest and progressive forestry programs.[39]

As discussed below in Part II, impacts of surface mining will have obvious adverse effects on wildlife enjoyment and wildlife viewing. Surface mining operations will degrade the

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Legislators Debate Higher Taxes, Controls as Strip Mining Rebounds, Chattanooga Times Free Press (April 7, 2008).

[35] Royal Blue Plan at 32.

[36] *Id.* at 4-5.

[37] *Id.* at 4.

[38] Sundquist Plan at 4.

[39] *See* Royal Blue Plan at 13, 25; Sundquist Plan at 4-5.

scenic resources of the WMA and result in noise and dust, further lowering the area's recreational value.[40] OSM has acknowledged the adverse effects of dust and noise on recreational use and the "correlation between recreational satisfaction and high scenic quality for outdoor recreation."[41] Thus, because surface mining operations in the North Cumberland WMA will significantly damage the wildlife-and-recreation-based uses of the WMAs, such operations would be incompatible with the State's goals for the WMAs and should therefore be declared unsuitable.

C. Surface Mining in the Petition Area is Incompatible with the State Plans for the Cumberland Trail, Tennessee Greenways and Trails Plan, and the Tennessee State Park Plans.

Information since OSM's January 13, 2006 Statement of Reasons (2006 SOR) on the petition filed by private parties further demonstrates that surface coal mining operations in the vicinity of the Smoky Mountain segment of the Cumberland Trail would conflict with the protection afforded the Cumberland Trail State Park. In 2008, the Greenways and Trails Advisory Council reiterated the national significance of the Cumberland Trail State Scenic Trail and State Park and emphasized that the continued development and eventual completion of the

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[40] Flat Fork Statement of Reasons at 10 ("[S]urface coal mining operations would diminish the esthetic values of proposed overlooks."); *Id.* at 15 ("[S]urface coal mining operations would be expected to affect the visual and noise quality of the . . . [a]rea, thus impacting the visitor's recreational experience."); Fall Creek Falls Statement of Reasons, 65 Fed. Reg. at 39183 (acknowledging that "noise, dust, and vibration" are inherent impacts of surface mining operations in compliance with SMCRA); Fern Lake Watershed Statement of Reasons, 61 Fed. Reg. 49793, 49796 (finding that surface mining degrades visual quality even in non-pristine areas that have been subject to earlier surface mining).

[41] Flat Fork Statement of Reasons at 15. *See* Fall Creek Falls Statement of Reasons, 65 Fed. Reg. at 39187 (impacts of dust and noise from surface coal mining operations in or near the Park would impair recreational use of Park land and could have a negative impact on Park visitation, affecting the economic viability of the Park and the surrounding area).

Cumberland Trail remains a priority of the Plan.[42] Surface mining would frustrate the goals of the Tennessee Greenways and Trails Plan and conflict with the management objectives for Tennessee State Parks.

The purpose of the Greenways and Trails Plan is to create an interconnected, accessible network of greenways and trails across Tennessee, with the Cumberland Trail as the "backbone" of this system.[43] Tennessee law requires that the Cumberland Trail, as a state scenic trail, be located so as "to provide maximum potential for the appreciation of natural areas and for the conservation and enjoyment of the significant scenic, historic, natural, ecological, geological or cultural qualities of the areas through which such trails may pass."[44] Because the Cumberland Trail is also a state park, Tennessee law requires that it "shall be preserved in a natural condition so far as may be consistent with its human use and safety, and all improvements shall be of such character as not to lessen its inherent recreational value."[45] Likewise, the park must be managed consistently with the mission of Tennessee State Parks, which is "[t]o preserve and protect, in perpetuity, [the] unique examples of natural, cultural, and scenic areas," represented by the parks.[46]

As explained below, surface mining in the petition area would harm the scenic, historic, natural, ecological and cultural qualities of the areas through which the Cumberland Trail passes. Any such impacts would also be in direct conflict with the State's mission to preserve and protect in perpetuity both the resources of the Cumberland Trail State Scenic Trail and State Park, as well as the public's recreational uses of the North Cumberland WMA. This includes

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[42] 2008 Tennessee Greenways and Trails Plan at 30, *available at* http://www.state.tn.us/environment/recreation/plan/gt_plan2008.pdf.
[43] 2001 Tennessee Greenways and Trails Plan at 7-8, *available at* http://www.tennessee.gov/environment/recreation/pdf/5_Greenways_Plan.pdf.
[44] Tenn. Code Ann. § 11-11-104(1).
[45] Tenn. Code Ann. § 11-3-102.
[46] Mission Statement, Tennessee State Parks Strategic Direction: a Vision for the Future (Aug. 2005), *available at* http://www.state.tn.us/environment/parks/pdf/StrategicDirect.pdf.

protection of at least two rare floral species found in the North Cumberland WMA. The Canada lily (*Lilium canadense*) occurs at both Royal Blue and Sundquist WMAs and is state-listed as threatened.[47] The Ozark bunchflower (*Melanthium woodii*) occurs about 500 feet down slope of the ridge line at Royal Blue WMA within a moist ravine. That species is state-listed as endangered, and the occurrence at Royal Blue WMA represents one of only nine known occurrences in Tennessee.[48] Within the same ravine as the Ozark bunchflower, there is an occurrence record of the state-threatened leatherleaf meadowrue (*Thalictrum coriaceum*). There are eight known occurrences in Tennessee, but four are considered historical (not observed within the last 25 years).[49]

Because SMCRA's permitting requirement's and performance standards do not provide sufficient protection to these resources, mining in the vicinity of the Trail would be incompatible with the Tennessee Greenways and Trails Plan as well as the enabling legislation and mission statement for Tennessee State Parks.

D. Surface Mining in the Petition Area is Incompatible with Tennessee's Comprehensive Wildlife Conservation Strategy.

Mining in the petition area is incompatible with Tennessee's Comprehensive Wildlife Conservation Strategy ("CWCS"), also sometimes referred to as the State Wildlife Action Plan ("SWAP").[50] The primary goal of the CWCS is to prevent nongame wildlife within the state

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[47] Tennessee Department of Environment and Conservation, Natural Heritage Program (2010), Tennessee Natural Heritage Inventory Database, Nashville, Tennessee.
[48] *Id.*
[49] *Id.*
[50] Congress required each state to complete a Comprehensive Wildlife Conservation Strategy to ensure that state conservation programs funded under the federal "State Wildlife Grants Program" are designed to maximize benefits to nongame wildlife. TWRA, "Tennessee's State Wildlife Action Plan," *available at* http://www.tennessee.gov/twra/cwcs/tncwcs2005.pdf and http://www. tennessee.gov/twra/cwcs/tncwcs2005app.pdf (last visited September 16, 2010).

from declining to the point of endangerment.[51] The plan proceeds through a number of steps before ultimately arriving at a set of specific "priorities for conservation action."[52] First, the CWCS categorizes habitat across the state based on the value of the habitat to those species deemed to have the greatest conservation need ("GCN" species). Habitat value is ranked separately for terrestrial, aquatic and subterranean species.

Second, the CWCS assesses "priority problems" for GCN species occurring within particular terrestrial, aquatic and subterranean regions within the state. Finally, after exploring the primary sources of stress impacting imperiled species in the major regions of the state, the CWCS identifies the conservation actions that are likely to be most effective in addressing the priority problems across the state. The CWCS describes some of the GCN species in the petition area that would be harmed as a result of surface mining in the petition area. The ridge lines of this petition area unite the North Cumberlands and provide a contiguous corridor for these animals.

Continued surface mining within the petition area would be incompatible with several of the CWCS's priority conservation actions, as determined by the process described above. According to the CWCS, much of the habitat within the petition area is of 'very high' and 'high' importance to the 'first tier' of terrestrial and aquatic GCN species, respectively.[53] Further, the CWCS identifies coal mining activities as a particularly problematic source of habitat destruction in the state's Cumberland region, which encompasses the petition area.[54] The CWCS states, for

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[51] *Id.*
[52] CWCS at 30.
[53] The CWCS categorizes habitat across the state into four classes: 'Very High', 'High', 'Medium' and 'Low.' *Id.* at 82-83, 88, 92 (Maps 7 and 11). "First tier" species are those defined as wildlife by Tennessee law, excluding federally listed and game species. *Id.* at 44.
[54] *Id.* at 118-119.

example, "construction of roads and other infrastructure necessary for access to coal mines…can be very damaging to terrestrial habitats."[55]

To combat the damaging effects of surface mining on terrestrial and aquatic habitat and GCN species, the CWCS identifies specific statewide priority conservation actions. Significantly, the top two strategies for abating the effects of incompatible mining practices are: 1) "Propose/support state legislation urging the federal Office of Surface Mining to designate critical units of aquatic, subterranean, and terrestrial habitats as 'lands unsuitable for mining'"; and 2) "Encourage the federal Office of Surface Mining to designate critical units of aquatic, subterranean, and terrestrial habitats as 'lands unsuitable for mining' under current federal policy guidelines."[56] Therefore, the CWCS finds that preventing surface mining by designating the most valuable habitats in the state – such as the petition area – as "lands unsuitable for mining" is the best action for combating mining's serious adverse impacts on these habitats and GCN species.

It follows that allowing further surface mining in the petition area would be incompatible with the CWCS. OSM dismissed this allegation in 2006 by improperly accusing the private petitioners of misstating the CWCS's first proposed conservation action.[57] OSM cited the abbreviated description of the proposed conservation action used in Table 65 to support this assertion. However, the petitioners' characterization of the proposed conservation action was drawn from the "full description" contained in Appendix F, which states, "Propose/support state legislation urging the federal Office of Surface Mining to designate critical units of aquatic,

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[55] *Id.* at 119.
[56] http://www. tennessee.gov/twra/cwcs/tncwcs2005app.pdf at Appendix F, referenced at 147-71.
[57] 2006 SOR at 28-29.

subterranean, and terrestrial habitats as 'lands unsuitable for mining.'"[58] As such, OSM's rejection of the private petitioners' allegation was based on an incomplete reading of the CWCS.

II. OSM SHOULD DESIGNATE THE PETITION AREA AS UNSUITABLE FOR SURFACE COAL MINING OPERATIONS BECAUSE SUCH OPERATIONS WOULD AFFECT FRAGILE OR HISTORIC LANDS, RESULTING IN SIGNIFICANT DAMAGE TO IMPORTANT HISTORIC, CULTURAL, SCIENTIFIC, AND ESTHETIC VALUES AND NATURAL SYSTEMS, WITHIN THE MEANING OF §522(a)(3).

The ridge lines of the petition area are renowned for their globally significant natural resources. The petition area lies within the larger Cumberland Plateau region, which extends over 450 miles from northern Alabama to western West Virginia. Widely considered one of the most biologically rich regions on earth, the Cumberland Plateau contains the longest hardwood-forested plateau in the world.[59] According to The Nature Conservancy, the plateau is home to countless unique species "found nowhere else."[60] The Tennessee portion of the Cumberland Plateau, in particular, is renowned for its biodiversity and expanses of unbroken forest. According to the Tennessee Department of Environment and Conservation ("TDEC"), it is the "Heart of the Cumberlands" and one of the most ecologically significant places in the world.[61] Because of these and other values, the petition area fits within the "fragile lands" criterion for designation as lands unsuitable for surface mining.

The Department of the Interior's SMCRA regulations define the term 'fragile lands' as:

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[58] Each page of the relevant tables clearly directs the reader to Appendix F for the "full description" of the proposed conservation action. CWCS at 147-78, Tables 62-67.

[59] The Nature Conservancy, Tennessee: A Big Deal to Connect the Cumberlands, *available at* http://www.nature.org/wherewework/northamerica/states/tennessee/features/art23012.html (last visited June1, 2010); The Nature Conservancy, Northern Cumberlands, *available at* http://www.nature.org/wherewework/northamerica/states/tennessee/preserves/art10172.html (last visited June1, 2010).

[60] *Id.*

[61] Tennessee Department of Environment and Conservation, Connecting the Cumberlands through the North Cumberlands Acquisition, *available at* http://tennessee.gov/environment/northcumb/ (last visited August 18, 2010).

> areas containing natural, ecologic, scientific, or esthetic resources that could be significantly damaged by surface coal mining operations. Examples of fragile lands include valuable habitats for fish or wildlife, critical habitats for endangered or threatened species of animals or plants, uncommon geologic formations, paleontological sites, National Natural Landmarks, areas where mining may result in flooding, environmental corridors containing a concentration of ecologic and esthetic features, and areas of recreational value due to high environmental quality.[62]

"Fragile lands" exist within the petition area and would be significantly damaged by surface coal mining operations. The petition area contains valuable habitat for priority migratory songbirds, as well as species that Tennessee has ranked as being in the greatest need of conservation ("GNC species"). Surface mining in the petition area would result in significant harm to this habitat, and the species that depend on it, by fragmenting large tracts of contiguous forest and denuding ridgetops in the petition area.

Further, as the 2007 "Connecting the Cumberlands" conservation project recognized, the lands that constitute the petition area have exceptional value as environmental corridors containing a concentration of ecologic and esthetic features, and as areas of recreational value due to their high environmental qualities. The Cumberland Trail State Park, which bisects the petition area, and the Big South Fork NRRA located downstream of the petition area not only provide recreational benefits but are also historically and culturally significant. For all these reasons these lands qualify as fragile lands within the meaning of §522(a)(3).

The adverse environmental effects and risks associated with surface mining in the petition area could significantly affect these fragile lands in and downstream of the petition area and result in significant damage to important historic, cultural, scientific, and esthetic values and natural systems, within the meaning of §522(a)(3). As OSM has recognized, the inherent impacts of mining include the removal of wildlife habitat within the mining area, alterations of

[62] 30 C.F.R. § 762.5.

the soil and geologic structure, elevated levels of conductivity in surface water, and increased sedimentation to the receiving streams.[63]

A. Surface Mining in the Petition Area Would Damage Important Environmental Corridors and Areas That Are of Recreational Value Due to High Environmental Quality.

As set forth in OSM's SMCRA regulations, 'fragile lands' also include: (1) "environmental corridors containing a concentration of ecologic and esthetic features"' and (2) "areas of recreational value due to high environmental quality."[64] The ridge lines of the petition area unite the North Cumberlands and provide numerous examples of both.

As discussed more fully below, the State's 2007 "Connecting the Cumberlands" acquisition recognized that the public lands on the Cumberland Plateau, including those in the petition area, have exceptional recreational values and a concentration of ecologic and esthetic features, such as corridors of unfragmented forests, scenic vistas, and superb biological diversity.[65] For instance, the Royal Blue and Sundquist WMAs serve as a corridor of vital habitat for priority songbirds; therefore, they offer unique opportunities for bird watching and are popular destinations among birdwatchers.[66] In fact, the American Bird Conservancy has designated Royal Blue WMA as one of its Globally Important Bird Areas in Tennessee.[67] The public lands that constitute the petition area are also popular destinations for a variety of outdoor

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[63] *See, e.g.*, Statement of Reasons on Fall Creek Falls Petition, 65 F.R. 39178, 39183 (June 23, 2000).
[64] 30 C.F.R. § 762.5.
[65] *See* TDEC North Cumberlands Acquisition; Public Benefits, *available at* http://tennessee.gov/environment/northcumb/benefits.shtml (last visited August 18, 2010); *see also* Sustainable Forestry Conservation Easement, "Brimstone Property" at 7, 13.
[66] *See* Scott County, Sundquist WMA, *available at* http://www.scottcounty.com/?q=node/9 (last visited September 12, 2010); Scott County, Royal Blue WMA, *available at* http://www.scottcounty.com/?q=node/8 (last visited September 12, 2010).
[67] American Bird Conservancy, Globally Important Bird Areas in Tennessee, *available at* http://www.abcbirds.org/abcprograms/domestic/sitebased/iba/tennessee.html (last visited June 4, 2010).

recreational activities, including hiking, biking, fishing, camping, and wildlife viewing.[68] Because of its recreational values, the petition area is an important source of tourism-generated income for the State of Tennessee and the four counties that contain these lands.[69]

Surface mining in the petition area would interfere with these recreational opportunities. It would diminish wildlife viewing opportunities by destroying the valuable habitat upon which these animals thrive. The visual and noise impacts of surface mining operations would also deplete the scenic quality of the petition area, reducing its appeal as a place for hiking, camping, wildlife viewing, and fishing. The negative impacts of surface mining on water quality of streams in the petition area could further deter hikers and campers, who use these waters for drinking water and for fishing. Surface mining operations could further conflict with these activities because public safety considerations will require that areas near surface coal mining operations be closed to recreational uses.

OSM's regulations state clearly that "[d]amage does not have to be permanent or irreparable in every instance to be significant."[70] Indeed, the D.C. District Court rejected OSM's attempt in its 1983 regulations to include an irreparable harm standard in the definition of fragile lands.[71] Thus, even short- to medium-term impacts of surface mining operations on such values is a factor that warrants designation, as OSM has since recognized in other lands unsuitable designations.[72] Accordingly, OSM cannot lawfully reject allegations of harm in the

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[68] *See* TDEC North Cumberlands Acquisition; Public Benefits, *available at* http://tennessee.gov/environment/northcumb/benefits.shtml (last visited August 18, 2010).

[69] *See* TDEC, North Cumberlands Acquisition Fact Sheet, *available at* http://tennessee.gov/environment/northcumb/facts.shtml (last visited August 18, 2010) (recognizing the petition areas' recreational value for the state and local economies).

[70] 52 Fed. Reg. 18,792.

[71] *In re: Permanent Surface Mining Regulation Litigation II*, No. 79-1144 (D.D.C. 1984).

[72] *See* Statement of Reasons on Flat Fork LUM petition (1990) at 13 (determining that surface coal mining operations within the petition area would adversely affect the fragile lands in terms of esthetic resources, even though impacts were "short to medium term."); *see also* Statement of Reasons on Fall Creek Falls petition, 65 F.R. 39178, 39187 (June 23, 2000) (designating lands unsuitable because surface mining could cause "significant damage

current petition on the highly theoretical basis that reclamation may eventually alleviate that harm.

In addition, surface mining in the petition area will adversely impact the recreational value of the Smoky Mountain segment of the Cumberland Trail, which traverses lands in the vicinity of significant coal reserves. The Cumberland Trail is a 300-mile historical trail celebrating the heritage of Tennessee.[73] It was designated a State Scenic Trail in 1971 and a State Park in 1998. Notably, in evaluating a petition to designate lands as unsuitable, OSM is specifically required to "consider...areas adjoining...Scenic Trails designated under Tenn. Code Ann. §11-11-101."[74] More recently, the State has recognized the Cumberland Trail as reflecting the essence and spirit of the area by designating the Cumberland Trail the official Millennium Legacy Trail for Tennessee.[75] As discussed above, in 2008, the Tennessee Greenways and Trails Advisory Council emphasized the national significance of the Cumberland Trail State Scenic Trail.[76]

The Smoky Mountain segment of the Cumberland Trail begins at Cove Lake State Park and traverses the heart of the Cumberland Mountains, roughly bisecting the public lands in the petition area. The Cumberland Trail not only provides positive economic benefits to the local communities it passes through, but also provides outstanding opportunities for Tennesseans to explore and enjoy the unique natural, scenic, and cultural qualities of the Cumberland Plateau.

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to the important cultural values of the Park, *including recreational, educational and religious activities*" and could cause significant damage to important esthetic values of the Park, adversely affecting recreational experience of visitors to the Park) (emphasis added).

[73] 2001 Tennessee Greenways and Trails Plan at 7-8, *available at* http://www.tennessee.gov/environment/recreation/pdf/5_Greenways_Plan.pdf.

[74] 30 C.F.R. § 942.762.

[75] 2001 Tennessee Greenways and Trails Plan at 10-11, *available at* http://www.tennessee.gov/environment/recreation/pdf/5_Greenways_Plan.pdf.

[76] *Id.* at 20.

The potential noise, water, and air pollution from surface mining in the petition area would significantly diminish the esthetic and recreational values of the Cumberland Trail, obscuring scenic vistas and impairing water quality within the nearby rivers and streams that are used by hikers and campers as a supply of potable water. Further, rock and debris from blasting, and potential landslides from mining sites and haul roads, could present significant hazards to recreational users.

SMCRA's normal permitting procedures, including the joint review provision of §522(e)(3) and the 300-foot buffer requirement of §522(e)(5), do not provide sufficient protection for the unique resources of the Cumberland Trail. It is worth reiterating that, in the Fall Creek Falls Statement of Reasons, OSM noted that impacts on the Fall Creek Falls State Park resulting from mining outside the park would include: "fugitive dust and noise," "visual impacts," and impacts to the "natural systems, ecologic resources, cultural resources, and esthetic values of the park."[77] In that case, OSM found that such impacts would "impair the recreational use of Park land" and " have a negative impact on Park visitation, thus affecting the economic viability of the Park and the surrounding area."[78] OSM further found that these impacts would be in "direct conflict" with the Park's mission.[79] Indeed, in considering the lands unsuitable petition, OSM specifically rejected the argument that the 300-foot buffer requirement was sufficient to protect Fall Creek Falls' recreational values from the impacts of surface coal mining.[80]

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[77] Statement of Reasons on Fall Creek Falls petition, 65 F.R. 39178, 39187 (June 23, 2000).
[78] *Id.*
[79] *Id.*
[80] *See id.*

OSM also saw fit to designate the Flat Fork watershed adjacent to Frozen Head State Park, in part to protect the unique resources of that public park.[81] There, the Director found that surface coal mining outside the park's boundaries would lead to "alteration of water chemistry and increased sedimentation" and adverse effects on the park's designated overlooks, all of which would be incompatible with the park's mission "to protect and preserve the natural resources within the park."[82] OSM's designation of lands outside these state parks in order to protect these public resources shows that SMCRA's safeguards were not considered sufficiently protective of park lands.[83]

The area surrounding the Smoky Mountain segment of the Cumberland Trail contains the very same threats that led to the Fall Creek Falls and Flat Fork designations. Any one of the variety of impacts that have been shown to occur despite full compliance with SMCRA could damage the "scenic, historic, natural, ecological, geological or cultural qualities," which the designation as a state scenic trail and state park seeks to maximize.

Mining within portions of the Royal Blue WMA would also detract from the recreational value of the Interstate 75 corridor, a popular scenic drive for tourists as it bisects the Royal Blue WMA. As OSM recognized in its Statement of Reasons granting the Flat Fork lands unsuitable petition, scenic overlooks from outside and within a petition area are esthetic values that qualify as fragile lands. Further, surface coal mining operations can significantly damage such esthetic values, a factor that weighed in favor of designating the entire Flat Fork watershed as unsuitable

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[81] Statement of Reasons for Petition to Designate Certain Lands in the Flat Fork Watershed, Tennessee, as Unsuitable for Surface Coal Mining Operations (24 April 1990).
[82] *Id.* at 9-10.
[83] Undoubtedly both the Fall Creek Falls and the Flat Fork designations were made assuming that OSM would follow its own regulations implementing §522(e).

for surface mining.[84] The views from overlooks along Interstate 75 similarly constitute fragile lands that could be significantly damaged by surface mining in the petition area.

B. Surface Mining in the Petition Area Would Damage Important Historic and Cultural Values.

As defined by the Department of the Interior, the phrase 'historic lands' means "areas containing historic, cultural, or scientific resources."[85] The petition area and downstream areas contain all three, and surface mining in the petition area would damage these important resources.

In its 2006 SOR, OSM criticized the private parties' allegation regarding the cultural and historic significance of the petition area by asserting that most of the discussion referred to the Cumberland Trail State Park and that this resource already receives sufficient protection under SMCRA.[86] For the reasons discussed in the previous section, SMCRA and its regulations are not sufficient to protect the Trail from the negative impacts of surface mining. In addition, it is important to note that since 2005, the Trail has gained national significance, as well. It is the lynchpin of the Great Eastern Trail, a new long-distance hiking trail that will run from the Alabama-Florida state line to New York, furthering the original vision of a network of trails across the entire Appalachian region.[87] The petition area's value as a place of historic, scientific, and cultural resources is further evidenced by the proposal to federally designate the Cumberland Plateau region as a National Heritage Corridor.[88] Finally, since the prior petition, the State of Tennessee has recognized lands within the petition area as containing important historic, cultural, and scientific values, as a result of

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[84] Statement of Reasons on Flat Fork LUM petition, at 13 (1990).
[85] 30 C.F.R. § 762.5.
[86] 2006 SOR at 19.
[87] *See* The Cumberland Trail Conference Guide to the Cumberland Trail, *available at* http://www.cumberlandtrail.org/ (last visited September 20, 2010).
[88] The Alliance for the Cumberlands, *The Cumberland Plateau Heritage Corridor: Feasibility Study and Assessment of Impacts for National Heritage Corridor Designation* (2006), *available at* http://www.tennessee.gov/environment/recreation/cumberlandplateau.pdf.

Cumberlands" acquisition, the largest of its kind in Tennessee since the creation of the Great Smoky Mountains National Park.

CONCLUSION

For the reasons set forth above, the State of Tennessee respectfully requests that:

1. The petition area be designated as unsuitable for surface mining operations; and

2. No permit be issued for surface mining operations in the petition area while this petition is pending.

FOR THE PETITIONER THE STATE OF TENNESSEE:

Date: 9-28-10

ROBERT E. COOPER, JR.
Attorney General and Reporter

Date: 9/28/10

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PHIL BREDESEN
Governor
State of Tennessee

APPENDIX C: SPECIAL-STATUS SPECIES

There are a number of special status species, both aquatic and terrestrial, potentially in or adjacent to the evaluation area. The following discussion identifies and describes potentially impacted special status species.

AQUATIC SPECIAL-STATUS SPECIES

Tennessee has among the highest diversity of fish fauna of any state in the United States (Carter et al. 2012). Thus, there are a number of known federal and state-listed species (i.e., mollusks, fish) that are present, or could potentially occur in the evaluation area or in the counties (Anderson, Campbell, Morgan, and Scott) associated with the evaluation area. A full description of each species is presented below.

FISHES

Seven federally listed fish species occur within the four affected Tennessee counties (USFWS 2015). Critical habitat has been designated for three of the six federally listed species. However, only one species (spotfin chub) has designated critical habitat within the evaluation area. Five additional species listed as threatened or endangered at the state level in Tennessee may also be present in or near the evaluation area (TDEC 2014). Two species, emerald darter and rosyface shiner, have been "deemed In Need of Management" at the state level in Tennessee are also known to occur within the evaluation area. These species are further discussed below.

Ashy darter (*Etheostoma cinereum*): The ashy darter, a Tennessee threatened species, is a small fish that occurs in small to medium upland rivers. It prefers areas of bedrock or gravel substrate with minimal silt deposits and is known to occur in Campbell, Morgan, and Scott Counties (TDEC 2014). It has been found in numerous streams draining the North Cumberland Wildlife Management Area (NCWMA) (Carter et al. 2003, 2012; TNHP 2009). Primary threats to this species include pollution, siltation, and habitat loss and fragmentation due to damming, agriculture practices, and land development activities (NatureServe 2014).

Blackside dace (*Chrosomus cumberlandensis*): The blackside dace is a minnow that inhabits pools of small upland tributaries to the upper Cumberland River system. This species is listed as threatened at both the federal and state level in Tennessee. It prefers areas with sand, sandstone, and shale substrates and is known to occur in Campbell and Scott Counties (TDEC 2014). This species is thought to have once been widespread in headwater streams in the upper Cumberland River system although its range has been severely reduced due to habitat degradation. In streams draining the NCWMA, it occurs primarily in the Clear Fork drainage, but in 2002 it was discovered in Straight Fork, a tributary to the New River (Carter et al. 2003, 2012; TNHP 2009). Recently, blackside dace has been discovered in four streams within the Big South Fork drainage (upper Straight Fork, Jake Branch, Cross Branch, and an unnamed tributary of Straight Fork), in Scott County Tennessee. This species was not previously known to occur in Big South Fork, and this finding suggests a possible range expansion to the south and west (Mattingly and Floyd 2013). Primary threats to this species include acid mine drainage, and siltation due to surface mining, agriculture, silviculture, and land development (NatureServe 2014). A habitat conservation plan is currently in place for conservation of blackside dace in the Royal Blue Unit of the NCWMA. The TWRA holds an incidental take permit for forest management activities including timber harvest, road construction, and prescribed burning.

Blue sucker (*Cycleptus elongatus*): The blue sucker, a Tennessee threatened species, is a bottom feeding fish found in large rivers and lower parts of major tributaries. This species frequently occurs in channels and flowing pools with moderate current. The blue sucker spawns in upstream riffle areas and may travel up to 100 miles to spawn (NatureServe 2014). It is known to occur in Anderson and Campbell Counties (TDEC 2014). Primary threats to the blue sucker include water quality degradation, siltation, and dam construction (NatureServe 2014).

Cumberland arrow darter (*Etheostoma sagitta*): The Cumberland arrow darter is a federal candidate species for listing under ESA. This small fish species utilizes habitats such as rocky riffles and pools of headwaters, creeks, and small rivers. Generally this darter avoids swift currents and occurs in slow to moderate current in cool, sluggish pools or areas above and below riffles over bedrock, rubble, cobble, and pebble, often interspersed with sandy areas. It is common only in intermittently flowing first- or second-order creeks, preferring protective stones near the bank, or ledges and recesses at stream margins. Spawning peaks in April and occurs in shallow riffles often under or near rocks (NatureServe 2015). This species is known to occur in Campbell and Scott Counties within the evaluation area (TDEC 2014).

Cumberland darter (*Etheostoma susanae*): The Cumberland darter is a small fish, listed as endangered at both the federal and Tennessee state levels, which inhabits shallow water in low velocity shoals and backwater areas of moderate to low gradient stream reaches with stable sand or sandy-gravel substrates. It tends to avoid areas with large gravel or boulder substrates (IUCN 2014). This species is known to exist is Morgan and Scott Counties and has been reported in creeks in the upper Cumberland River watershed (TDEC 2014). Critical habitat was designated in 2012 and consists of 54 miles of rivers and streams, adjacent to but not within the evaluation area such as Jellico Creek and Capuchin Creek. However, these populations are found upstream of the petition area and do not receive drainage from the petition area. Primary constituent elements associated with Cumberland darter critical habitat designation include the presence of pool and run habitats, silt-free sand and bedrock substrates, adequate stream flow, and good to excellent water quality evidenced by diverse fish and macroinvertebrate communities (USFWS 2012a). Primary threats to this species include habitat loss and severe water quality degradation due to coal mining, logging, agriculture, and development within the upper Cumberland basin (NatureServe 2014).

Duskytail darter (*Etheostoma percnurum*): The duskytail darter is listed as endangered at both the federal and Tennessee state levels. The duskytail darter is a small fish that inhabits major streams ranging from larger creeks to moderately large rivers. It occurs in gently flowing pools, generally in the vicinity of riffles, among large rocks over bedrock or sand. Only four naturally occurring populations are known to exist, one of which is in the Big South Fork (USFWS 2012b). The Big South Fork population is separate taxon; the tuxedo darter (*E. lemiscatum*), which is described below. Primary threats to this species include pollution, siltation, and general habitat and water quality degradation due to mining, logging, and damming (NatureServe 2014).

Emerald darter (*Etheostoma baileyi*): The emerald darter is deemed in need of management in the State of Tennessee (TNHP 2009). This species occurs in all four counties and is known to be present within the evaluation area (TDEC 2014). Habitat includes rocky pools and runs, sometimes riffles, of creeks and small to medium rivers. This species prefers shallow habitats with low to moderate flow. Spawning peaks in May (NatureServe 2015).

Redlips darter (*Etheostoma maydeni*): The redlips darter is a relatively new species resulting from the ashy darter being split into two separate taxa. Biology and habitat preference of the redlips darter is almost identical to that of the ashy darter. The primary difference is that the ashy darter is found in the Tennessee River basin, and the redlips darter (*E. maydeni*) is found in the Cumberland system, both within Big South Fork (Powers, Kuhajda, and Ahlbrand 2012).

Rosyface shiner (*Notropis rubellus*): The rosyface shiner is deemed in need of management in the State of Tennessee (TNHP 2009). This species is occurs within Campbell and Scott Counties and has been documented in the evaluation area (TDEC 2014). The rosyface shiner is typically found in large creeks and small rivers with gravel or rubble substrates. This species frequently occurs in or around riffles and prefers clear waters with high to moderate flow (NatureServe 2015).

Slender chub (*Erimystax cahni*): The slender chub, a threatened species at the federal level and state level in Tennessee, is a small riverine minnow historically found in the Holston, Powell, and Clinch Rivers. This species is known to have been heavily impacted by habitat degradation due to coal mining throughout its range in Tennessee. Despite extensive surveys, the slender chub has not been collected since 1996 (USFWS 2014b).

Sickle darter (*Percina williamsi*): The sickle darter, a Tennessee threatened species, is a small fish found in flowing pools over rocky, sandy, or silty substrates in clear creeks or small rivers. This darter often occurs near woody debris, vegetation such as water willow, or large boulders, and it spends most of its time swimming in current in the water column. The sickle darter spawns in gravel shoals and is not tolerant to high turbidity (NatureServe 2014). This species is listed as being present in Morgan County (TDEC 2014), but is believed to be extirpated throughout much of its historic range (NatureServe 2014). Primary threats to the sickle darter include habitat and water quality degradation due to pollution and siltation, and habitat fragmentation due to dam construction (NatureServe 2014).

Silverjaw minnow (*Notropis buccatus*): The silverjaw minnow, a Tennessee threatened species, is a small fish which inhabits creeks and rivers with moderate current and sandy or gravel substrates. This species spawns in riffles with and scatters its eggs across the substrate (NatureServe 2014). The silverjaw minnow is listed as being present in Campbell County (TDEC 2014). Primary threats include habitat loss or degradation due to development in or adjacent to home range watersheds.

Spotfin chub (*Erimonax monachus*): The spotfin chub, a federally and Tennessee threatened species, is a small, slender fish which prefers clear water over gravel, boulders, and bedrock in large creeks and medium-sized rivers having moderate current. This fish is rarely seen over sand, and appears to avoid silty areas. The spotfin chub currently survives in only four tributary systems including the Emory River, and critical habitat was designated in 1977. Critical habitat includes the Emory River in Morgan County, Tennessee, which is within the evaluation area (USFWS 1977). Primary threats to this species are habitat loss and degradation including pollution and siltation due to mining runoff, logging, agriculture, and land development (USFWS 2011a).

Tuxedo darter (*Etheostoma lemiscatum*): The tuxedo darter is very similar to the duskytail darter and was only recently considered to be a separate taxon. With regard to current taxononmy, it should be noted that while the duskytail darter (*E. percnurum*) is the officially listed taxon, the taxon that occurs in the evaluation area is actually the tuxedo darter (*E. lemiscatum*) (Blanton and Jenkins 2008). Biology and habitat preferences are the same as those described above for the duskytail darter, but the Tuxedo darter is only known to occur in Big South Fork. threats to this species include pollution, siltation, and general habitat and water quality degradation due to mining, logging, and damming (NatureServe 2014).

Yellowfin madtom (*Noturus flavipinnis*): The yellowfin madtom, a threatened species at the federal and Tennessee state level, is a small nocturnal catfish that inhabits warm pools and backwaters of moderate-sized streams less than one meter deep, with moderate gradient, and clean water with little silt (USFWS 2014c). Although once considered extirpated from the Clinch River, this species was reported at 8 locations in 2004. Habitat loss and degradation due to coal mining is a major contributor to the decline of yellowfin madtom. A five-year review of yellowfin madtom populations, completed by USFWS in 2012, indicated that populations currently appear to be stable, and there is no evidence to suggest that

anthropogenic threats have increased since 2007 (USFWS 2012c). Critical habitat was designated by the US Fish and Wildlife Service (USFWS) in 1977 but does not include any areas within the evaluation area (USFWS 1977).

MOLLUSKS

Anthony's riversnail (*Athearnia anthonyi*): Anthony's riversnail, a freshwater snail listed as endangered at the federal and Tennessee state level, prefers medium to large river habitats with cobble/boulder substrates in the vicinity of riffles with strong current (USFWS 1997). This species is known to occur in Anderson and Campbell Counties (TDEC 2014). Overall, the greatest threat to the riversnail is habitat modification and destruction due to point and non-point source pollution (USFWS 2010). The most significant of these impacts is siltation caused by excessive releases of sediment from activities such as agriculture, resource extraction (e.g., coal mining, silviculture), road construction, and urban development (Waters 1995). The species has been successfully propagated, however, due to water and habitat quality degradation the success of potential reintroductions is uncertain (USFWS 2010). No viable populations are currently known to exist within the evaluation area (USFWS 2011b).

Alabama lampmussel (*Lampsilis virescens*): The Alabama lampmussel is listed as endangered at the federal and Tennessee state level. This freshwater mussel has a smooth, shiny outer shell, and is greenish to straw colored, sometimes with rays. It is found in sand and gravel substrates in shoal areas of small to medium sized streams (TDEC 2014). Until recently the Alabama lampmussel was believed to be extirpated from Tennessee, and known to occur only in the Paint Rock River system in northern Alabama, where the population was thought to be 50-1000 individuals. However, it was recently rediscovered in the upper Emory River (Dinkins, Faust, and Ahlstedt 2012). Very few live Alabama lampmussels had been seen in the wild (NatureServe 2014).

Birdwing pearlymussel (*Lemiox rimosus*): The birdwing pearlymussel is listed as endangered at the federal and Tennessee state level. This freshwater mussel prefers small-medium sized rivers in riffle areas with sand and gravel substrates in mod-fast currents (NatureServe 2014). Dams, channel dredging, sand and gravel mining, coal mining, sewage wastes and agricultural run-off have caused or have likely contributed to declines in populations throughout its range (Jones et al. 2009). Because of severe population declines during the twentieth century, the birdwing pearlymussel was listed as endangered by the USFWS in 1976 (Federal Register 41:24062– 24067). This species has been documented in the upper Clinch and watershed (NatureServe 2014, TDEC 2014), but is believed to be extirpated within the project area.

Cracking pearlymussel (*Hemistena lata*): The cracking pearlymussel is listed as endangered at the federal and Tennessee state level. This freshwater mussel species is critically imperiled with a total estimated population of 50-1,000 remaining individuals. Preferred habitat includes sand, gravel, and cobble substrates in swift currents or mud and sand in slower currents. It has been extirpated from much of its historic range but is still believed to be present in Clinch River in Anderson County, Tennessee (TDEC 2014), but may not occur within the evaluation area. Primary threats to the cracking pearlymussel include habitat loss and degradation due to pollution and sedimentation from coal mining, dam construction, and agriculture (NatureServe 2014).

Cumberland bean (*Villosa trabalis*): The Cumberland bean, endangered at the federal and Tennessee state level, occurs primarily in creeks and small rivers. Its shell is brown with thin wavy green rays. Several darters and a sculpin have been identified as fish hosts (Williams, Bogan, and Garner 2008). This critically imperiled species is believed to have a remaining population of 1,000-2,500 individuals and occurs in only four rivers (NatureServe 2014). It is known to occur in Morgan and Scott Counties, Tennessee (TDEC 2014). It has also been reported to occur in the Big South Fork River, but is rare

(Ahlstedt et al. 2004). Primary threats to the Cumberland bean include habitat and water quality degradation including pollution and siltation due to dam construction, logging, agriculture, and acid mine runoff (NatureServe 2014).

Cumberland elktoe (*Alasmidonta atropurpurea*): The Cumberland elktoe, endangered at the federal and Tennessee state level, is a freshwater mussel with a somewhat shiny black shell with greenish rays. Its habitat ranges from small creeks to medium-sized rivers. The mussel is most common in smaller stream habitats. The preferred habitat appears to be shallow flats or pools with slow current and sand substrate with scattered cobble/boulder material, although it may be found in mud or rocky substrates and faster currents. Native host fishes, necessary for successful reproduction, include whitetail shiner (*Cyprinella galactura*), northern hog sucker (*Hypentelium nigricans*), rock bass (*Ambloplites rupestris*), longear sunfish (*Lepomis megalotis*), and rainbow darter (*Etheostoma caeruleum*) (NatureServe 2014). This mussel is restricted to tributaries of the upper Cumberland River in Kentucky and Tennessee. It has one of the most restricted ranges of any Cumberlandian species. Critical habitat for the Cumberland elktoe was designated in 2004 and includes a total of 135 miles of rivers and streams including Rock Creek, Big South Fork, and Clear Fork within the evaluation area. Primary constituent elements for this species include permanent flowing streams suitable for all life stages, geomorphically stable stream and river banks, suitable substrates with low siltation, water quality necessary for survival of mussels and fish hosts, and presence of host fish (USFWS 2004a). Habitat loss and water quality degradation due to coal mining, logging, agriculture, and dam construction area the primary threats to the Cumberland elktoe (NatureServe 2014).).

Cumberlandian combshell (*Epioblasma brevidens*): The Cumberlandian combshell is endangered at the federal and Tennessee state level. This freshwater mussel occurs in shoals in large creeks and small to medium-sized rivers (NatureServe 2014). Its shell is yellowish to tawny with narrow broken green rays. This species appears to be a long-termed brooder with spawning occurring in late summer and glochidia held until late spring (NatureServe 2014). In laboratory studies, six species of perciform fish have been identified to serve as glochidial hosts for this species: *Etheostoma blennioides* (greenside darter), *Etheostoma maculatum* (spotted darter), *Etheostoma rufilineatum* (redline darter), *Etheostoma vulneratum* (wounded darter), *Etheostoma simotreum* (snubnose darter), *Percina caprodes* (logperch), *Cottus baileyi* (black sculpin), *Cottus bairdi* (mottled sculpin), and *Cottus carolinae* (banded sculpin) (USFWS 2003, 2004b; Yeager and Saylor 1995). Currently, this species has been documented in the upper and Clinch and Powell drainages of the evaluation area (NatureServe 2014). Critical habitat for the Cumberlandian combshell was designated in 2004 and includes a total of 330 miles of rivers and streams including parts of Big South Fork and the Clinch River. None of the designated critical habitat falls within the evaluation area. Primary constituent elements for this species include permanent flowing streams suitable for all life stages, geomorphically stable stream and river banks, suitable substrates with low siltation, water quality necessary for survival of mussels and fish hosts, and presence of host fish (USFWS 2004b). Primary threats to the Cumberlandian combshell include dam construction and pollution, particularly associated with coal mining (NatureServe 2014).

Dromedary pearlymussel (*Dromus dromas*): This freshwater mussel species, endangered at the federal and Tennessee state level, prefers clear, clean, fast-flowing water. It cannot tolerate excessive siltation (USFWS 1984a). This mussel is yellow-green in color with interrupted green rays on the shell. The species got its name from the distinctive hump on the shell of larger individuals (USFWS 1984a). Like other freshwater mussels, this species reproduces by releasing larvae into the water which lodge in the host fish's gills, where they develop into juvenile mussels. Fish hosts for this mussel species include black sculpin (*Cottus baileyi*), greenside darter (*Etheostoma blennioides*), fantail darter (*Etheostoma flabellare*), snubnose darter (*Etheostoma simoterum*), tangerine darter (*Percina aurantiaca*), blotchside logperch (*Percina burtoni*), logperch (*Percina caprodes*), channel darter (*Percina copelandi*), gilt darter (*Percina evides*), and Roanoke darter (*Percina roanoka*) (Jones et al. 2004). This species was historically

one of the most common mussels in the Tennessee River; currently the species is documented in upper Clinch and Powell Rivers (NatureServe 2014). Primary threats to the dromedary pearlymussel include dam construction and water pollution due to coal mining activities (NatureServe 2014).

Fanshell (*Cyprogenia stegaria*): This freshwater mussel species, endangered at the federal and Tennessee state level, is rounded in shape with numerous pustules, elevated growth lines, and broken green rays. The Fanshell prefers to inhabit the river bottoms in medium to large streams (Dennis 1984). It has been found in river habitats with gravel substrates and a strong current, in both deep and shallow water (Ortmann 1919; Parmalee 1967).The mussel is reported as a long-term breeder (holds glochidia overwinter for spring release) (Ortmann 1919). Known fish hosts include the banded sculpin, (*Cyprogenia stegaria*); greenside darter, (*Etheostoma blennioides*); mottled sculpin, (*Cottus bairdi*); Tennessee snubnose darter, (Etheostoma simoterum); banded darter (*Etheostoma zonale*); Tengerine darter (*Percina aurantiaca*); blotchside logperch (*Percina burtoni*); logperch (*Percina caprodes*); and Roanoke darter (*Percina roanoka*) (Schulz and Marbain 1998; Jones and Neves 2001, 2002). Currently, this species has been documented in the upper and lower Clinch drainages (NatureServe 2014). However, the lower clinch population is believed to be extirpated. Primary threats to the fanshell include dam construction and water pollution. Water quality degradation and pollution specifically associated with coal mining activities is the primary threat to this species in the Clinch River (NatureServe 2014).

Finerayed pigtoe (*Fusconaia cuneolus*): This species is a freshwater mussel, endangered at the federal and Tennessee state level, with fine green rays on a yellow to brown shell. It prefers clear, high gradient streams in firm cobble and gravel substrates (Ahlstedt 1984). In laboratory experiments by Bruenderman and Neves (1993), eight fish were identified as suitable hosts: fathead minnow (*Pimephales promelas*); river chub (*Nocomis micropogon*); stoneroller (*Campostoma anomalum*); telescope shiner (*Notropis telescopus*); Tennessee shiner (*Notropis leuciodus*); white shiner (*Luxilus albeolus*); whitetail shiner (*Cyprinella galactura*); and the mottled sculpin (*Cottus bairdi*). In addition, several of these species were reconfirmed as hosts and other species were identified as likely hosts: mimic shiner (*Notropis volucellus*), and whitefin shiner (*Cyprinella nivea*) (Neves 1991). The finerayed pigtoe has been extirpated throughout most of its historical range and experienced an estimated 90% population decline. The only known remaining populations are found in the Clinch River and Powell River drainages. Primary threats to this species include dam construction, siltation, and pollution associated with coal mining (NatureServe 2014).

Fluted kidneyshell (*Ptychobranchus subtentum*): This federally endangered freshwater mussel species inhabits small to medium rivers in areas with swift current or riffles, although a few populations were recorded in large river shoal areas. It is often found embedded in sand, gravel, and cobble substrates (Gordon and Layzer 1989) and requires flowing, well-oxygenated waters. Shape of the shell is roughly oval elongate, and solid and greenish yellow coloring which becomes brown with age. This species is unusual in that outer portion of a brooding female's outer gills folded in a curtain-like fashion (NatureServe 2014). It is thought to have a late summer or early fall fertilization period with glochidia incubating overwinter. Glochidia are released the following spring or early summer and have an adhesive end that sticks to silt-free stones on the stream bottom. Host fishes include: barcheek darter (*Etheostoma obeyense*), redline darter (*Etheostoma rufilineatum*), fantail darter (*Etheostoma flabellare*), redline darter (*Etheostoma caeruleum*), banded sculpin (*Cottus carolinae*) (Luo and Layzer 1993; USFWS 2013). Currently, this species has been documented in the Clinch and Powell Rivers of the evaluation area, with the largest remaining population found in the upper Clinch River (NatureServe 2014). Critical habitat for the fluted kidneyshell was designated in 2013 and includes a total of 1,180 miles of rivers and streams including portions of the Clinch and Powell Rivers close to, but not within the evaluation area. Primary constituent elements for this species include Riffle habitats within large, geomorphically stable stream channels, Stable substrates of sand, gravel, and cobble with low to moderate amounts of fine sediment and containing flow refugia with low shear stress, natural flow regime adequate for feed and

reproduction, suitable water quality for survival of mussels and fish hosts, and presence of host fish (USFWS 2013). Primary threats to this species include dam construction, siltation, and pollution associated with coal mining, particularly in the Clinch River (NatureServe 2014).

Littlewing pearlymussel (*Pegias fabula*): The littlewing pearlymussel, endangered at the federal and Tennessee state level, is a small mussel that occurs in creeks and small rivers. Its shell is tawny to brown, usually with variable green rays. Fish hosts reported are the black sculpin (*Cottus baileyi*), emerald darter, and greenside darter (*Etheostoma blennioides*) (Williams, Bogan, and Garner 2008). This critically imperiled species has an estimated population of 2,500-10,000 (NatureServe 2014). It has been found at several sites in the Big South Fork and the population there is considered to be the largest one remaining. This population could be used as a source for restoration of other streams (Ahlstedt et al. 2004). This species has also been documented in the upper Clinch watershed. Primary threats to the littlewing pearlymussel include water quality degradation due to dam construction, logging, agriculture, and especially coal mining activities and associated acid mine runoff (NatureServe 2014).

Orangefoot pimpleback (*Plethobasus cooperianus*): Orangefoot pimpleback, an endangered species at the federal and Tennessee state level, is a round freshwater mussel with pustules only on the posterior three-fourths of the shell and a live mussel has an orange foot. Fish hosts for orangefoot pimpleback have not been identified. This species is found in medium to large rivers in sand, gravel, and cobble substrates in riffles and shoals in deep water and steady currents as well as some shallower shoals and riffles (Gordon and Layzer 1989; Bogan and Parmalee 1983; Cummings and Mayer 1992; USFWS 1984b). This species has been documented in the Clinch, Powell, and Cumberland Rivers; however, its presence within the evaluation area is currently unknown. Primary threats to the orangefoot pimpleback include dam construction, siltation, and water pollution due to logging, agriculture, and coal mining (NatureServe 2014).

Oyster mussel (*Epioblasma capsaeformis*): The oyster mussel, an endangered species at the federal and Tennessee state level, occurs in shoals of small to large rivers in sand and gravel substrate. Its shell is yellowish green with thin green rays. Several darters and sculpins have been identified as fish hosts (Williams, Bogan, and Garner 2008). This critically imperiled species has experienced a 70–90% population decline and has an estimated remaining population of 1,000-2,500 (NatureServe 2014). This species has been documented to occur in the Big South Fork but is rare (Ahlstedt et al. 2004). It is also known to occur in the upper Clinch and Powell Rivers. Critical habitat for the oyster mussel was designated in 2004 and includes a total of 201 miles of rivers and streams including portions of Big South Fork, and parts of the Clinch and Powell Rivers, close to but not within the evaluation area. Primary constituent elements for this species include permanent flowing streams suitable for all life stages, geomorphically stable stream and river banks, suitable substrates with low siltation, water quality necessary for survival of mussels and fish hosts, and presence of host fish (USFWS 2004a). Primary threats to the oyster mussel include dam construction, siltation, and water pollution (NatureServe 2014).

Pink mucket (*Lampsilis abrupta*): This freshwater species, endangered at the federal and Tennessee state level, occurs in the bottoms streams among gravel and cobble in depths ranging from one inch to five feet in depth and swiftly moving currents and in much deeper waters with slower currents (Gordon and Layzer 1989). The pink mucket is a rounded, slightly elongate mussel with a thick, inflated, and smooth shell, which is usually yellow-brown in color. Laboratory studies have confirmed that four of nineteen fish tested are suitable hosts for the pink mucket. These include the largemouth bass (*Micropterus salmoides*), spotted bass (*Micropterus punctulatus*), smallmouth bass (*Micropterus dolomieu*), and walleye (*Stizostedion vitreum*) (Barnhart 1997). Other reported glochidial fish host species include the sauger (*Stizostedion canadense*) and the freshwater drum (*Aplodinotus grunniens*) (USFWS 1985). The pink mucket is unique in that the females possess a spotted mantle flap which may serve to mimic a fish eyespot to attract host fish (USFWS 1985). Currently, this species has been documented in the upper

Clinch River, and may occur within the evaluation area. Primary threats to the pink mucket include dam construction, siltation, and water pollution associated with coal mining (NatureServe 2014).

Purple bean (*Villosa perpurperea*): This freshwater mussel, endangered at the federal and Tennessee state level, has a dark brown to black shell with numerous closely spaced fine green rays. Its habitat is creeks to medium-sized rivers and occasionally headwaters. It is found in substrates ranging from silty-sand to boulder-sized rocks. Native host fish include sculpin (*Cottus carolinae*), greenside darter (*Etheostoma blennioides*), redline darter (*Etheostoma rufilineatum*), and fantail darter (*Etheostoma flabellare*). The purple bean is critically imperiled with an estimated remaining population of 50–1,000 individuals (NatureServe 2014).This mussel is restricted to a few tributaries of the upper Tennessee River. It was recently found in the upper Emory River, where it was thought to have been extirpated. Critical habitat for the purple bean was designated in 2004 and includes a total of 202 miles of rivers and streams including parts of the Clinch and Powell Rivers, close to but not within the evaluation area. Primary constituent elements for this species include permanent flowing streams suitable for all life stages, geomorphically stable stream and river banks, suitable substrates with low siltation, water quality necessary for survival of mussels and fish hosts, and presence of host fish (USFWS 2004b). Primary threats to the purple bean include dam construction, siltation, and water pollution associated with coal mining (NatureServe 2014).

Rough pigtoe (*Pleurobema plenum*): This freshwater mussel species, endangered at the federal and Tennessee state level, is found in medium to large rivers in sand, gravel, and cobble substrates in shoals. It is occasionally found on flats and muddy sand (Gordon and Layzer 1989; USFWS 1984c). The species is relatively large, rounded to slightly angular, or elongate, shaped like an equilateral triangle, with a brown satin-like appearance. This species is probably a short-term breeder (Ortmann 1919). Currently, this species has been documented in the upper Clinch and Cumberland rivers of the evaluation area. Primary threats to the rough pigtoe include dam construction, siltation, and water pollution associated with coal mining (NatureServe 2014).

Rough rabbitsfoot (*Quadrula cylindrica strigillata*): This freshwater mussel species, endangered at the federal and Tennessee state level, inhabits medium-sized to large rivers in swift currents but often exists in areas close to, but not in, the swiftest current. It is reported to live clean water in gravel bottoms or in riffles in shallow water (Bogan and Parmalee 1983). It is a freshwater mussel with a yellow to greenish colored shell with green rays. Adult specimens reach lengths of 5 inches (Parmalee and Bogan 1998). It is a short-term brooder with spawning occurred from May through June in water temperature 68.0 to 71.6 degrees (USFWS 2003, 2004b). Critical habitat for the rough rabbitsfoot was designated in 2004 and includes a total of 245 miles of rivers and streams including parts of the Clinch and Powell Rivers, close to but not within the evaluation area. Primary constituent elements for this species include permanent flowing streams suitable for all life stages, geomorphically stable stream and river banks, suitable substrates with low siltation, water quality necessary for survival of mussels and fish hosts, and presence of host fish (USFWS 2004b). Primary threats to the rough rabbitsfoot include dam construction, siltation, and water pollution associated with coal mining (NatureServe 2014).

Sheepnose mussel (*Plethobasus cyphyus*): This federally endangered freshwater mussel is distinctive with an oval shape and flattened smooth surface except for a single row of bumps or knobs running along the ventral margin, is generally considered a large-river species (USFWS 2003). They inhabit riffles and gravel/cobble substrates but usually has been reported from deep water (>2 m) with slight to swift currents and mud, sand, or gravel bottoms (Gordon and Layzer 1989). It also appears capable of surviving in reservoirs, such as upper Chickamauga Reservoir immediately below Watts Bar Dam (Ahlstedt 1989). Sheepnose mussels are short-termed brooders with gravid females, and have been found between May and July (Gordon and Layzer 1989). Glochidia are released and mimic fish food organisms and attached to the following known fish host species blackspotted topminnow, blacktail shiner, bleeding shiner,

bluntnose minnow, brassy minnow, bullhead minnow, central stoneroller, common shiner, eastern blacknose dace, fathead minnow, longnose dace, mimic shiner, Ozark minnow, pearl dace, red shiner, river shiner, silver chub, southern redbelly dace, spotfin shiner, steelcolor shiner, striped shiner, suckermouth minnow, western mosquitofish, whitetail shiner (USFWS 2003; Guenther et al. 2009). Currently, this species has been documented in the Clinch and Powell rivers, and may occur within the evaluation area. Primary threats to the sheepnose mussel include dam construction, siltation, and water pollution associated with coal mining (NatureServe 2014).

Shiny pigtoe (*Fusconaia cor*): This freshwater mussel species, endangered at the federal and Tennessee state level, has prominent dark green to black rays on a yellow to brown shell (USFWS 1984d). This species is known to inhabit shoals and riffles of small to medium sized clear rivers with moderate to fast current (Bogan and Parmalee 1983).A short-term brooder that spawns in late May to early June. The following fish species are known hosts of shiny pigtoe glochidia, whitetail shiner (*Cyprinella galactura*), common shiner (*Luxilus cornutus*), warpaint shiner (*Luxilus coccogenis*) and telescope shiner (*Notropis telescopus*) (Neves 1991). It is typically well burrowed in sand and cobble substrates. It does not appear tolerant of deeper water or reservoirs (USFWS 1984d). Currently, this species has been documented in the upper Clinch and Powell rivers of the evaluation area. Primary threats to the shiny pigtoe include dam construction, siltation, and water pollution associated with coal mining (NatureServe 2014).

Slabside pearlymussel (*Pleuronaia dolabelloides*): This freshwater mussel species, endangered at the federal and Tennessee state level, occurs in moderate to high gradient riffles systems in creeks to large rivers. It is generally found at depths <1 m, moderate to swift current velocities, and substrates from coarse sand to heterogeneous assemblages of larger sized particles. The slabside pearlymussel is primarily a large creek to moderately-sized river species, inhabiting sand, fine gravel, and cobble substrates in relatively shallow riffles and shoals with moderate current (Parmalee and Bogan 1998). This species requires flowing, well-oxygenated waters to thrive. This species is a short-term, summer brooder (May until August). Known fish host species include popeye shiner (*Notropis ariommus*), Tennessee shiner (*Notropis leuciodus*), silver shiner (*Notropis photogenis*), rosyface shiner (*Notropis rubellus*), saffron shiner (*Notropis rubricroceus*), telescope shiner (*Notropis telescopus*) (Neves 1991); as well as small mouth bass (*Micropterus dolomieu*) (Barnhart and Roberts 1997). Currently, this species has been documented in the upper Clinch and Powell Rivers of the evaluation area (NatureServe 2014). Critical habitat for the slabside pearlymussel was designated by the USFWS in 2013 and includes a total of 970 miles of rivers and streams including portions of the Clinch and Powell rivers, close to but not within the evaluation area. Primary constituent elements for this species include Riffle habitats within large, geomorphically stable stream channels, Stable substrates of sand, gravel, and cobble with low to moderate amounts of fine sediment and containing flow refugia with low shear stress, natural flow regime adequate for feed and reproduction, suitable water quality for survival of mussels and fish hosts, and presence of host fish (USFWS 2013). Primary threats to the slabside pearlymussel include dam construction, siltation, and water pollution associated with coal mining (NatureServe 2014).

Spectaclecase (*Cumberlandia monodonta*): This federally endangered freshwater mussel species has an elongate and compressed shell that is greenish or brownish. Spectaclecase occurs in large rivers and is a habitat-specialist, relative to other mussel species. Baird (2000) noted its occurrence on outside river bends below bluff lines. It seems to most often inhabit riverine microhabitats that are sheltered from the main force of current. It occurs in substrates from mud and sand to gravel, cobble, and boulders in relatively shallow riffles and shoals with slow to swift current (Buchanan 1980; Parmalee and Bogan 1998; Baird 2000). According to Stansbery (1967), spectaclecase is usually found in firm mud between large rocks in quiet water very near the interface with swift currents. Specimens have also been reported in tree stumps, root masses, and in beds of rooted vegetation (Stansbery 1967; Oesch 1995).The species appears to spawn twice a year during relatively short periods in the autumn (October and November) and spring (April and May). No fish hosts have yet been identified for this species. Knudsen and Hove (1997)

tested five fish species and the larval tiger salamander and Barnhart and Baird (2000) laboratory tested 26 species all were negative. Currently, this species has been documented in the upper Clinch River within the evaluation area. Primary threats to the spectaclecase include dam construction, siltation, and water quality degradation (NatureServe 2014).

Tan riffleshell (*Epioblasma florentina walkeri*): The tan riffleshell, endangered at the federal and Tennessee state level, is a subspecies of the yellow blossom (*E. florentina*) that occurs in headwater streams. Its shell is brown to yellow with green rays. Found in headwaters, riffles, and shoals in sand and gravel substrates (NatureServe 2014). The following fish species are known hosts for Tan riffleside glochidial: greenside darter (*Etheostoma blennioides*), fantail darter (*Etheostome flabellare*), redline darter (*Etheostoma rufilineatum*), and snubnose darter (*Etheostoma simoterum*) (Bogan and Parmalee 1983; Winston, M.R. and R. J. Neves 1997). Currently, this species has been documented in Big South Fork River and the upper Clinch River within the evaluation area. Primary threats to the tan riffleshell include dam construction, siltation, and water pollution (NatureServe 2014).

BENTHIC MACROINVERTEBRATES

Valley flame crayfish (*Cambarus deweesae*): The valley flame crayfish is endangered at the Tennessee state level. This aquatic crustacean is a borrowing species and in known to occur in the Clinch and Emory drainages in Anderson and Campbell Counties. This species is particularly tolerant to disturbances and has no known threats (NatureServe 2014).

TERRESTRIAL SPECIAL-STATUS SPECIES

There are several known federal and state-listed (including state species Deemed in Need of Management) species (wildlife and plants) that are present (or likely to be present) in the evaluation area or in the counties (Anderson, Campbell, Morgan, and Scott) associated with the evaluation area. Below is a specific discussion of the listed birds, mammals, reptiles, amphibians, and plants.

BIRDS

Bald eagle (*Haliaeetus leucocephalus*): The bald eagle, a USFWS bird of conservation concern species and protected under the Bald and Golden Eagle Protection Act, is a large eagle with dark brown feathers, white head feathers, and yellow beak, eyes, legs, and feet (TWRA 2014a). It breeds in forested areas near large bodies of water (TWRA 2014), from central Alaska to the Texas Gulf Coast and the Florida Keys (NatureServe 2014). Bald eagles winter on reservoirs and large rivers in Tennessee (TWRA 2014). Due to the reproductive threat caused by the pesticide DDT, there were no known successful bald eagle nests in Tennessee from 1961 to 1983 (TWRA 2014). However, since that first nest in 1983 near Dover, TN, there are now more than 175 nesting pairs in Tennessee (TWRA 2014). Most of these pairs remain in Tennessee year-round. Northern migrants arrive in Tennessee in late October, which boosts the state's bald eagle populations to a peak of 300-500 individuals between late January and mid-February (TWRA 2014). Currently, this species is known to occur in all four counties associated with the evaluation area (eBird 2014). However, most of these sightings are located outside the evaluation area, with one observation near the evaluation area's southern border (eBird 2014).

Barn owl (*Tyto alba*): The barn owl, a state species deemed in Need of Management, is a pale colored medium-sized owl, with a white, heart-shaped face (TWRA 2015). In Tennessee, this species typically inhabits upland and open areas, often around human structures such as farms (TDEC 2014). This species is known to occur in Anderson County (TDEC 2014), but no observations have been recorded within the evaluation area (eBird 2014).

Bewick's wren (*Thryomanes bewickii*): The Bewick's wren, a state endangered species, is a small insectivorous songbird with a distinct slender decurved bill (NatureServe 2014). In Tennessee, this species typically inhabits rural farms with brushy hedgerows and old buildings (TWRA 2014). Declines may be due to competition between species, habitat changes, inclement weather, and predators (NatureServe 2014). Currently, only 1-2 pairs are known to occur in Tennessee, near Rutherford County, which is not near the evaluation area (eBird 2014; TWRA 2014).

Black-billed cuckoo (*Coccyzus erythropthalmus*): The black-billed cuckoo, a USFWS bird of conservation concern species, is a slender, medium sized bird, with grayish-brown dorsal feathers and whitish ventral feathers (TWRA 2014). This species ranges from the western Great Plains east to Virginia, and prefers forests, forest edges, and thickets, frequently associated with water (TWRA 2014).The population of this species has declined in areas where riparian habitats are degraded or eliminated by land use practices (NatureServe 2014). This species is an uncommon migrant across Tennessee and rare summer resident, especially in western Tennessee (TWRA 2014). Spring migrants can be in Tennessee between late April and early June while fall migrants can be in Tennessee from mid-August to early October (TWRA 2014). This species has been observed in Anderson and Scott counties, including one observation within the evaluation area dated May 11, 2013 (eBird 2014).

Black-capped chickadee (*Poecile atricapillus*): The black-capped chickadee, a USFWS bird of conservation concern species, is a very small songbird with a black cap and bib, white cheeks and ventral side, gray dorsal, wing and tail feathers, and buffy-colored sides (TWRA 2014). This species prefers deciduous and mixed forests generally above 4,000 feet elevation across Alaska, Canada and the northern half of the contiguous United States (TWRA 2014). No known occurrences of black-capped chickadees occur within the evaluation area (eBird 2014), and no population threats or declined were discussed (TWRA 2014).

Blue-winged warbler (*Vermivora pinus*): The blue-winged warbler, a USFWS bird of conservation concern species, is a small yellow songbird with a black line through its eye, blue-gray wings and tail, and an olive-green back (TWRA 2015). In Tennessee, this species prefers shrubby, secondary growth habitats, such as abandoned farmlands and forest clearings which have scattered trees (TWRA 2015). This species has been recorded at several locations within the evaluation area (eBird 2015).

Canada warbler (*Wilsonia canadensis*): The Canada warbler, a USFWS bird of conservation concern species, is a small bird with bright yellow breast feathers with a black "necklace" (TWRA 2014). This species prefers large stands of deciduous and coniferous forests, with a dense shrubby understory from northern Georgia north to the boreal areas of Canada (TWRA 2014). Range wide, this species is declining (TWRA 2014) likely because of habitat loss on breeding and wintering grounds (NatureServe 2014). Also, this species is an uncommon migrant in Tennessee, becoming a locally common summer resident in eastern Tennessee (TWRA 2014). There are several observations of the Canada warbler around the evaluation area, including four observations within the NCWMA (2010, 2013, and 2014; eBird 2014).

Cerulean warbler (*Dendroica cerulea*): The cerulean warbler, a USFWS bird of conservation concern species and a state species deemed in Need of Management, is a small bird. Typical coloration is a bright sky-blue (males) to bluish-green (females) cap and dorsal feathers, and white (males) to cream-colored (female) ventral feathers (TWRA 2014). The cerulean warbler breeds in mature deciduous forests from northern Alabama, to southern Ontario, and west to the Great Plains (TWRA 2014). It is estimated that 80% of the global population of cerulean warblers, nest in the Appalachian Mountains, from the Cumberland Mountains north to West Virginia's mountains (TWRA 2014). A recent (December 2014) analysis of the distribution of known Cerulean warblers was determined that 80% (292 birds) and 85% of the high-density sites occur within the petition area (Welton 2014). Nowhere else in the species range do breeding densities exceed those found in the Cumberland Mountains of Tennessee, with six to ten

breeding pairs per ten acres recorded (Buehler, Welton, and Beachy 2006). The cerulean warbler habitat model (Beachy and Buehler 2005) indicates that 39% of the Cumberland Mountains (more than 80,000 ha) is currently potential breeding habitat for approximately 36,000 breeding pairs, if fully utilized. The ridgelines within the evaluation area include a large amount of cerulean warbler habitat (figure 4-X). However, this species is declining faster than any other eastern songbird, due to habitat loss caused by coal mining, development, and agriculture (TWRA 2014). Data from the Breeding Bird Survey show that this species has declined 4.1% per year between 1966 and 2007 (Murray pers. comm. 2010). There are at least 20 observations of the cerulean warblers within the evaluation area (eBird 2014).

Fox sparrow (*Passerella liaca*): The fox sparrow, a USFWS bird of conservation concern species, is a larger sparrow that has reddish-brown and white streaks on its chest, and is gray and red on its dorsal side (TWRA 2015). This species occurs in shrubby fields and woodland edges (often in multiflora rose hedgerows) in middle and western Tennessee during migration and winter, but there are no breeding records in the state (TWRA 2015). This species has been observed immediately adjacent to the evaluation area (eBird 2015).

Golden-winged warbler (*Vermivora chrysoptera*): The golden-winged warbler, a state species deemed in Need of Management and currently under review for listing under the ESA, is a small songbird with a black (males) or gray (females) throat and face patch, and a yellow crown and wing-patch (TWRA 2015). In Tennessee, golden-winged warblers, like blue-winged warblers discussed above, prefer secondary growth areas such as abandoned pastures, which have scattered trees and shrubs (TWRA 2015). This species was in the Northern Cumberlands Forest Resources Habitat Conservation Plan, but was recently removed from coverage under the habitat conservation plan since this species is associated with early successional communities, which TWRA is not taking (TWRA pers. comm. 2011). This species has been observed in several locations within and adjacent to the evaluation area (eBird 2015).

Henslow's sparrow (*Ammodramus henslowii*): The Henslow's sparrow, a USFWS bird of conservation concern species, is a small, brown sparrow that has a short tail, dorsal feathers that are dark brown streaked, a white throat and belly, and an olive-green nape (TWRA 2015). In Tennessee, Henslow's sparrows prefer overgrown fields and meadows that are typically wet, and have standing dead vegetation or scattered low shrubs or tree saplings from which to call (TWRA 2015). This species has been observed in two locations within the evaluation area (eBird 2015).

Kentucky warbler (*Geothlypis formosa*): The Kentucky warbler, a USFWS bird of conservation concern species, is a small yellow bird, with black face markings and greenish dorsal feathers (TWRA 2015). In Tennessee, Kentucky warblers prefer large forest stands with mature trees and a thick understory (TWRA 2015). This species has been observed in many locations within the evaluation area (eBird 2015).

Least bittern (*Ixobrychus exilis*): The least bittern, a USFWS bird of conservation concern species, is a small heron, with a buffy-yellow long neck and sides (TWRA 2014). This species prefers marshes with tall, emergent vegetation, such as cattails, giant cutgrass, and rushes, with areas of open water throughout the eastern United States (TWRF 2014) This secretive wetland bird probably has declined over the last century from impacted (drained, filled, degraded) wetlands (NatureServe 2014). This species has not been observed in the evaluation area, but has been observed in a few adjacent locations (eBird 2014).

Loggerhead shrike (*Lanius ludovicianus*): The USFWS bird of conservation concern species, is a robin-sized gray songbird, with a black face mask and white throat (TWRA 2015). In Tennessee, this species prefers short grasslands (including cropland, pastureland, and old fields) with isolated trees or shrubs, which have been lost to development or succession (TWRA 2015). This species has not been observed within the evaluation area, but has been observed in a few places adjacent to the evaluation area (eBird 2015).

Louisiana waterthrush (*Parkesia motacilla*): The Louisiana waterthrush, a USFWS bird of conservation concern species, is a small thrush-like species that is brown except for a distinctive white eye-stripe that extends to the neck (TWRA 2014). This species prefers forested streams in hardwood forests across most of the eastern United States (TWRA 2014). Yet this species may be declining due to habitat loss (TWRA 2014). This species has been observed approximately four times within the evaluation area, and a dozen observations adjacent to the NCWMA (eBird 2014).

Northern saw-whet owl (*Aegolius acadicus*): The northern saw-whet owl, a USFWS bird of conservation concern and state threatened species, is the smallest avian predator (8-inches), with mostly mottled brown and white feathers, a round head and yellow eyes with black pupils (TWRA 2014). This species occurs throughout forests in the western and eastern portion of United States (TWRA 2014). In Tennessee, most nesting records are from high elevations (above 5,000 feet) in spruce-fir forest. During migration they have been captured in mist nets in deciduous and mixed forests primarily in central and eastern Tennessee (TWRA 2014). However, the northern saw-whet owl is a locally rare permanent resident in the eastern Tennessee mountains, and a rare migrant and winter resident across Tennessee (TWRA 2014). This species is listed as state threatened because of its small population size (TWRA 2014). No observations have been recorded within the evaluation area (eBird 2014).

Prairie warbler (*Setophaga discolor*): The prairie warbler, a USFWS bird of conservation concern species, is a bright yellow, small songbird that has an olive green back, and black markings on its sides (TWRA 2015), In Tennessee, this species breeds in a variety of low elevation shrubby habitats, including early seral forests and open fields (TWRA 2015). This species has been observed in several locations within the evaluation area (eBird 2015).

Prothonotary Warbler (*Protonotaria citrea*): A USFWS bird of conservation concern species, is a small, golden yellow songbird, with gray wings and a black eye (TWRA 2015). In Tennessee, this species breeds in wooded swamps, flooded bottomland forests, and along slow-moving rivers (TWRA 2015). This species has not been observed within the evaluation area, though there are some recorded observations nearby (eBird 2015).

Red crossbill (*Loxia curvirostra*): A USFWS bird of conservation concern species, is a small, dull red (males) or green (females) songbird that has a bill that is crossed in fledglings and adults to extract seeds from pinecones (TWRA 2015). In Tennessee, this species prefers mature coniferous forests (TWRA 2015). This species has been observed in one location within the evaluation area and two just outside the evaluation area (eBird 2015).

Red-headed woodpecker (*Melanerpes erythrocephalus*): The red-headed woodpecker, a USFWS bird of conservation concern species, is a medium sized bird with a red head, white body and black wings (TWRA 2015). In Tennessee, this species is a year-round resident that breeds in open deciduous woodlands, river bottoms, groves of dead and dying trees, orchards and parks (TWRA 2015). This species has been observed in several locations within the evaluation area, and many locations in adjacent parcels (eBird 2015).

Rusty blackbird (*Euphagus carolinus*): The rusty blackbird, a USFWS bird of conservation concern species, is 9 inches long with males having a greenish gloss during the breeding season, and rusty-colored feather tips during the nonbreeding season (TWRA 2014). This species breeds mostly in the boreal forest of Canada and Alaska, and winters mostly in the southeast United States (TWRA 2014). In Tennessee, rusty blackbirds are uncommon winter residents that are typically observed in flooded or wet hardwood forests, beaver ponds, and pond edges (TWRA 2014).This species possibly has the most rapidly declining population in North America (TWRA 2014), likely from the degradation and reduction of wintering woodland wet habitats (NatureServe 2014). This species has been observed in Anderson, Campbell, and

Morgan Counties, with two observations located on the eastern portion of the NCWMA in the evaluation area (eBird 2014).

Sharp-shinned hawk (*Accipiter striatus*): The sharp-shinned hawk, a state species deemed in Need of Management, is a small hawk with gray dorsal feathers and reddish-brown ventral feathers (TWRA 2015). This species also has a distinctive barred, long, narrow, square-tipped tail with a white terminal band (TWRA 2015). In Tennessee, this species typically inhabits large stand of deciduous, coniferous, and mixed pine-hardwood forests, and often in towns and parks in the winter. This species has been observed in several locations within the evaluation area and many areas nearby (eBird 2015).

Short-eared owl (*Asio flammeus*): The short-eared owl, a USFWS bird of conservation concern species, is a medium-sized owl that has a large, round head, with dark patches around yellow eyes (TWRA 2015). In Tennessee, this species prefers open areas, such as brushy fields (TWRA 2015). This species has not been observed in or near the evaluation area (eBird 2015).

Swainson's warbler (*Limnothlypis swainsonii*): The Swainson's warbler, a USFWS bird of conservation concern and state species deemed in Need of Management, is a small bird with brownish-olive dorsal feathers, dull white ventral feathers, a white eye line, and a rusty cap (TWRA 2014). The breeding range of this species is from eastern Oklahoma to northern Florida (TWRA 2014). The Swainson's warbler prefers mountainous sites in eastern Tennessee with dense evergreen understories associated with moist forest ravines (TWRA 2014). This species is state-listed because of a loss of breeding habitat, especially in western Tennessee (TWRA 2014). This species was in the Northern Cumberlands Forest Resources Habitat Conservation Plan, but was recently removed from coverage under the habitat conservation plan since this species is associated with aquatic communities that TWRA was proposing to remove (TWRA pers. comm. 2011). This species has been observed in two locations in the western portion of the evaluation area, and in all four of the associated counties (eBird 2014).

Wood thrush (*Hylocichla mustelina*): The wood thrush, a USFWS bird of conservation concern species, is a medium-sized bird, with orange-brown dorsal feathers, and white ventral feathers with black spots (TWRA 2014). This species breeds in a wide variety of deciduous and mixed forests but needs a well-shaded understory, small trees with low, exposed branches, and a fairly open forest floor with leaf litter (TWRA 2014). This species has been observed in several locations within the evaluation area (eBird 2014).

Worm-eating warbler (*Helmitheros vermivorum*): The worm-eating warbler, a USFWS bird of conservation concern species, is a small buffy-olive bird with a black eye stripe and black crown stripes (TWRA 2014). This species breeding range is from southern Connecticut, to northern Alabama (TWRA 2014). In eastern and central portions of Tennessee, this species breeds in large stands of mature deciduous or mixed deciduous-coniferous forest with patches of dense understory, typically on steep slopes (TWRA 2014). Similar to several species above, this species' population is declining as breeding forests become fragmented (TWRA 2014). There are about a dozen observations of this species on the NCWMA, and many more on adjacent lands (eBird 2014).

MAMMALS

Gray bat (*Myotis grisescens*): The gray bat, a federally endangered species, is a gray to reddish-colored migratory small bat that resides in caves in forested areas (NatureServe 2014) primarily in Alabama, Arkansas, Kentucky, Missouri, and Tennessee (USFWS 2009). The species is especially vulnerable due to its loyalty to particular caves. It is very sensitive to disturbance, including the mere presence of humans with lights; disturbance may result in bats moving to less favorable roosting places. Disturbance can be minimized by the protection of buffers of undisturbed vegetation around the entrances of caves inhabited

by gray bats; the protection of wooded travel corridors between roosting and foraging sites; and the carefully controlled and monitored use of herbicides and pesticides in areas adjacent to foraging and roost sites (NatureServe 2014).This species uses only eight caves in Tennessee for hibernation, which increases its risk of vulnerability to habitat destruction and white-nosed syndrome (TWRA 2014). This species has been observed in most of the eastern two-thirds of the state, but only in Anderson and Campbell Counties (Tennessee Bat Working Group 2014a). The USFWS (2014) has no records of any gray bat hibernacula within or near the evaluation area. One of these caves is located in Hawkins County, where the population was estimated at 270,000 bats.

Indiana bat (*Myotis sodalis*): The Indiana bat, a federally endangered species, is a dull grayish chestnut small bat that is a permanent resident in Tennessee (NatureServe 2014), and ranges from western Iowa and eastern Oklahoma west to the New England states (Tennessee Bat Working Group 2014b). It hibernates in dense clusters of up to 5,000 individuals and spends summers in forests. In summer, Indiana bat habitat consists of wooded or semi-wooded areas, often along streams. Hibernacula can be affected from deforestation which can alter cave temperature, humidity, and air and water flow. Compatible forest management is most important for ensuring long-term availability of suitable summer habitat. In 2009, this species national population was estimated at 387,000 bats, which is less than half the 1967 population (USFWS 2014d). Currently this species occurs in Anderson and Campbell Counties (Tennessee Bat Working Group 2014b); however, the USFWS (2014d) has no records of any Indiana bat hibernacula within or near the evaluation area.

Northern Long-eared Bat (*Myotis septentrionalis*): The northern long-eared bat is currently (February 2015) federally listed as threatened species (USFWS 2015), though is not state-listed in Tennessee (TWRA 2014). This species, while known to occur in Tennessee, is an uncommon resident in caves, attics, under shutters or tree bark (TWRA 2014). While the northern long-eared bat has several threats to its populations such as wind farms, loss of habitats and hibernacula, the main threat is white-nosed syndrome (USFWS 2014d). This disease has spread rapidly throughout this species' population, and listing would be unlikely if it were not for this disease (USFWS 2014a). While there are no documented northern long-eared bat hiberacula records within the evaluation area, a hibernacula has been documented within a mile of the southeast corner of evaluation area, just below the Buffalo Mountain Wind Farm. Therefore, it is likely that northern long-eared bats are using terrestrial habitats, small caves or abandoned mines within portions of the evaluation area.

REPTILES AND AMPHIBIANS

Northern pinesnake (*Pituophis melanoleucus melanoleucus*): The northern pinesnake, a state threatened species, is an upland species found in pine and mixed pine and oak forest habitats, frequently along dry mountain ridges. It prefers areas with well-drained sandy soils (TDEC 2014). This large, heavy-bodied constrictor is white, yellowish, or light gray with dark brown to reddish blotches on the sides and back that are lighter toward the tail and darker near the head (TWRA 2014). This species is known to occur in Anderson and Morgan Counties and is potentially present within the evaluation area (TDEC 2014). Primary threats to the northern pinesnake include a decline in habitat quality, primarily due to fire suppression, and road mortality (TWRA 2014).

TERRESTRIAL INVERTEBRATES

No federally or state-listed terrestrial invertebrates occur within the evaluation area. For those terrestrial invertebrates listed in chapter 4 that are ranked global or state imperiled species, specific habitat information can be found on the Anderson and Campbell county species lists.

PLANTS

Cumberland rosemary (*Conradina verticillata*): Cumberland rosemary, federally and state threatened, is a low (less than 20 inches), aromatic, perennial evergreen shrub, forming clumps or mats of sprawling branches that root at the nodes. Cumberland rosemary is endemic to the upper Cumberland Plateau in north-central Tennessee and adjacent southeastern Kentucky and restricted there to floodplain habitats. Suitable habitats are full to moderate sunlit gravel bars in floodplains of the Big South Fork and its major tributaries. Substrate can vary from dense deep sands to cobble boulders that are well drained. Populations occur on boulder/cobble/gravel bars, sand bars and islands, sandy river banks, floodplains in river gorges, and similar sunny riparian areas where seasonal flooding minimizes competition and creates new gravel-bar habitats for colonization. High quality populations are annually scoured by spring flooding to preserve and restore open conditions. Annual floods also act as a disperser through the transport of viable plant fragments downstream. Common associates include green-headed coneflower (*Rudbeckia laciniata*), along with globally rare plants such as large-flowered Barbara's-buttons (*Marshallia grandiflora*) and Virginia spiraea (NatureServe 2014).

As of 2011, there are 11 occurrences that have been observed at some point between 1989 and 2011 and 94 occurrences were believed to be extant in Tennessee (USFWS 2011c). Most occurrences are very small and isolated from others. Fewer than 4,000 total individuals were estimated at the known locations when the 1996 plan was published (USFWS 2011c). This species' abundance and distribution has probably been reduced by dam construction and by water pollution from nearby coal mining. Habitat destruction due to intensive recreational use also poses a threat (NatureServe 2014).

Virginia spirea (*Spiraea virginiana*): Virginia spiraea, federally threatened and state endangered, is a clonal shrub often occurring in dense clumps that grow up to approximately 4 feet high. This species occurs along creek edges with margins of exposed rock and piled detritus, bars of gravel, rubble and/or boulders, and including dolomitic limestone. It occurs in alluvial silt collected within cracks in the bedrock. These sites experience a regime of periodic flooding. Elevations range from 850–1,420 feet (NatureServe 2014). Virginia spiraea is endemic to the southern Appalachians and occurs from Pennsylvania and Ohio south to Georgia and Tennessee where it occurs on streams that drain into the Ohio River and primarily within the Appalachian (Cumberland) Plateau and Blue Ridge physiographic regions. Virginian spiraea is especially vulnerable to land-use conversion and habitat fragmentation due to its limited range, small number of populations, and lack of sexual reproduction. Many sites are threatened by changes in hydrology by impoundment and by impact from recreational use, hydroelectric facilities, and run-off debris (NatureServe 2014).

Cumberland sandwort (*Minuartia cumberlandensis*): Cumberland sandwort, federally and state endangered, is a perennial herbaceous plant that grows in cool, humid, rockshelters formed through differential weathering of sandstone strata. This species grows on sandy floors of these rock houses and in similar situations such as beneath sandstone ledges. The few species that share this habitat with Cumberland sandwort include Lucy Braun's white snakeroot (*Eupatorium luciae-brauniae*) and featherbells (*Stenanthium gramineum*). Cumberland sandwort is narrowly endemic to the Cumberland Plateau of northcentral Tennessee and adjacent Kentucky. There are currently 21 to 80 occurrences known with most of them concentrated within a small portion of the overall range, in Pickett State Park in the Big South Fork National River and Recreation Area. Most of the national area's populations are located in rockshelters or lower ledges of the sandstone cliffline that rims the Big South Fork River gorge. Threats include cliffline erosion, impact associated with recreational use, and cutting of trees away from the rockhouses increasing the sunlight and evaporation thus drying out the habitat (NatureServe 2014). The officially-listed taxon is *Arenaria cumberlandensis*, but the 2013 five-year review available on the USFWS website notes the taxonomic change to *Minuartia* is accepted but not under the ESA until a technical correction to the list of endangered and threatened species is published in the Federal Register.

Pink lady's slipper (*Cypripedium acaule*): Pink lady's slipper, state commercially exploited, is a large, showy orchid that grows six to 15 inches tall. Pink lady's slipper has a wide range in eastern Canada and the United States, and is common in parts of this range. Pink lady's slipper occurs in a wide variety of habitats growing in mixed hardwood coniferous forests of pine and hemlock on rocky/mossy slopes, and in drier oak or coniferous woodlands in acidic soils. Threats include exploitation for horticultural or medicinal purposes and habitat loss and disturbance in parts of its range (NatureServe 2014).

Pale corydalis (*Corydalis sempervirens*): Pale corydalis, state endangered, is the only pink flowered corydalis and is an annual or biennial with one to several branched stems reaching up to 51 inches tall. The species is characteristic of two habitats including rocky sites on dry to dry-mesic, well-drained, often acidic soils; and recently disturbed sites, including burned areas. Pale corydalis occurs on exposed rocky areas, ledges, and cliffs from the Carolinas to Canada and Alaska and is a rock outcrop obligate in the Appalachians. Pale corydalis has a limited distribution and occurs in restricted, infrequent habitat (NatureServe 2014).

American ginseng (*Panax quinquefolius*): American ginseng, state special concern species commercially exploited, is an herbaceous, perennial plant with bright red fruits and palmate, serrated leaves. Plants occur primarily in rich, cool, moist, but not extremely wet hardwood-dominated or mixed woods, under a closed canopy, especially on slopes or ravines, and often over a limestone or marble parent material on soil with a good humus component. Plants occasionally occur in rocky woods, among swampy hardwoods, or at the edges of dense woods. Associated species include bloodroot (*Sanguinaria canadensis*), black cohosh (*Cimicifuga racemosa*), maidenhair fern (*Adiantum pedatum*), and yellow lady's slipper (*Cypripedium pubescens*). American ginseng was formerly widespread in the Appalachian and Ozark regions but due to its popularity and unique habitat requirements, the wild plant has been overharvested, as well as lost through destruction of its habitat, habitat fragmentation, and deer browsing, and is rare in most parts of the United States and Canada (NatureServe 2014).

American ginseng occurs fairly frequently in major portions of its range (Appalachia and the Ozarks) but typically have very few plants per occurrence (NatureServe 2014).

Ozark bunchflower (*Melanthium woodii*): Ozark bunchflower, state endangered, is a perennial herb forming bulbs and spreading by means of underground rhizomes. The species occurs primarily on slopes and stream terraces in moist, hardwood forests, usually over basic soils. Threats include logging and clearing of hardwood forests, overbrowsing by deer, and competition from exotic pest plants (NatureServe 2014).

Tubercled rein-orchid (*Platanthera flava* var. *herbiola*): Tubercled rein-orchid, state threatened, is a perennial herb that rarely blooms and chiefly reproduces vegetatively. Tubercled rein-orchid prefers wet prairies and meadow, swales in mesic prairies, or the sandy or peaty habitats along the edges of marshes, swamps, or lakeshores. These habitats are in full sum or in the partial shade of scattered shrubs such as willows (*Salix* spp.) and dogwoods (*Cornus* spp.). This unusual orchid is relatively widespread in the northeastern United States and extreme southeastern Canada, but appears to be rare or threatened throughout most of its range. The extensive loss of prairies and wetland habitats is a serious threat to this species along with habitat fragmentation and forest management practices. Tubercled rein-orchid is especially vulnerable to sedimentation and succession (NatureServe 2014).

Butternut (*Juglans cinerea*): Butternut, state threatened, is a large deciduous nut-bearing tree reaching nearly 100 feet in height. Butternut achieves optimal growth on well-drained soils of bottomlands and floodplains, but rarely occurs in pure stands, and seldom found on dry, compact, or infertile soils. Butternut typically grows in rich mesophytic forests, lower slopes, ravines, and various types of bottomland, including banks and terraces of creeks and streams. In Tennessee, butternut, occurs along

creek bottoms in mesic forests and on lower slopes. The species is being seriously impacted by a canker fungus that is spreading rapidly through its range, and few stands remain uninfected. Butternut is an important source of mast for wildlife, especially in the northern part of its range, where black walnut does not occur (NatureServe 2014).

Goldenseal (*Hydrastis canadensis*): Goldenseal, state commercially exploited, is a perennial herb with a single, erect, hairy stem 10 to 15 inches tall that occurs in rich woods, wooded slopes and valleys on average, medium, well-drained soil in dense shade. The species grows best in rich, mesic hardwood forest, especially those underlain by limestone or alkaline soils, but is also known from slightly acidic soils too. These forests are often second growth forests with various species composition from region to region. Areas with goldenseal tend to have a nice collection of spring wildflowers and fern diversity is likely higher than surrounding areas. Due to its use as an herbal supplement the species has been primarily wild-harvested and over-collection of the plant is a predominant threat (NatureServe 2014).

As of 2012, there were approximately 700 occurrences in the United States and Canada with 154 in Tennessee. Habitat destruction is a primary threat throughout its range. This along with the interaction and compounding intensification of over-collection it is suggested that these two threats may be increasing the rate of decline in areas of its range where these two threats are actively occurring. Invasive species is also a threat along with timber operations and all-terrain vehicle trails.

Hairy willowherb (*Epilobium ciliatum*): Hairy willowherb, state threatened, is a clumping perennial often exceeding 4.9 feet in height usually occurring in wetlands, but may be found in a great variety of habitats, including moist places, stream-sides, ditches, ponds, roadsides, and recently cleared areas and wasteland. The species is highly threatened by land-use conversion, habitat fragmentation, sedimentation, and forest management practices (NatureServe 2014).

Halberd-leaf tearthumb (*Polygonum arifolium*): Halberd-leaf tearthumb, state threatened, is a branched, sprawling annual plant with square stems and many prickles that are turned backwards. Halberd-leaf tearthumb primarily occurs in wet areas including marshes, swamps, wet ravines, and wet meadows as well as along rivers (NatureServe 2014).

Narrow-leaf ramps (*Allium burdickii*): Narrow-leaf ramps, state threatened commercially exploited, is a narrow leaf perennial herb that occurs in rich deciduous upland woods, wooded bluffs, wooded areas along rivers and streams, and cemetery prairies. The species is highly threatened by forest management practices and over-harvest, and to a lesser extent by land-use conversion and habitat fragmentation (NatureServe 2014).

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APPENDIX D: ACOUSTIC MEASUREMENT AND ASSESSMENT OF IMPACTS OF SURFACE COAL MINING IN NORTH CUMBERLAND WILDLIFE MANAGEMENT AREA AND EMORY RIVER TRACTS CONSERVATION EASEMENT AREA

Acoustic Measurement and Assessment of Impacts of Surface Coal Mining in North Cumberland Wildlife Management Area and Emory River Tracts Conservation Easement Area

Final Report

May 28, 2012

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Acoustic Measurement and Assessment of Impacts of Surface Coal Mining in North Cumberland Wildlife Management Area and Emory River Tracts Conservation Easement Area

Executive Summary

Introduction

On September 29, 2010, the State of Tennessee petitioned the Office of Surface Mining (OSM) to designate the ridgelines within North Cumberland Wildlife Management Area (NCWMA) and Emory River Tracts Conservation Easement (ERTCA) as unsuitable for surface coal mining. If approved by the Secretary of the Interior, the petition would prevent surface mining of coal for 600 feet on each side of the ridgelines in the designated area, creating a 1,200 foot ridge top corridor encompassing 67,326 acres. As part of the evaluation process of the petition, OSM will prepare an Environmental Impact Statement (EIS). One of the topics that will be evaluated is acoustic impacts of coal mining. The purpose of this study was to assess potential acoustic impacts of surface coal mining in the petition area and surrounding NCWMA and ERTCE areas, and, where data are available, assess acoustic impacts of other human-caused sounds in the NCWMA and ERTCE areas, including vehicles (including ORVs), logging, hunting, biking, hiking and other similar activities. A computer noise model (SoundPlan) was used to model the current acoustic impacts of two operational mines in the NCWMA. Land cover in the NCWMA and ERTCE areas consists primarily of deciduous forests (85%), mixed deciduous/coniferous forests (5%), grassland (5%), and several others totaling 5%. The land cover type in this area was based on the USGS National Land Cover Database; however, it should be noted that land cover is constantly changing. Logging is common in the NCWMA and ERTCE areas, and logged areas can change from mature deciduous forest to open and back to early succession deciduous forest within a few years.

Definitions

A-Weighting (dBA): A-weighting is used to account for differences in human hearing sensitivity as a function of frequency. A-weighting de-emphasizes the high (6.3 kHz and above) and low (below 1 kHz) frequencies, and emphasizes the frequencies between 1 kHz and 6.3 kHz, in an effort to simulate the relative response of human hearing.

Background Ambient Sound Level (L_{90}): L_{90} is commonly used to indicate the residual or background sound level in the absence of most transient noise events. L_{90} is frequently used for establishing the sound level for assessing changes to the environment.

Decibel (dB): A logarithmic measure commonly used in the measurement of sound. The decibel provides the possibility of representing a large span of signal levels in a simple manner as opposed to using the basic pressure unit Pascal. The difference between the sound pressure for silence versus a loud sound is a factor of 1,000,000:1 or more, therefore it is less cumbersome to use a small range of equivalent values: 0 to 130 decibels.

Existing Ambient Sound Level (L_{50}): The sound level of all sounds in a given area, including all natural sounds as well as all mechanical, electrical and other human-caused

sounds. The existing ambient sound level can be characterized by the L_{50} exceedence level (i.e., the median).
L_{eq} (Equivalent Sound Level): The logarithmic average (i.e., on an energy basis) of sound pressure levels over a specific time period. L_{eq} must be used carefully in quantifying background ambient sound levels because occasional loud sound levels may heavily influence (increase) the L_{eq} value, even though sound levels for that period of time are typically lower.

Results
Acoustic measurements were made at seven locations in the NCWMA units between October 29 and November 27, 2011; 1759 hours of acoustic data were collected. Measurement locations were selected to provide two data sets: existing ambient sound levels (absent coal mining sounds), and sound levels of coal mining operations (at the two operating mines in the area, Southern Coal and Triple H).

Ambient Sound Levels
Ambient sound levels absent coal mining sounds were determined for the primary land cover types in the petition area, deciduous forest and mixed forest (>90% of petition area). Metrics were computed for two ambient situations, one with flowing water sounds and one without. Flowing water, while a natural sounds, resulted in elevated (by about 10 dBA) ambient sound levels. Existing ambient (L_{50}), background ambient (L_{90}), and average sound (L_{eq}, logarithmic average) levels for three different time periods were determined for both ambient situations. Table 1 shows sound levels for two types of ambient (with and without water influence) during three time periods, full twenty four hour period (0000-2400), typical daytime hours (0700-1900, and typical nighttime hours (1900-0700).

Table 1. Background ambient (L_{90}), existing ambient (L_{50}) and energy-averaged (L_{eq}) sound levels in the NCWMA and ERTCE areas for two ambients (with and without water influence) and three time periods.

		Time Period	Leq	L10	L50	L90
HHH Sites (without water)	All Hours	0000-2400	32.5	33.2	30.1	28.3
	Daytime	0700-1900	37.9	39.0	32.8	29.4
	Nighttime	1900-0700	29.9	29.6	27.5	27.2

		Time Period	Leq	L10	L50	L90
ROBL Sites (with water)	All Hours	0000-2400	42.3	45.0	39.8	36.3
	Daytime	0700-1900	42.2	44.7	39.1	35.4
	Nighttime	1900-0700	42.3	45.2	40.3	36.7

Coal Mine Sound Levels
Two coal mines currently operate in the study area, the National Coal mine and the Triple H mine. The National Coal mine is a large mine, operating 24 hours a day, 7 days per week, while the Triple H mine is relatively small, operating during daytime hours only

and on weekdays only. Table 2 contains the results of the sound level measurements at two current coal mines during the three time periods mentioned above.

Table 2. Sound levels of two coal mines in the NCWMA area for three time periods.

		Time Period	Leq	L10	L50	L90
National Coal (@1312 ft)	All Hours	0000-2400	70.1	68.7	62.6	56.4
	Daytime	0700-1900	71.4	69.3	64.2	56.7
	Nighttime	1900-0700	67.9	64.0	61.6	54.9

		Time Period	Leq	L10	L50	L90
Triple H (@ 1066 ft, weekdays)	All Hours	0000-2400	39.4	41.4	35.1	31.8
	Daytime	0700-1900	49.9	53.6	47.1	37.1
	Nighttime	1900-0700	30.7	31.4	29.7	28.5

Table 3 provides an estimate of the total acreage that would likely experience elevated sound levels due current mining operations (National Coal and Triple H) as well as modeled results of ten hypothetical mines along ridge lines in the petition area. One expects the modeled impacts of ten hypothetical mines to be greater than the National Mine because these ten mines are along the ridgelines in the petition area, they are elevated in nature and their propagated sounds are less influenced by terrain blockage.

Table 3. Areas of acoustic impact of National and Triple H coal mines (no haul truck roadways) and ten hypothetical ridgeline mines in the petition area. (values are in units of acres)

dBA	National Coal Mine	Triple H Coal Mine	Average areas of impact from ten hypothetical ridge mines	Standard Dev. of estimate of ten hypothetical mines
>40 dBA	3,639	107	9,626	2,559
>45 dBA	1,149	46	2,841	1,238
>50 dBA	348	12	915	406
>55 dBA	141	6	240	63

Coal Haul Truck Sound Levels

Coal haul trucks were measured at the National Coal mine. A typical hour (1000-1100 on Nov. 9, 2011) revealed nine trucks with a median 77.1 dBA @ 50 ft (range 73.9-78.4 dBA), and duration of each >45 dBA averaged 1:28 minutes. In the case of a future mine location, it was not possible to model potential coal truck impact without knowing the mine location and the proposed roadway to the mine. However, it is possible to model the potential impact of coal haul trucks on a unit, per-mile basis, and future assessments can use this estimate per mile when specific locations are known. The impacts of 5 coal haul trucks per hour for a 1-mile distance on both the National Coal Mine road and the

Triple H road are shown in Table 4. As with other potential impacts, variability can be considered due to terrain differences.

Table 4. Modeled area of impacts (in acres) of 5 coal haul trucks per hour at 30 mph for a 1-mile distance on two different roads.

dBA	National Coal Mine Road	Triple H Mine Road
>40 dBA	441	428
>45 dBA	288	244
>50 dBA	170	121
>55 dBA	76	63

Blast Sound Levels

A single blast event was measured during the acoustic measurements at the mine sites. The blast event occurred at the Triple H mine, on October 31, 2010, at 13:39:46. The maximum sound level at 1066 ft was 75.2 dBA, and the total event duration was about 10 seconds (Table 5). Data from this blast event was used to model blast impacts at the Triple H mine. The short term area impacted by the blast event was considerably larger than the area impacted by normal mining sounds; however, the duration of this impact was less than 10 seconds. As with the ten hypothetical mines modeled, we would expect a great deal of variability in the area impacted due to terrain features.

Table 5. Leq contours and area in acres impacted by mining sounds and a single blast event at Triple H mine.

dBA contour	Triple H Mine only	Triple H Mine and single blast event
>40 dBA	107	833
>45 dBA	46	303
>50 dBA	12	140
>55 dBA	6	72

Coal Mine Sounds Compared to Non-coal Mining Sounds

Table 6 provides a comparison of the mining operation sound levels and other sources at similar distances. Sound levels of sounds other than mining sounds were adjusted to the same distance (1312 ft) used to measure the coal mining sounds to provide a relative comparison of sound sources in the petition area (adjustment assumed point and line source propagation based on the nature of the source). It is important to note that re-computing sound levels to different distances than actually measured may introduce some error.

Table 6. Sound levels of coal mining and other human activities in and near NCWMA.

Sound Source	Sound Level @ 50 feet	Sound Level @ 1312 feet	Source
Surface Coal Mine, large	NA	62.6 dBA	National Coal mine, this report
Surface Coal Mine, small	NA	48 dBA (1066 ft.)	Triple H mine, this report
Logging Operation	75.5 dBA	47.1 dBA	CA Depart. Forestry 2006
Interstate Highway (70 mph)	76.8 dBA	62.6 dBA	TN Depart. Transportation; FHWA TNM
Highway (45-55 mph)	60.8 dBA	46.6 dBA	TN Depart. Transportation; FHWA TNM
ORV (at 25 mph)	69.7 dBA	35.3 dBA	TN NCWMA regulations; this report

Summary

Sound levels generated by a large contour strip mining operation are high compared to ambient baseline levels. These sound levels diminish as one gets further away from the operations. Coal mining sounds are fairly constant throughout the day when the mine is operating 24 hours/day. Under current OSM mining regulations in this region, the area of the actual mine is limited to 1500 linear feet along the contour elevation. Compared to other current human-caused sound sources in the NCWMA and ERTCE areas such as vehicles (including ORVs) and logging, a large coal mine such as National Coal, although louder than many other sources, may acoustically impact a smaller area since it is confined to a limited area.

Potential acoustic impacts of a large contour strip coal mine, based on a criterion of >55 dBA as a level of significance, could occur on approximately 240 acres (average of 10 modeled hypothetical mines; SD=63). Potential acoustic impacts based on a criterion of >45 dBA as a level of significance, could occur on approximately 2841 acres (average of 10 modeled hypothetical mines; SD=1238). The potential impacts of a large ridgeline mine were found to be generally higher than the National Mine due to the elevated nature and fewer terrain effects along the ridgeline.

Reactions to human-caused sounds by humans and wildlife are extremely variable; some individuals and species are very tolerant while others are not. It is difficult to assign a single dBA level of significance when assessing potential impacts to either humans or wildlife. The use of levels of significance of 55 dBA for humans and 45 dBA for wildlife were chosen due to several supportive references in the literature (see pages 37-39) and recommendations by agencies and organizations. If mining activity is proposed at a specific location, a more thorough review of human use and wildlife species at that location would be warranted to determine if these levels of 55 dBA and 45 dBA are appropriate.

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Introduction

On September 29, 2010, the State of Tennessee petitioned the Office of Surface Mining (OSM) to designate the ridgelines within North Cumberland Wildlife Management Area (NCWMA) and Emory River Tracts Conservation Easement (ERTCA) as unsuitable for surface coal mining. The areas covered by the petition include the Royal Blue, Sundquist and New River units that comprise the North Cumberland Wildlife Management area. The petition area also includes the Emory River Tract Conservation Easement, which is managed by Frozen Head State Park for public use. A portion of the Cumberland Trail also traverses the property. Much of the property covered by the petition is part of Tennessee's 2007 "Connecting the Cumberlands" conservation initiative. Lands in this initiative are managed by the state of Tennessee for hunting, fishing, hiking, camping, wildlife viewing and other outdoor recreational activities. The petition states that surface mining would be inconsistent with such uses. Other activities that occur in the petition include mountain biking, logging, and off road vehicle use.

If approved by the Secretary of the Interior, the petition would prevent surface mining of coal for 600 feet on each side of the ridgelines in the designated area, creating a 1,200 foot ridge top corridor encompassing 67,326 acres. This area contains most of the older growth forest that exist in the area as well as a diverse array of habitats and wildlife, some of which are considered rare or threatened. The ridgelines covered in the petition include about 40 percent of the total North Cumberland Wildlife Management Area and Emory River Conservation Easement Tract.

As part of the evaluation process of the petition, OSM will prepare an Environmental Impact Statement (EIS). One of the topics that will be evaluated is esthetics; OSM has broken the esthetics topic into visual and auditory impacts. The purpose of this study was to assess potential auditory impacts.

Objectives

The objectives of this study were to determine the availability of existing acoustic data, collect additional data if necessary, and analyze the data to establish the soundscape baseline of the area identified as the study area. Where acoustic data are available for the activities listed below, provide an assessment of the impacts of surface coal mining, and other likely land use activities such as logging, off road vehicle use, and other recreation including hunting, fishing, camping, hiking (including wilderness races), mountain biking, etc., on the soundscape of the study area.

Study Area

The study area is located within the coalfields in Anderson, Campbell, Morgan and Scott Counties, Tennessee. These areas include the Royal Blue, Sundquist and New River units that comprise the North Cumberland Wildlife Management area, as well as the Emory River Tract Conservation Easement. The ridgelines covered in the petition include about 40 percent of the total North Cumberland Wildlife Management Area and Emory River Conservation Easement Tract. The location is to the west –northwest of Knoxville, TN. Figure 1 shows the location of the study area shown in relationship to Tennessee cities. Figure 2 shows a detailed breakdown of the NCWMA and Emory

River Tracts, along with the petition area. The petition primarily requests designation of 600 feet on either side of the ridgelines in the NCWMA and ERCTE areas as unsuitable for surface mining, a total of 67,326 acres. The wildlife management areas are managed for multiple uses including recreation and resource extraction. The recreational uses include hunting, fishing, off road vehicle riding, rock climbing, hiking, camping, mountain biking, wilderness racing (running/walking), and other outdoor activities. The extraction uses include logging, surface and underground coal mining, oil and gas well development. The Cumberland Trail State Park also passes through the study area more or less from southwest to northeast.

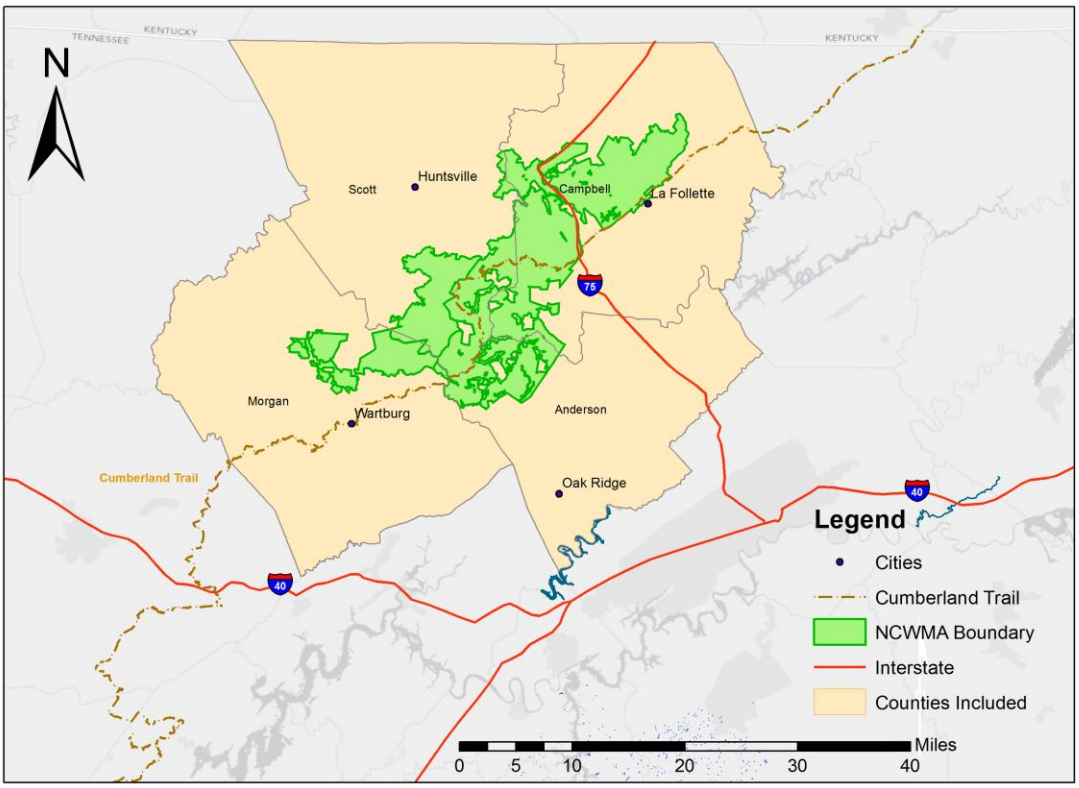

Figure 1: Location of NCWMA and ERTCE relative to Tennessee cities.

Two coal mines are currently operational in the study area (Figure 2). The National Coal mine is currently located at 36.189359N, 84.310123E, and the Triple H mine is currently located at 36.439836N, 84.113285E. Both the National Coal mine and the Triple H mine are "contour strip mines." This method of coal mining consists of removing overburden on a hillside to expose the coal seams, mining the coal seams, and proceeding around the hillside following the contour at the coal seam level. Overburden is removed to reveal the coal seams, and is stacked along the created bench. After the coal from the seam is removed and any auger/highwall mining is competed, the overburden is replaced and the hillside re-vegetated. Coal mining by the auger/highwall method entails boring

horizontal or near-horizontal holes in an exposed face of the coal, and loading the removed coal onto trucks for transport.

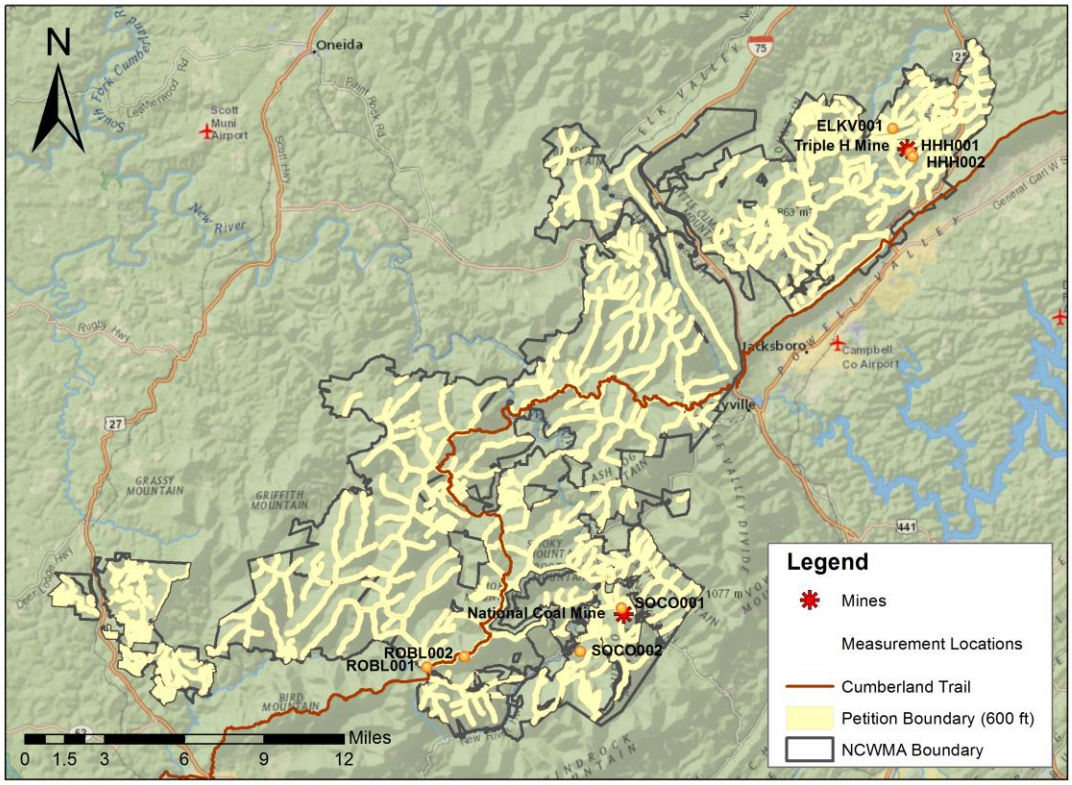

Figure 2. Area of NCWMA and ERTCE with two coal mines and monitor locations, with petition area boundary.

The Triple H mine is a relatively small operation while the National Coal mine is a large operation. Equipment used at each mine and the approximate number of daily coal trucks is shown in Table 1. Equipment used and estimates of the number of coal haul trucks per day are from coal mine personnel and OSM field inspectors.

Table 1. Equipment used at the National Coal and Triple H coal mines, November 2011.

National Coal Mine
Maintenance Truck
CAT 773B Fuel Truck
275 Komatsu Dozer
CAT 885 Loader
CAT 992D Loader
CAT988F Loader
Track Drill Rig DM 445
2000 KW Generator
Highwall Miner
Fuel Tanker truck
980 G Loader
Various Tandem Coal Trucks
Track Excavator
Coal trucks per day (approx.): 30

Triple H Mine
Rock truck, Volvo 40 ton, 2 each
Komatsu 600 (front-end loader)
Cat 330 (tracked excavator)
Gardner Denver 35 air blast drill
Coal Auger, Salem S-1500-B. (diesel)
Road Grader, Caterpillar
Coal truck, MAC DM 800, 30 ton
Coal truck: MAC RD 800, 30 ton
Coal haul trucks per day (approx.): 2

Land Cover

Land cover types in the study area were determined using the National Land Cover Dataset (NLCD), a 16-class land cover classification scheme that has been applied consistently across the conterminous United States at a spatial resolution of 30 meters (Fry et al. 2011). Land cover in the study area consists primarily of deciduous forests (85.83%), mixed deciduous/coniferous forests (5.40%), and grassland (4.97%) (Table 2; Figure 3). Although the land cover type in this area was based on the most recent USGS National Land Cover Database (2006), it should be noted that land cover is constantly changing in this area. Logging is common in the NCWMA and ERTCE areas, and logged areas can change from mature deciduous forest to open and back to early succession deciduous forest within a few years. Thus, one should view these forest land cover percentages as constantly changing.

Table 2. Land cover and percent of each in study area.

Land Cover Type	Percent of Study Area
Open Water	0.05%
Developed, Open Space	2.50%
Developed, Low Intensity	0.11%
Developed, Medium Intensity	0.02%
Barren Land	0.11%
Deciduous Forest	85.83%
Evergreen Forest	0.35%
Mixed Forest	5.40%
Scrub/Shrub	0.56%
Grassland/Herbaceous	4.97%
Pasture/Hay	0.04%
Woody Wetlands	0.05%
	100.00%

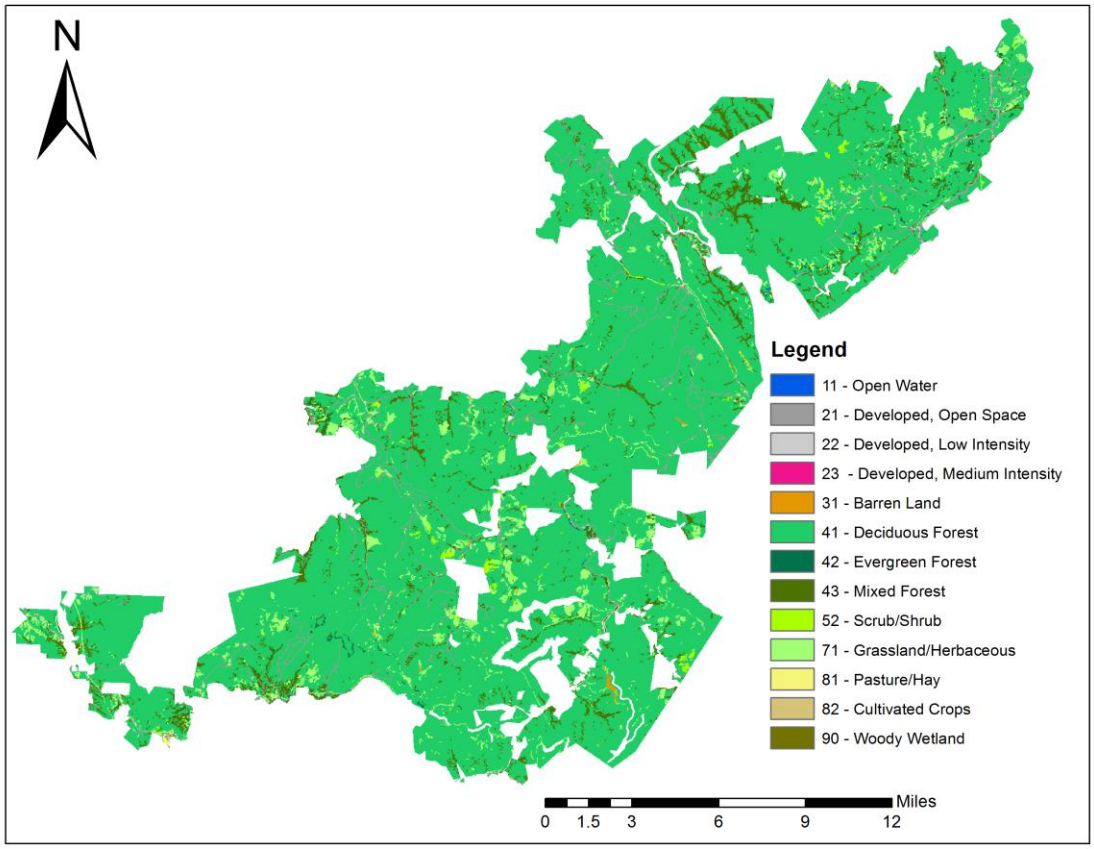

Figure 3. Land cover in the study area (see Appendix II for descriptions of each land cover type and code).

Methods

The approach of the study was to collect acoustic data in the primary land cover types of the study area in order to establish current ambient acoustic conditions of the NCWMA and ERTCE areas. Acoustic data were also collected at two operating coal mines, National Coal and Triple H. Using these two data sets, the measured current ambient sound levels and the measured sound levels of the two mines, a computer sound model was used to estimate acoustic impacts of coal mining on the soundscape of the NCWMA and ERTCE areas.

Ambient measurements consisted of long-term acoustic data collection (>25 days) in the two primary land cover types in the study area, deciduous forest (85%) and mixed deciduous/coniferous forest (5%). Ambient conditions varied according to proximity to flowing water; sound levels near flowing water were somewhat elevated compared to sound levels not near flowing water. For this reason, ambient sound levels were determined for two ambient conditions, without and with flowing water. Additionally, sound levels were determined for three daily time periods, all day (0000-2400), daytime (0700-1900), and nighttime (1900-0700). Coal mining operation measurements consisted of short-term acoustic data collection (2 to 8 days of continuous measurements) at two operating coal mines in the area, National Coal and Triple H. In addition to numerical sound level data, digital recordings were collected to identify common sound sources in the study area and the percent time each was audible. The data collected and resulting metrics are shown in Table 3.

Table 3. Acoustic data and associated metric computed.

Data Collected:	Metric Computed:
Sound Pressure Level Data (1-second L_{eq} for 1/3 octave bands, 20-20,000 Hz; dBA)	• L_{eq}, L_{10}, L_{50}, L_{90}, L_{min}, and L_{max} for each hour and day of the measurement period
Digital Recordings	• Time Audible • Identification of sources of sound • Distribution of sources of sounds

Ambient Sound Levels

Exceedence metrics are frequently used as “baseline” or “ambient” or “background” levels when assessing potential acoustic impacts of a proposed action. An exceedence metric is the sound pressure level (L), in decibels, exceeded *x* percent of the time for the specified measurement period. L_{50} is the sound pressure level exceeded 50 percent of the time (L_{50} is the same as the median). L_{90} is the sound pressure level exceeded 90 percent of the time. L_{90} is often considered the appropriate metric for establishing background ambient sound levels (Dunholter et al. 1989).

The petition area covers 67,326 acres. In order to measure and calculate ambient sound levels of this entire area requires the assumption that areas with similar land cover (and thus probably similar mammals, birds, and insects) will have similar ambient sound levels. This is not entirely true as there are local acoustic differences depending on the location, these differences include the acoustic effects of nearby running water (creeks and rivers), wind through the tree canopy, wind sounds in exposed areas, and proximity to roadways to name a few. However, this assumption has generally proven to be valid (Ambrose 2006). For this reason the approach used to quantify ambient sound levels into a single value utilized data measured in similar land cover areas and extrapolated those values to other areas with like land cover. In the NCWMA and ERTCE areas, deciduous forests (85%) and mixed forests (5%) are the primary land cover types. The remote measurement locations were in these land cover types (ROBL001 and ROBL002 HHH001 and HHH002 on weekends). Ambient sound level metrics (L_{eq}, L_{10}, L_{50}, and L_{90}) were computed for two ambient conditions (with and without flowing water) and for three time periods by calculating median values for all hours during the three time periods.

Deciduous forest and mixed forest covered over 90% of the study area, while grassland accounted for about 5% of the study area. A grassland measurement site was established as part of this work but was found in data processing to be influenced by distant traffic noise and hence was not used to establish an ambient sound level for the grassland areas. Therefore, when establishing baseline natural and existing ambient sound levels, only data collected in deciduous forest and mixed forest land cover was used for this determination.

Coal Mine Operation Sound Levels

The active mining area is an area roughly 200’ by 1500’ and heavy equipment operate within this limited area. The literature contains sound level reference values of various individual pieces of machinery and heavy equipment and other moving sources (truck traffic to and from the mine). This study did not attempt to establish the sound levels of the individual pieces of equipment at the mine; rather, we measured the combined sound levels of these many sources by monitoring the overall sound levels of the mine during normal operation at fixed distances from the operations. Acoustic monitors were placed at two locations 1066 feet (325 m) and 1719 feet (524 m) from Triple H, and at a location1312 foot (400 m) from National Coal. Sound level measurements were not collected within the active mine area itself, but instead measured at these specific locations from the mine operating area. This approach allowed us to assess attenuation rates of mining sounds in the land cover and terrain type in the petition area. Eight days of acoustic data were collected at the Triple H mine, and two days of acoustic data at the National Coal mine. There was very little daily variation in sound levels at either, hence only a few days were needed to determine sound levels of normal mine operation. The Triple H mine was a smaller operation compared to the National Coal mine as evidenced in the overall measured sound levels.

Baseline mining operation sound levels were determined by calculating the logarithmic means of all hourly L_{50} values for the time periods each mine was operating.

The National Coal mine operated 24-hours per day; hence the computed baseline sound levels for National Coal were based on the time period of 0000-2400 hours. At the Triple H mine, activity at the mine and operations were during daytime hours (0700-1900), and therefore the baseline mining sound levels for Triple H were based on this time period only.

Acoustic Monitors

Four ANSI Type 1 sound level meters were used in this study. Monitors consisted of a Larson-Davis 831 Sound Level Meter (SLM), Larson-Davis PRM831 preamplifier, PCB 377B20 microphone, Larson-Davis ESP106-2 Environmental Shrouds (windscreen and bird spike), and a Roland R05 digital recorder. The recorder used the microphone output from the Larson-Davis 831 SLM. A 12-volt battery system powered the system. The equipment was stored in a weather-proof container (Figures 4 and 5).

Figure 4. Acoustic monitor at HHH001 (microphone/windscreen on one tripod, and anemometer on separate tripod).

Figure 5. Acoustic monitor at ROBL002.

All SLMs and components met ANSI Type 1 standards (IEC 804:1985, Integrating-Averaging Sound Level Meters), and were professionally calibrated annually within 12 months of deployment. A B&K 4231 acoustic calibrator that complied with Class 1 accuracy requirements of ANSI S1.40-1984, American National Standard Specification for Acoustical Calibrators (9184), or IEC 942:1988, Sound Calibrators (1988), was used to check calibration in the field. All system components were time-synchronized with GPS time at deployment, and any time off-sets observed during subsequent visits were recorded. Monitors were capable of operating extended periods of time (>25 days). All monitors collected continuous 1-second decibel data (dBA and L_{eq} for 1/3 octave bands, 20-20,000 Hz, set to "Fast" time weighting), and continuous digital audio recordings (MP3, 128 kpbs).

In addition to the Larson-Davis sound level meters, two high-quality digital recorders and external microphones were used to collect continuous audio recordings which were later analyzed to identify common sound sources and the percent time that each was audible. The recording packages consisted of a Roland R05 digital recorder and two Shure WL183 omni-directional microphones. Digital recordings were used primarily for sound source identification, but were also post-processed to provide dB data. MP3 recording systems were calibrated by collecting simultaneous recordings and measurements with an ANSI Type 1 sound level meter. In comparative tests, A-weighted metrics computed from the digital recordings were generally ±1.0 dBA of A-weighted metrics computed

from the LD831 (Type 1) sound level meters. However, it should be noted that metrics computed from the digital recordings do not meet ANSI Type 1 standards.

Acoustic monitors were deployed as follows. Two of the Type 1 Larson Davis 831 systems were used to collect long-term baseline ambient data in the primary land cover types in the study area. Two of the Type 1 Larson-Davis 831 systems were used to collect coal mine operational data, and were moved between the Triple H mine and the National Coal mine during the measurement period. The digital recording systems were used at different distances from the coal mines and were used to check attenuation rates of coal mining sounds.

Observer Logging

Decibel data alone do not allow identification of sources of sounds. When conducting acoustic studies, it is important that the source of common sounds, both natural and human-caused, be identified. Further, it is important to determine the percent of time that such sounds are audible. This was accomplished by collecting continuous digital recordings, and later analyzing these recordings in the office. Listening and logging sound sources is labor intensive, thus logging is only conducted for a sub-sample of the measurement period. Office logging using the digital recordings was conducted for twelve days per season at each of the primary measurement locations, using a sample scheme of a 10 second recording every 4 minutes. In past studies, this sample scheme has proven to be very accurate, generally ±5% actual conditions (Ambrose 2006).

Location of Acoustic Monitors

Areas of like vegetation, land cover, topography, elevation, and climate generally possess similar acoustic characteristics, including sound sources (birds, insects, mammals), sound levels, propagation and attenuation properties. The USGS National Land Cover Database (Fry et al. 2011) was used to determine the primary land cover types. Measurement locations were selected in consultation with OSM staff after review of primary land cover types and human use patterns in the study area. Acoustic data were collected at seven locations (Table 4).

Table 4. Locations of acoustic monitors and recorders in study area, November 2011.

Name	Latitude	Longitude	Use
ELKV001	36.45109	84.12274	Grassland land cover measurement near Triple H
HHH001	36.43762	84.11097	Coal mine operation sound levels (Triple H)
HHH002	36.43575	84.10972	Coal mine operation sound levels (Triple H)
ROBL001	36.16225	84.44305	Mixed forest land cover measurement
ROBL002	36.16765	84.41778	Deciduous forest land cover measurement
SOCO001	36.19265	84.31140	Coal mine operation sound levels (National Coal)
SOCO002	36.16936	84.33977	Coal mine operation sound levels (National Coal)

Monitors at ROBL001 and ROBL002 were deployed to collect long-term, baseline ambient data in the primary land cover types (mixed deciduous/coniferous forest and

deciduous forest cover >90% of the study area). ROBL001 was located in the western part of the Royal Blue Unit of the NCWMA, near the southeastern border with the New River Unit. This location was near the eastern border of the Emory River Tract Conservation Easement Area and the northern border of Frozen Head State Park. ROBL002 was located in the south-central part of the Royal Blue Unit. Monitors at HHH001, HHH002, and ELKV001 were in Sundquist Unit of NCWMA and were deployed to collect sound level data relative to the Triple H mine. Monitors at SOCO001 and SOCO002 were in the southern part of the Royal Blue Unit and were deployed to collect sound level data relative to the National Coal mine. Monitors HHH001, HHH002, and ELKV001 were 1066 feet, 1722 feet, and 5167 feet from the Triple H mine, respectively. SOCO001 was 1312 feet from the National Coal mine and SOCO002 was 11450 feet from the National Coal mine.

Measurement period

In most acoustic impact assessments, baseline sound levels in summer and winter are collected and assessment of potential impacts include both seasons. This assessment of potential acoustic impacts of surface mining in the NCWMA and ERTCA areas had to be completed by January 2012, thus there was a limited time period to collect and analyze acoustic data. For this study, acoustic data were collected in only one season, winter (November 2011), and modeling assessments was based on winter baseline conditions. In most areas, winter is a quieter season than summer (Ambrose 2006), thus these winter measurements provided the opportunity to assess potential impacts during the quietest time of the year. Measurement periods for determining baseline acoustic conditions (background ambient and existing ambient sound levels) need to be of sufficient duration to include periods of natural variability (such as high and low winds). Generally, a measurement period of 25 days will provide acoustic data sufficient to be within 3 dB of sound levels for the entire season (NPS 2008). Measurement periods for determining sound levels of typical human activities, such as coal mine operations, are much less variable day-to-day, thus measurement periods can be much shorter, generally from 2 to 7 days.

Acoustic Data from Other Sound Sources

Other human activities that contribute to acoustic conditions in the study area include vehicles (on both gravel roads and major highways, and also including off road vehicles), camping, hunting, fishing, mountain biking, and logging. Sound levels for these activities were obtained from published and unpublished literature.

Modeling

Computer noise models are used to estimate acoustic impact of new sources in an environment. A computer model (SoundPlan) was used to: 1) model the current impact of the two operational mines; and 2) provide a means of estimating noise impact in NCWMA and ERTCE areas that may be considered for future mine operations. The computer model used for this work is a “ray-trace” model which conceptually treats acoustic sources as points, lines or areas in which “rays” emanate from these sources that approximate the path of sound waves. The paths of the rays are stored by the computer model together with the distance that each ray travels, various model objects that a ray

encounters (barrier or terrain line) and the conditions of the media that the ray travels through (atmospheric effects). The computer model has the capability of predicting sound levels generated by point sources (generator or a material conveyor belt for example) or line sources (roadways for example) and also area sources (a large area where many sources of sound are present, both stationary and moving). The model estimates the magnitude of the sound energy produced by the sources and then predicts the attenuation of the sound as it travels through the air and reaches a point receiver (such as a residential home), or in a grid fashion to compute contours (for example, all areas >55 dBA).

The acoustic model contained standard environmental propagation features such as geometric spreading, atmospheric absorption, ground effects and terrain effects. A concentrated point source modeling approach was chosen for the mine operations themselves based on a review of the measured data in the vicinity of the active mines and field observations. The large and small mine source levels were calibrated to the nearby in-situ sound level measurements once the proper modeling elements were in place, ie terrain, atmospheric and ground cover. The difference between predicted hourly sound levels and the measured results at locations near the mines (HHH001 and SOCO001) were within 0.5 dB.

Existing and background ambient sound levels in the NCWMA were measured as part of this work, and this allows the prediction of "impact" by comparing predicted hourly sound levels ($LeqA_{hr}$) from a new source to the ambient sound levels of an undisturbed area.

Using the measured current ambient sound levels and the measured sound levels of the two mines, the computer sound model was used to estimate acoustic impacts of coal mining on the soundscape of the NCWMA and ERTCE areas. The impact estimate must be based upon a sound level metric of some kind, for example "all areas that receive an hourly L_{eq} sound level above the ambient sound levels are impacted" or "all areas that receive a maximum sound level greater than 55 dBA are impacted" or some similar comparison. For this assessment of impacts, four different acoustic scenarios were modeled: all areas >40 dBA, >45 dBA, >50 dBA, and >55 dBA.

Definition of Acoustic Terms

Definitions of common acoustic terms are provided in Appendix I. Acoustic equipment and measurement procedures followed protocols outlined in "Acoustical Sampling & Analysis Guide 2008-12-02 v1.0" (NPS 2008).

Decibel Basics

The decibel is a logarithmic value used to describe the amplitude of sound pressure levels. The decibel provides the possibility of representing a large span of signal levels in a simple manner as opposed to using the basic pressure unit Pascal. The difference between the sound pressure for near silence versus a loud sound is a factor of 1:1,000,000 or more, therefore it is less cumbersome to use a small range of equivalent values, for example, 0 dB to 100 dB. Since acoustic data are logarithmic, these data cannot be summed or averaged using standard arithmetic. They must be converted back to their

original sound pressure values before being arithmetically manipulated, and then reconverted to the decibel scale. Two sound pressure levels of equal decibel level added together result in an increase of 3 dB. For example, two sounds of 40 dB added together equal 43 dB. Four sounds of the same dB level added together result in an increase of 6 dB. An increase of 6 dB is a doubling of sound pressure; hence, 50 dB is about 128 times greater than 10 dB. While an increase of 6 dB corresponds to a doubling of sound pressure level, humans perceive an increase of 10 dB as a doubling of loudness. Hence, 50 dB would be perceived as 16 times louder than 10 dB. Humans with normal hearing can hear sounds down to about 0 dB in the 1,000 Hz range. A change of 5 dB is clearly noticeable to humans. Table 5 provides some examples of common sound sources and corresponding sound levels, and Figure 6 provides some examples of frequencies of common sounds.

Table 5. Common sound sources and approximate dBA value (with measured distance).

Source	dBA	Distance (ft)
Chainsaw	90	3
Truck, Diesel Tractor Trailer, 65 mph	85	50
Truck, Diesel, Coal Haul, 25 mph	80	50
Automobile, 65 mph	75	50
ORV, 25 mph	70	50
Automobile, 35 mph	65	50
Conversation, Normal	60	3
Moderate Rainfall	50	3
Conversation, Quiet	40	3
Creek, Flowing Water	30	100
Whisper	20	3

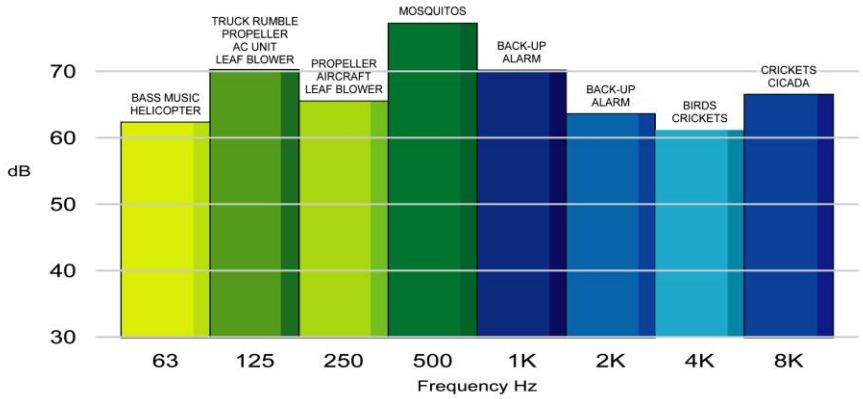

Figure 6. Frequency characteristics of common sources of environmental sound.

Results

Acoustic measurements were made at seven locations between October 29 and November 27, 2011; 1759 hours of acoustic data were collected. Measurement locations, land cover type, and dates of data collection are shown in Table 6.

Table 6. Measurement locations, data use, dates of data collection, and number of hours at each site, northern Tennessee, October-November 2011.

Name	Land Cover, Mine	Dates	Hours
ELKV001	Grassland, near Triple H mine	10-31 to 11-6	139
HHH001	Deciduous Forest, near Triple H mine	10-29 to 11-7	213
HHH002	Deciduous Forest, near Triple H mine	10-29 to 11-6	196
ROBL001	Mixed Forest, Royal Blue Unit	10-30 to 11-27	674
ROBL002	Deciduous Forest, Royal Blue Unit	11-7 to 11-27	478
SOCO001	Deciduous Forest, near National Coal mine	11-8 to 11-9	29
SOCO002	Deciduous Forest, near National Coal mine	11-8 to 11-9	30

Ambient Sound Levels

Hourly ambient sound levels (L_{eq}, L_{10}, $L_{50,}$ and L_{90}) were calculated from data collected at HHH001 and HHH002 (weekends only when the Triple H mine was not working) and ROBL001 and ROBL002 (all days). All monitors were within the primary land cover types in the area, deciduous forests or mixed deciduous-coniferous forests. The ROBL monitoring locations were within 1 km of flowing water, and this resulted in elevated ambient levels at the ROBL sites. For this reason, two ambient data sets were computed; one for the HHH sites without the influence of flowing water, and another for the ROBL sites, where water sounds resulted in somewhat elevated ambient sound levels. These ambient levels are the median values of all hours for the time periods shown (Table 7).

Detailed metrics for each site (hourly dBA metrics and frequency metrics) are shown in Appendices III and IV. Appendix III includes all sites where ANSI Type I sound level meters were used. Appendix IV includes two sites (ELKV001 and SOCO002) where acoustic metrics were obtained by post-processing MP3 digital recordings. MP3 recording systems were calibrated by collecting simultaneous recordings and measurements with an ANSI Type 1 sound level meter. These data do not meet ANSI Type I standards, but are generally ±1 dBA of data collected with a Type 1 sound level meter.

Table 7. Median existing ambient sound levels (dBA) for three time periods at HHH sites (weekends only) and ROBO sites (all days), November 2011.

		Hour	Leq	L10	L50	L90
HHH Sites (weekends)	All hours	0000-2400	32.5	33.2	30.1	28.3
	Daytime	0700-1900	37.9	39.0	32.8	29.4
	Nighttime	1900-0700	29.9	29.6	27.5	27.2

		Hour	Leq	L10	L50	L90
	All hours	0000-2400	42.3	45.0	39.8	36.3
ROBL Sites	Daytime	0700-1900	42.2	44.7	39.1	35.4
	Nighttime	1900-0700	42.3	45.2	40.3	36.7

Sound Levels of Coal Mine Operations

Coal mine operation sound levels for the National Coal mine and the Triple H mine for three time periods of the day are shown in Table 8. The Triple H mine worked daytime hours, weekdays only, therefore only data for daytime are shown.

Table 8. Sound levels of coal mine operations at National Coal mine and Triple H mine, November 2011.

		Time Period	Leq	L10	L50	L90
National Coal (@1312 ft)	All Hours	0000-2400	70.1	68.7	62.6	56.4
	Daytime	0700-1900	71.4	69.3	64.2	56.7
	Nighttime	1900-0700	67.9	64.0	61.6	54.9

		Time Period	Leq	L10	L50	L90
Triple H (@ 1066 ft, weekdays)	All Hours	0000-2400	39.4	41.4	35.1	31.8
	Daytime	0700-1900	49.9	53.6	47.1	37.1
	Nighttime	1900-0700	30.7	31.4	29.7	28.5

Sound Levels of Coal Haul Trucks

Sound levels of coal hauling trucks from the National Coal mine were measured on Nov. 9, 2011. On average, about 30-40 trips per day are made from this mine to a coal processing plant. Sound levels of nine trucks during the 1000 hour are shown in Table 9 and Figure 7. Trucks maximum dBA averaged 76.5 dBA @ 50 ft, and the time >45 dBA averaged 1:28 minutes per truck.

Table 9. Maximum dBA and duration of coal hauling trucks from National Coal mine, Nov. 9, 2011, 1000 hour.

Time	Lmax	Duration
10:03:35	78.4	0:02:33
10:11:03	73.9	0:00:34
10:22:59	77.1	0:01:24
10:36:06	76.9	0:01:04
10:39:46	77.6	0:03:31
10:45:09	77.4	0:00:39
10:50:34	74.2	0:00:57
10:52:09	75.6	0:00:40
10:54:04	77.7	0:01:47

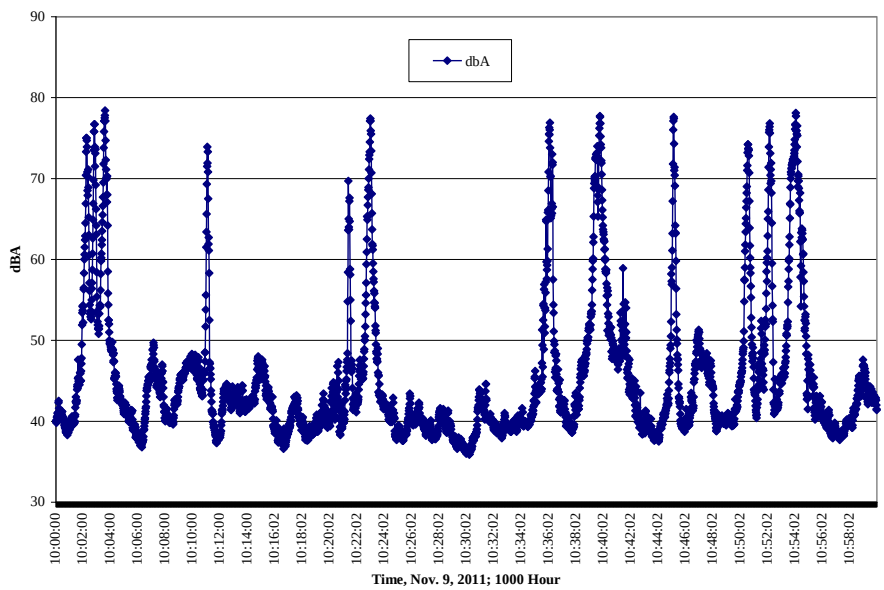

Figure 7. Coal hauling trucks from National Coal mine, Nov. 9, 2011, 1000 hour.

Sound Levels of Blast Event at Triple H Mine

Infrequent blasting operations do occur at these mining locations and a single blast event was recorded during acoustic measurements at the mine sites. A single blast occurred at the Triple H mine, on October 31, 2010, at 13:39:46. The maximum sound level at 1066 ft was 75.2 dBA, and the duration was about 10 seconds (Figure 8). Data from this blast event was used to model estimated impacted areas based on a short term time period (1-2 seconds, 75.2 dBA maximum) and an hourly time period for comparison to other model results.

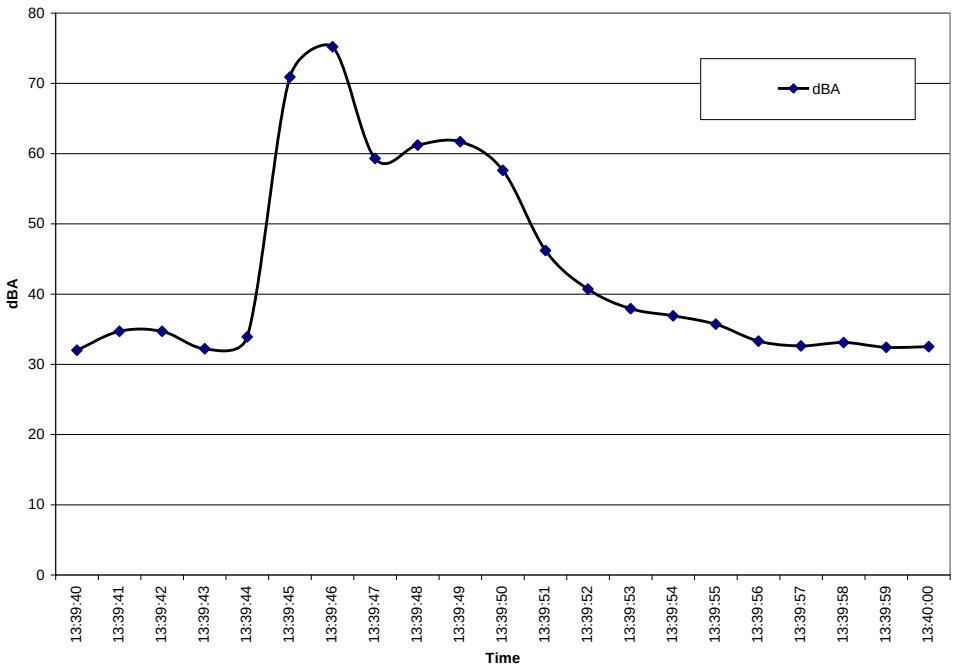

Figure 8. Blast amplitude (75.2 dBA) and duration (about 10 seconds) for a blast event at Triple H mine on October 31, 2010, at 13:39:46.

Sound sources and Percent Time Audible

The hourly percent time that human-caused sounds were audible at measurement locations in the North Cumberland Wildlife Management Area units are shown in Table 10. Data for ELKV001, HHH001, and HHH002 represent weekdays only, when the Triple H mine was operational. Common sound sources and the percent time each was audible are shown in Table 11. At four locations (ROBL001, ROBL002, HHH001 weekends and HHH002 weekends) where mine sounds were not present, audibility data are shown in Appendix IV.

Table 10. Percent time that human-caused sounds were audible at measurement locations* in North Cumberland Wildlife Management Areas, November 2011.

Hour	ELKV001	HHH001	HHH002	ROBL001	ROBL002	SOCO001	SOCO002
0	100.0	100.0	96.7	13.9	5.0	100.0	100.0
1	100.0	80.0	96.7	7.8	10.6	100.0	100.0
2	90.0	60.0	76.7	12.8	10.6	100.0	100.0
3	83.3	80.0	83.3	15.6	6.1	100.0	100.0
4	80.0	86.7	80.0	15.0	6.1	100.0	100.0
5	100.0	90.0	96.7	17.2	10.0	100.0	100.0
6	96.7	73.3	96.7	13.3	21.7	100.0	100.0
7	100.0	93.3	90.0	12.2	20.0	100.0	100.0
8	100.0	100.0	100.0	21.1	23.9	100.0	100.0
9	100.0	100.0	100.0	33.3	28.3	100.0	93.3
10	86.7	100.0	100.0	31.1	26.1	100.0	100.0
11	100.0	100.0	100.0	28.3	27.8	100.0	100.0
12	96.7	73.3	86.7	31.1	24.4	100.0	100.0
13	80.0	83.3	83.3	26.1	23.9	100.0	100.0
14	93.3	100.0	100.0	21.1	20.0	100.0	100.0
15	86.7	100.0	100.0	26.7	25.6	100.0	100.0
16	90.0	100.0	100.0	30.0	30.0	100.0	100.0
17	96.7	100.0	100.0	30.0	28.9	100.0	100.0
18	100.0	86.7	90.0	22.2	21.1	100.0	100.0
19	90.0	56.7	76.7	16.1	13.9	100.0	100.0
20	66.7	50.0	63.3	15.0	12.8	100.0	100.0
21	63.3	46.7	63.3	22.8	16.7	100.0	93.3
22	56.7	53.3	50.0	11.1	12.8	100.0	100.0
23	60.0	56.7	56.7	13.9	2.2	100.0	100.0

* Data for ELKV001, HHH001, and HHH002 represent weekdays only, when the Triple H mine was operational.

Table 11. Sound sources at measurement locations* and percent time audible of each, November 2011.

Sound Source	Measurement Location						
	ELKV001	HHH001	HHH002	ROBL001	ROBL002	SOCO001	SOCO002
Jets	3.8	2.8	1.7	6.4	5.5	0.0	0.8
Propeller Aircraft	2.5	0.8	0.4	2.3	1.3	0.0	1.1
Helicopter	0.1	0.0	0.0	0.1	0.1	0.0	0.0
Vehicles	78.8	85.7	83.1	11.2	10.8	83.9	54.4
Trains	9.3	9.6	15.1	0.0	0.0	0.0	0.0
Motors	0.0	0.0	0.0	0.2	0.0	68.3	49.4
People	0.1	1.4	2.1	0.3	0.1	0.3	0.6
Domestic Animals	0.4	0.3	3.1	0.0	0.0	0.0	3.3
Unknown Human Sounds	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Wind	49.4	0.1	5.3	53.1	70.5	0.6	13.9
Water	27.9	76.3	52.8	100.0	100.0	2.8	54.4
Mammal	3.3	0.0	0.4	0.0	0.0	0.0	0.0
Birds	24.6	25.6	27.4	19.8	18.3	1.1	16.1
Insects	60.1	33.3	41.8	10.8	6.9	0.0	46.1
Animal Sounds	13.6	11.4	20.4	6.6	5.3	0.0	2.5

* Data for ELKV001, HHH001, and HHH002 represent weekdays only, when the Triple H mine was operational.

Discussion

Ambient Sound Levels

Few acoustic studies have been conducted in remote areas of eastern TN to determine existing (L_{50}) and background (L_{90}) ambient sound levels. One ongoing study involves measurements in Great Smoky Mountains National Park (GRSM) by the Federal Aviation Administration and National Park Service. Land cover in GRSM is similar to the NCWMA and ERTCE areas, with deciduous forest being the primary land cover. The existing ambient sound level in areas of NCWMA and ERTCE without flowing water for the time period 0000-2400 was 30.1 dBA, very close to levels in GRSM with like land cover type, 32.9 dBA (MacDonald, unpubl. data)(Table 12). Ambient sound levels in areas of NCWMA and ERTCE with flowing water were considerably higher, 39.8 dBA.

Table 12. Exisiting ambient sound level (L_{50}, 0000-2400) in the NCWMA and ERTCE areas (winter 2011) and Great Smoky Mountains National Park (winter 2005).

Location	L50	Num. Sites
Great Smoky Mtn. NP	32.9	6
NCWMA and ERTCE, non water ambient	30.1	2
NCWMA and ERTCE, with water ambient	39.8	2

Estimated Acoustic Impact from Contour Strip Mines

Noise studies and assessment of potential acoustic impacts of coal mining operations in Tennessee have been conducted by OSM and Tennessee Valley Authority (TVA) prior to this study. One study concluded that surface mining equipment would generate a maximum of 98 dBA at 50 feet (unpublished TVA data). Another study listed various activities associated with mining and provided a range of sound levels as follows: earth moving, 73 dBA to 96 dBA at 50 feet; impact tools and rock drills, 76 dBA to 97 dBA at 50 feet; and blasting, estimated at 105 dBA to 110 dBA at 50 feet (Nabelek 1985).

The average sound level at the National Coal mine for all operating hours (0000-2400) was 62.6 dBA at 1312 ft. The measured sound levels summarized in this report for mining operations, haul trucks, and blast events were similar to those reported in the literature.

Four levels of acoustic impact were modeled: areas of NCWMA and ERTCE that were >40 dBA, >45 dBA, >50 dBA, and >55 dBA. It should be noted that most people will not notice a sound source until it is about 5 dB above background levels, unless it has strong tonality. Table 13 provides estimates of impact acreage for the National Coal mine based on a daytime ambient sound level of 33 dBA and night ambient sound level of 27 dBA. Both of these ambients, daytime and nighttime, were computed from data collected at sites without the influence of flowing water. Daytime and nighttime ambient sound levels were reasonably close (within 5 dBA), and there will be very little difference in the affected areas for sound levels greater than 40 dBA The effect of the lower night time ambient sound level is in the 25-30 and 30-35 dBA contours which would be applicable

for a metric based on the concept of "increase above ambient" rather than a metric based on absolute sound levels as shown in Table 13. The lower night time ambient results in an additional 25,307 acres that have increased sound levels greater than the ambient sound level.

Table 13. Areas (in acres) acoustically impacted by the National Coal mine under two different ambient conditions (daytime 33 dBA; night hours of 27 dBA)

dBA	National Coal Mine (night ambient of 27 dBA)	National Coal Mine (daytime ambient of 33 dBA)
27 to 30 dBA	15,567	--
30 to 33 dBA	9,739	--
33 to 35 dBA	4,683	4,683
35 to 40 dBA	4,136	4,136
40 to 45 dBA	2,491	2,491
45 to 50 dBA	801	801
50 to 55 dBA	207	207

Topography is the defining characteristic of sound propagation in the NWCMA and impacted area estimates are dependent on the terrain and the location of the mine operations. A test was conducted to estimate the uncertainty of the impacted area estimates. Ten hypothetical large mining operations (similar to the National Coal mine) located on or near ridgelines in the petition area were modeled as part of this work to assess the variability and range of acoustic impacts of mines in the petition areas. The ten hypothetical ridgeline mines were found to have larger impact areas than the existing mines due to the elevated nature of ridgeline mining and lack of natural shielding effects caused by terrain features. The impacted area results of these ten hypothetical ridge mines are presented in Table 14.

Table 14. Average and standard deviation of number of acres impacted at different dBA level contours for ten hypothetical ridgeline mines in the petition area.

dBA	Average areas of impact from ten ridge mines	Standard Dev. of estimate
>40 dBA	9,626	2,559
>45 dBA	2,841	1,238
>50 dBA	915	406
>55 dBA	240	63

Estimated Acoustic Impact from Coal Haul Trucks

Trucks hauling coal from a mine to a processing plant have the potential to acoustically impact a large area. Factors influencing this impact include size and speed of trucks and road surface, but the primary factor is the distance from the mine to the processing plant. Because the locations of potential mines as well as locations of potential processing plants are not known, an estimated area of impact due to coal hauling trucks was determined on a unit or "per-mile" basis. If and when potential impacts from new mines are assessed, and mine locations and processing plant locations are known, impact assessment can be made by applying the estimated impact area per unit mile to the number of miles of haul truck roadway. Again topography plays a large role but the "per-mile" estimates were based on model results of the HHH and National Coal roadways that included a variety of terrain conditions. Table 15 provides the area (in acres) of impact due to coal hauling trucks for two scenarios, 5 trucks per hour at 30 mph and 10 trucks per hour at 30 miles per hour. Areas of impacts are shown for four dBA contours, >40 dBA, >45 dBA, >50 dBA, and >55 dBA.

Table 15. Areas of impacts, in acres, for a 1-mile linear distance of 5 coal haul trucks at 30 miles per hour, for different dBA contours for two roads.

dBA	National Coal Mine Road	Triple H Mine Road
>40 dBA	441	428
>45 dBA	288	244
>50 dBA	170	121
>55 dBA	76	63

Estimated Acoustic Impact from Blasting at Coal Mine

Blasting is common during coal mining operations; the frequency of blasting depends on the size of the mining operation and the speed of the mining operations along a ridgeline. At a large mine such as National Coal, blasting might occur every 2-3 days although this was not the case during the month-long measurement program. Blasting events have the potential to acoustically impact large areas, and although the blast event could be very loud, the impact is of a short duration and not typically associated with human annoyance but could be impactful to wildlife. A single blast event was recorded at the Triple H mine, on October 31, 2010, at 13:39:46. The maximum sound level at 1066 ft was 75.2 dBA, and the total duration of the event was about 10 seconds. Data from this blast event was used to model blast impacts at the Triple H mine. As expected, the impact area of the blast event was considerably larger than the area impacted by normal mining sounds, although the duration of each blast is about 10 seconds. As with the ten hypothetical mines modeled, a great deal of variability in the area impacted due to terrain features can be expected. Table 16 provides estimated impact areas based on mining conditions (blast and no-blast).

Table 16. Area (in acres) impacted by a mining operations and single blast event at Triple H mine, Leqhr.

dBA contour	Triple H Mine only Leqhr	Triple H Mine and blast Leqhr
>40 dBA	107	833
>45 dBA	46	303
>50 dBA	12	140
>55 dBA	6	72

Non-coal Mining Human-caused Noise Sources
A comparison was made of mining operation sound levels to other common human-caused sounds in the study area, including vehicles (highway vehicles and ORVs) and logging operations; however, it was not possible to obtain sound levels of other human activities in the study area, such as hiking, camping, fishing, hunting, and mountain biking.

Other Noise Sources, Logging
Logging sounds include falling trees, bringing logs to a landing with tractor or cable wire line, loading logs on transport trucks, and hauling logs to processing mill or other location. Typical equipment might include chainsaws, Caterpillar D7 high-track skidder units, Caterpillar 966 loader, and semi-trucks to haul logs. A typical logging operation is similar to a small coal mine operation in the number of pieces of heavy equipment (bull dozers, loaders, and haul trucks) and the hours of operation. The mean L_{eq} sound level of a typical logging operation in CA was 75.5 dBA (range 68-83 dBA) at a distance of 50 feet (California Department of Forestry and Fire Protection 2006). The mean L_{eq} sound level of the smaller coal mine in the study area, the Triple H mine, re-calculated to 50 feet was 78.6 (range 73.6-80.6 dBA), similar to logging operations. Predicted impacts from logging operations would be comparable to impacts from a small coal mine like the Triple H mine.

Other Noise Sources, Vehicles
Sound levels of roads and highways in the study area were computed using 2010 traffic count data from the Tennessee Department of Transportation web site and Traffic Noise Model (TNM) from the Department of Transportation's Federal Highway Administration. Average sound levels for interstate highways and non-interstate roads were computed. Traffic counts and sound levels are show in Table 17.

Table 17. Average annual daily traffic count and estimated dBA at 50 feet, calculated using the Federal Highway Administration Traffic Noise Model (TNM).

ROAD NAME	Year of Data	Annual Average Daily Traffic Count	Average Speed (MPH)	dBA at 50 feet
I-75 (north end)	2010	22894	70	76.3
I-75 (south end)	2010	29193	70	77.3
Route 63 east of I-75	2010	6445	55	67.6
New River Rd (south end)	2010	208	35	47.3
New River Rd (middle)	2010	766	35	52.7
New River Rd (north end)	2010	1678	35	56.5
SR116 (west side)	2010	359	45	52.9
SR116 (east side)	2010	598	45	54.6
Howard Baker Hwy, New River Rd	2010	6510	55	67.6
Howard Baker Hwy (west side)	2010	6660	55	67.7
Howard Baker Hwy (east side)	2010	5814	55	67.1
SR 63 west of I-75	2010	6445	45	65
SR 63 east of I-75	2010	21147	45	70.2
SR9	2010	909	45	54.6

Interstate 75 is a busy highway and traffic noise is almost constant. Many of the smaller, less traveled highways have much less traffic and, as a result, vehicle sounds are intermittent in time. These smaller roadways have lower speed limits and sound levels associated with these roadways are lower. On two of the gravel roads in the Royal Blue unit of NCWMA, vehicles were audible 11.2% of the time at ROBL001 and 10.8% of the time at ROBL002. These measurement sites were about 500 m and 125 m respectively from gravel roads, and vehicle sounds were clearly audible when passing by the sites. However, because vehicles were infrequent, they did not contribute significantly to the acoustic conditions in the areas.

Other Noise Sources, Off-Road Vehicles (ORV)

In the North Cumberland Wildlife Management areas, sound levels off road vehicles must not, by regulation, exceed 86 dBA at 50 feet (Tennessee Wildlife Resource Agency 2011). Maximum sound level regulations are generally based on a standard test procedure (SAE J1287). This standard specifies measurements of ORVs at full throttle at 50 feet; however, the NCWMA regulations do not specify which measurement procedure is used. Speed limits for ORVs in the NCWMA units are 25 mph in the NCWMAs, and at 25 mph, sound levels of ORVs may be approximately 70 dBA at 50 feet, depending on the make and engine size of the recreation vehicle. It was not possible to measure ORV sound levels at 25 mph at 50 feet during the study; however, a passby test of a common ORV type was conducted after the study to obtain typical passby sound levels. A 2006 Honda Foreman four-wheel type ORV was used, with a 450 cc engine and stock factory exhaust system. The test consisted of four pass-bys at 25 mph at 50 feet on a gravel road,

similar to roads in the study area, with no wind. The median sound level of the four pass-bys was 70.4 dBA (range 69.1-71.9 dBA). Although this sound level is significant relative to ambient baseline levels (37 dBA – 39 dBA), the intermittent nature of ORV travel in the NCWMA units means ORV traffic at current levels do not contribute significantly to the acoustic environment.

The background sound level measurements were conducted in November 2011 which was hunting season in this part of Tennessee. The hunters that were observed on ORVs were driving less than 25 mph, and sound levels appeared to be much lower than the 70.4 dBA level (at 25 mph at 50 feet) measured during the ORV passby test. This is understandable because hunters are generally not trying to make unnecessary noise. While the sound levels of hunters on ORVs were generally low, we did not observe or measure sound levels of individuals on ORVs riding at higher speed or on ORVs with modified exhaust systems. Such traffic could raise sound levels of ORVs significantly, but it was not observed during this study.

Other Noise Sources, Hiking, Mountain Biking, Hunting, Fishing, Camping
We did not observe or measure sound levels of hiking, mountain biking, camping, or fishing during this study. We did observe hunters, but only when traveling in vehicles, including ORVs. We suspect that sounds from these activities are relatively infrequent and at relative low levels when they do occur. Such sound sources would likely have an insignificant influence on the ambient sound levels in the NCWMA and ERTCE areas.

Coal Mine Sounds Compared to Non-coal Mining Sounds
Most source-specific noise studies, such as those of vehicle sounds, are based upon measurements made 50 feet from the source, referred to as a reference distance. That was not reasonable in this study because mining operations use several types of equipment, often operating at the same time, and operating over a large area (typically 1500 linear feet along the contour). For this reason, our measurements were made at 1000-1300 feet from the areas of coal mine operations.

National Coal mine sound levels measured at 1312 feet were 62.6 dBA. The principal (and loudest) non-coal mine sound sources in the NCWMA and ERTCE areas were vehicles and logging operations. Vehicle sounds on Interstate 75 are estimated to be 77 dBA at 50 feet (using the FHWA Traffic Noise Model) and were nearly constant. At a distance of 1312 feet these levels are estimated to be 62.8 dBA which is very similar to the measured levels at National Coal. Interstate 75 is near the eastern part of the Royal Blue WMA and Sundquist WMA for about 20 miles; hence the area of impact of Interstate 75 on the NCWMA areas is large (Table 18). Sounds of vehicles on other roads were not as loud as those on I-75, and typically have far less traffic volume (Table 14). Vehicles on gravel roads in the NCWMA and ERTCE areas were at much lower speeds, generally <25 mph, were much less frequent than other major roads (we observed about 3-6 vehicles per hour), and were usually at much lower sound levels (although measured ORV sound levels at 25 mph at 50 feet were about 70 dBA, trucks and automobiles were less). The other primary sound source in the NCWMA and ERTCE areas was logging. Logging operation sound levels were similar to the I75 traffic levels,

about 76 dBA (50 ft. reference distance). However, the area of impact of a typical logging operation was much less than a major highway. Sound levels of coal mine operation are compared to other human-caused sound sources in Table 15.

Table 15. Sound levels of human activities in and near NCWMA units, including coal mining.

Sound Source	Sound Level @ 50 feet	Sound Level @ 1312 feet	Source
Surface Coal Mine, large	NA	62.6 dBA	National Coal mine, this report
Surface Coal Mine, small	NA	48 dBA (1066 ft.)	Triple H mine, this report
Logging Operation	75.5 dBA	47.1 dBA	CA Depart. Forestry 2006
Interstate Highway (70 mph)	76.8 dBA	62.6 dBA	TN Depart. Transportation; FHWA TNM
Highway (45-55 mph)	60.8 dBA	46.6 dBA	TN Depart. Transportation; FHWA TNM
ORV (at 25 mph)	69.7 dBA	35.3 dBA	TN NCWMA regulations; this report

Based on sound level measurements of this study (ambient and coal mine operations), and references on sound levels of other sound sources in the NCWMA and ERTCE areas, it appears that a large-scale surface mine operation such as National Coal produces sound levels similar to those generated by a large interstate such as I-75, although the area impacted would be limited to the mine and surrounding area. The sound levels and areas of impact of other human-caused sound sources in the NCWMA and ERTCE areas, including vehicles sounds (truck and ORV) and logging operation sounds, would be less than a typical large coal mine (Table 16).

Table 16. Areas of acoustic impact of different human-caused sound sources at different dBA level contours in the NCWMA and ERTCE areas.

	Sound Source and Area of Impact (in acres)				
dBA	Large Coal Mine (no roadway included)	Small Coal Mine, Logging Operation (no roadway)	Interstate 75	Average and Stand. Dev. of 10 Hypothetical Large Coal Mines in Petition Area	
>40 dBA	3,639	107	14,392	9,626	2,559
>45 dBA	1,149	46	8,450	2,841	1,238
>50 dBA	348	12	5,038	915	406
>55 dBA	141	6	2,272	240	63

Acoustic Impacts of Coal Mining Sounds to Humans

Impacts of noise to humans have been studied and standards established by several organizations and agencies, including the American National Standards Institute (ANSI), the National Research Council (NRC), the World Health Organization (WHO), US Environmental Protection Agency (EPA) and others. Many organizations, including ANSI, BRC, WHO, and EPA recommend a criterion of >55 DNL as a level of

significance when assessing impacts to humans (Berglund and Lindvall 1995). "DNL" is the average noise level over a 24 hour period, with sound levels of human-caused sounds between the hours 2200-0700 increased by 10 dB to take into account increased sensitivity to noise during the nighttime hours. Assessments of impact using this criterion generally deal with residential neighborhoods or individual residences. There were few residences near the areas measured for this study.

The US Environmental Protection Agency (EPA) recommends using DNL and L_{eq} as the best descriptors when assessing environmental noise impacts. The EPA recommends that in areas of outdoor activity where quiet is a basis of use, L_{eq} not exceed 55 dBA (average over 24 hour period). Sound levels above this can result in human interference and annoyance (EPA 1974).

Based on a review of available literature and recommendations by various agencies and organizations, a criteria sound level of >55 dBA was chosen as the level above which annoyance and interference with outdoor activities occurs. The area of impact >55 dBA of a large coal mine is less (268 ac) than a long, linear sound source >55 dBA, such as I-75 (2,272 ac).

Acoustic Impacts of Coal Mining Sounds to Wildlife

Barber et al. (2009; 2010) provide a summary of issues relative to human-caused sounds and animals. The potential for negative impacts to animals due to human-caused sounds is high because many animals rely on auditory clues for predator avoidance, mate attraction, obtaining nesting territories, and finding prey. Such sources include aircraft, motor boating, vehicles, machinery, and heavy equipment, including mining equipment. The study of animal response to noise is a function of many variables including characteristics of the noise and duration, life history characteristics of the species, habitat type, season and current activity of the animal, sex and age, previous exposure and whether other physical stressors are present (Manci et al. 1988). Because of the many variables involved, it is a difficult field of study.

Wildlife reaction to human-caused sounds can range from mild, such as an increase in heart rate to more damaging effects on metabolism and hormone balance. Long term exposure to noise can cause excessive stimulation to the nervous system and chronic stress that is harmful to the health of wildlife species and their reproductive fitness (Fletcher 1980; 1990). Responses vary among species of animals and among individuals of a particular species. Variations in response may be due to temperament, sex, age, and prior experience with noise. Minor responses include head-raising and body-shifting, while more overt responses include running or moving short distances; birds may fly or exhibit other alert or nervous behavior. Panic and escape behavior can result from more severe disturbances, although some species adapt to such disturbances (NPS 1995).

Behavioral and physiological responses have the potential to cause injury, energy loss (from movement away from noise source), decrease in food intake, habitat avoidance and abandonment, and reproductive losses (NPS 1995). Studies have shown that when certain bird species are flushed from nests in response to noise, eggs may be trampled or

ejected from the nest and young are exposed to injury and predators (Bunnell et al. 1981; Gladwin et al. 1987). Young mammals have been trampled as adults attempt to flee from aircraft (Miller and Broughton 1974).

One owl species that has been studied extensively is the Mexican Spotted Owl (*Strix occidentalis lucida*) in the western United States. Several noise and disturbance studies have been conducted on this species. Delaney et al. (1999) found that the number of owls flushing was negatively related to distance and positively related to noise level (the closer the distance and the louder the noise, the more the owls flushed). They found that impacts to Mexican Spotted Owls generally occur at levels >45 dBA. Spotted Owls do not occur in TN; however, Barred Owls (*Strix varia*) are a similar species and may be impacted in similar ways. Barred Owls are not a threatened or endangered species.

Impacts to birds from noise from compressors associated with oil and gas production were greatest in areas with high sound levels, >50 dBA, but were measureable in areas with moderate sound levels, 40-50 dBA (LaGory et al. 2001). Lucas et al. (2007), also studying noise impacts from compressors, found that chronic industrial noise affects ovenbirds in areas near high sound levels (specific dBA levels and distance not provided, but compressor equipment similar to that in LaGory et al. study). Blickley and Patricelli (2006) suggest that Snowy Plovers need to be >400 meters away from noise sources in order to reduce the masking effect of such noise sources on their songs and calls. Snowy Plovers do not occur in TN.

Landon et al. (2002) found that pronghorn (*Antilocapra Americana sonoriensis*) used areas with lower sound levels (<45 dB) more than expected, and used areas with higher sound levels (>55 dB) less than expected. Pronghorn do not occur in Tennessee.

It is not currently possible to know and understand how and at what levels human-caused sounds impact animals; there are too many different species and too many different scenarios of human-caused sounds to understand all the possible combinations. Overall, available literature suggests that intermittent human-caused sounds <40-45 dBA do not significantly impact wildlife species. Chronic (near continuous) noise levels >45 dBA appears to impact some species but not others.

The potential impact of noise from surface coal mines on wildlife is probably similar to the types of impacts listed above. There may be some impact when sound levels are >45 dBA, but the impacts are likely variable and impact different species differently; some species are tolerant while others are not. The area of potential impact of a large coal mine at sound levels >45 dBA is about 2,841 acres (see Table 16). The size of the impact area depends on the topography of the mined area which influences attenuation rates of mining sounds. Impacts of noise due to surface contour coal mining are normally temporary in any given area (generally less than one year).

Summary

Sound levels generated by a large contour strip mining operation are similar to what can be found near a large interstate such as I-75 (approximately 63 dBA at a distance of 400 meters). Ambient sound levels measured in the NCWMA region were approximately 33 dBA (daytime) and 27 dBA (nighttime) existing ambient (L_{50}). Coal mine related sound levels diminish as one gets further away from the operations and sound level reduction due to terrain effects can be significant. Coal mining sounds are fairly constant throughout the day when the mine is operating 24 hours/day. Under current OSM mining regulations in this region, the area of the actual mine is limited to an area about 200 by 1500 linear feet along the contour elevation. Compared to other current human-caused sound sources in the NCWMA and ERTCE areas such as vehicles (on roads and highways and including ORVs) and logging, a large coal mine such as National Coal, although louder than any other source, acoustically impacts a smaller area due to the limited operating area of the mining activity

Potential acoustic impacts of a large contour strip coal mine, based on a criterion of >55 dBA as a level of significance, could occur on approximately 240 acres (average of 10 modeled hypothetical mines; SD=63). Potential acoustic impacts based on a criterion of >45 dBA as a level of significance, could occur on approximately 2841 acres (average of 10 modeled hypothetical mines; SD=1238). The potential impacts of a large ridgeline mine were found to be generally higher than the National Mine due to the elevated nature and fewer terrain effects along the ridgeline.

Reactions to human-caused sounds by humans and wildlife are extremely variable; some individuals and species are very tolerant while others are not. It is difficult to assign a single dBA level of significance when assessing potential impacts to either humans or wildlife. The use of levels of significance of 55 dBA for humans and 45 dBA for wildlife were based on available literature and recommendations by agencies and organizations. If mining activity is proposed at a specific location, a more thorough review of human use and wildlife species at that location would be warranted to determine if these levels of 55 dBA and 45 dBA are appropriate.

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Appendix. I. Definitions of Common Acoustic Terminology.

The following are definitions of acoustic terms used in this report (NPS 2005).

Audibility: Audibility is the ability of animals with normal hearing, including humans, to hear a given sound. Audibility is affected by the hearing ability of the animal, other simultaneous interfering sounds or stimuli, and by the frequency content and amplitude of the sound.

A-Weighting (dBA): A-weighting is used to account for differences in human hearing sensitivity as a function of frequency. A-weighting de-emphasizes the high (6.3 kHz and above) and low (below 1 kHz) frequencies, and emphasizes the frequencies between 1 kHz and 6.3 kHz, in an effort to simulate the relative response of human hearing.

Background Ambient Sound Level (L_{90}): L_{90} is commonly used to indicate the residual or background sound level in the absence of most transient noise events. L_{90} is frequently used for establishing the sound level for assessing changes to the environment (Dunholter et al. 1989). The Environmental Protection Agency recommends use of L_{90} when assessing potential acoustic impacts.

Decibel (dB): A logarithmic measure commonly used in the measurement of sound. The decibel provides the possibility of representing a large span of signal levels in a simple manner as opposed to using the basic pressure unit Pascal. The difference between the sound pressure for silence versus a loud sound is a factor of 1,000,000:1 or more, therefore it is less cumbersome to use a small range of equivalent values: 0 to 130 decibels.

Existing Ambient Sound Level (L_{50}): The sound level of all sounds in a given area, including all natural sounds as well as all mechanical, electrical and other human-caused sounds. The existing ambient sound level will be characterized by the L_{50} exceedence level (i.e., the median).

Frequency: The number of times per second that the sine wave of sound repeats itself. It can be expressed in cycles per second, or Hertz (Hz). Frequency equals Speed of Sound / Wavelength.

L_{eq} (Equivalent Sound Level): The logarithmic average (i.e., on an energy basis) of sound pressure levels over a specific time period. "Energy averaged" sound levels are logarithmic values, and as such are generally much higher than arithmetic averages. L_{eq} values are typically calculated for a specific time period (1-hour and 12-hour time periods are often used). L_{eq} values are computed from all of the 1-second L_{eq} values for the specific time period. L_{eq} must be used carefully in quantifying background ambient sound levels because occasional loud sound levels may heavily influence (increase) the L_{eq} value, even though sound levels for that period of time are typically lower.

L_{max}: The maximum sound pressure level for a given period.

L_{min}: The minimum sound pressure level for a given period.

L_x (Exceedence Percentile): This metric is the sound pressure level (L), in decibels, exceeded *x* percent of the time for the specified measurement period. L_{50} is the sound pressure level exceeded 50 percent of the time (L_{50} is the same as the median). L_{90} is the sound pressure level exceeded 90 percent of the time. L_{90}

is often considered the appropriate metric for establishing background ambient sound levels.

Noise Free Interval (NFI): The length of the continuous period of time during which only natural sounds are audible or there is silence.

Octave: The interval between two frequencies having a ratio of 2 to 1. The *octave* is an important frequency interval relative to human hearing, and octave band analysis is a standard for acoustic analysis. The frequency resolution in octave band analysis is relatively poor; hence finer frequency resolution is often used in acoustic analysis. Generally, one-third octave band analysis is used. Three one-third octave bands are in one octave, so the resolution of such a spectrum is three times better than the octave band spectrum.

Sound: Sound can be defined as a pressure variation in air or other media that is within the hearing range of a given species. This pressure variation has two components: amplitude (sound pressure level) and frequency content. Sound pressure is a measure of the fluctuations in air pressure caused by the presence of sound waves.

Sound Level: Generally, *sound level* refers to the *weighted* sound pressure level obtained by frequency weighting, usually A- or C-weighted.

Sound Pressure: Sound pressure is the instantaneous difference between the actual pressure produced by a sound wave and the average barometric pressure at a given point in space. Not all pressure fluctuations detected by a microphone are sound (e.g., wind over the microphone). Sound pressure is measured in Pascals (Pa), Newtons per square meter, which is the metric equivalent of pounds per square inch.

Sound Pressure Level (SPL): The logarithmic form of sound pressure. Generally, *sound pressure level* refers to *unweighted* sound pressure levels of one-third octave bands.

Appendix II. National Land Cover Database (NLCD) characterization classes.

Land Cover Class	Land Cover Subclass	Description
Water	11 Open Water	All areas of open water, generally with less than 25% cover of vegetation/land cover.
	12 Perennial Ice/Snow	All areas characterized by year-long surface cover of ice and/or snow.
Developed	21 Low Intensity Residential	All areas with a mixture of constructed materials and vegetation. Constructed materials account for 30-80% of the cover. Vegetation may account for 20 to 70% of the cover. These areas most commonly include single-family housing units. Population densities will be lower than in high intensity residential areas.
	22 High Intensity Residential	Includes highly developed areas where people reside in high numbers. Examples include apartment complexes and row houses. Vegetation accounts for less than 20% of the cover. Constructed materials account for 80 to100% of the cover.
	23 Commercial/Industrial/ Transportation	Includes infrastructure (e.g. roads, railroads, etc.) and all highly developed areas not classified as High Intensity Residential.
Barren	31 Bare Rock/Sand/ Clay	Perennially barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, beaches, and other accumulations of earthen material.
	32 Quarries/Strip Mines/Gravel Pits	Areas of extractive mining activities with significant surface expression.
	33 Transitional	Areas of sparse vegetative cover (less than 25% of cover) that are dynamically changing from one land cover to another, often because of land use activities. Examples include forest clearcuts, a transition phase between forest and agricultural land, the temporary clearing of vegetation, and changes due to natural causes (e.g. fire, flood, etc.).
Forested Upland	41 Deciduous Forest	Areas dominated by trees where 75% Or more of the tree species shed foliage simultaneously in response to seasonal change.
	42 Evergreen Forest	Areas dominated by trees where 75% or more of the tree species maintain their leaves all year. Canopy is never without green foliage.
	43 Mixed Forest	Areas dominated by trees where neither deciduous nor evergreen species represent more than 75% of the cover present.

Appendix II. National Land Cover Database (NLCD) characterization classes (cont.).

Shrubland	51 Shrubland	Areas dominated by shrubs; shrub canopy accounts for 25-100% of the cover. Shrub cover is generally greater than 25% when tree cover is less than 25%. Shrub cover may be less than 25% in cases when the cover of other life forms (e.g. herbaceous or tree) is less than 25% and shrubs cover exceeds the cover of the other life forms.
Non-Natural Woody	61 Orchards/Vineyards/ Other	Orchards, vineyards, and other areas planted or maintained for the production of fruits, nuts, berries, or ornamentals.
Herbaceous Upland Natural/Semi-natural Vegetation	71 Grasslands/ Herbaceous	Areas dominated by upland grasses and forbs. In rare cases, herbaceous cover is less than 25%, but exceeds the combined cover of the woody species present. These areas are not subject to intensive management, but they are often utilized for grazing.
Herbaceous Planted/Cultivated	81 Pasture/Hay	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops.
	82 Row Crops	Areas used for the production of crops, such as corn, soybeans, vegetables, tobacco, and cotton.
	83 Small Grains	Areas used for the production of graminoid crops such as wheat, barley, oats, and rice.
	84 Fallow	Areas used for the production of crops that do not exhibit visible vegetation as a result of being tilled in a management practice that incorporates prescribed alternation between cropping and tillage.
	85 Urban/Recreational Grasses	Vegetation (primarily grasses) planted in developed settings for recreation, erosion control, or aesthetic purposes. Examples include parks, lawns, golf courses, airport grasses, and industrial site grasses.
Wetlands	91 Woody Wetlands	Areas where forest or shrubland vegetation accounts for 25-100% of the cover and the soil or substrate is periodically saturated with or covered with water.
	92 Emergent Herbaceous Wetlands	Areas where perennial herbaceous vegetation accounts for 75-100% of the cover and the soil or substrate is periodically saturated with or covered with water.

Appendix III. Acoustic metrics, HHH001, HHH002, ROBL001, ROBL002, SOCO001.

Hourly Metrics, HHH001 (weekdays), 96 hours.

Hour	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}
0	25.2	52.3	34.9	31.6	29.8	32.9
1	24.9	55.9	35.5	32.8	30.7	33.5
2	24.8	52.6	35.5	32.0	29.0	33.6
3	25.3	57.6	32.4	30.3	27.1	31.2
4	24.2	55.3	27.4	26.1	25.7	27.1
5	25.3	51.9	33.8	28.3	26.8	31.1
6	25.2	50.7	32.6	30.1	29.0	31.8
7	25.7	66.3	48.6	35.9	29.0	45.4
8	26.6	66.2	53.1	48.4	43.8	50.2
9	27.4	66.9	52.6	48.0	43.2	50.0
10	33.6	69.4	56.1	50.0	43.6	52.5
11	27.3	66.5	56.3	52.5	43.2	53.5
12	26.2	64.6	51.9	36.2	31.2	46.9
13	29.5	75.2	56.5	51.6	42.2	53.3
14	28.9	71.4	55.9	51.3	46.7	53.0
15	27.5	69.6	55.8	50.0	43.9	52.4
16	28.0	70.3	56.3	52.5	47.1	53.9
17	26.4	66.0	55.8	49.4	33.7	51.9
18	26.3	64.7	52.2	38.5	31.4	47.7
19	25.6	51.7	34.5	32.2	31.3	33.4
20	25.3	44.2	34.6	32.1	31.5	33.3
21	25.1	52.8	32.7	31.1	30.1	31.6
22	24.9	59.4	34.4	32.8	31.6	33.4
23	24.9	54.0	35.1	33.1	31.5	33.9

Appendix III. Acoustic metrics, HHH001, HHH002, ROBL001, ROBL002, SOCO001 (cont.).

Frequency Metrics, HHH001 (0000-2400 weekdays), 96 hrs.

Freq	L_{90}	L_{50}	L_{10}
12.5Hz	32.8	37.1	42.3
15.8Hz	33.6	37.6	42.9
20Hz	32.5	37.0	42.0
25Hz	30.8	35.4	41.3
31.5Hz	30.4	35.5	40.6
40Hz	30.0	34.4	40.7
50Hz	29.3	34.7	40.6
63Hz	28.6	34.5	39.3
80Hz	27.2	32.1	38.8
100Hz	23.3	28.7	36.1
125Hz	20.8	26.4	34.0
160Hz	21.5	27.4	33.8
200Hz	21.7	28.1	34.3
250Hz	20.9	25.8	33.5
315Hz	20.1	24.4	32.4
400Hz	21.2	25.0	32.2
500Hz	22.3	25.2	31.7
630Hz	22.3	25.7	31.7
800Hz	22.4	25.7	31.8
1000Hz	22.8	25.7	32.1
1250Hz	22.7	25.7	32.7
1600Hz	22.7	27.5	33.3
2000Hz	21.5	24.6	31.3
2500Hz	19.1	22.6	30.0
3150Hz	17.5	21.7	27.7
4000Hz	15.1	19.2	25.4
5000Hz	12.3	17.9	24.7
6300Hz	9.6	15.5	22.9
8000Hz	8.5	13.8	22.2
10000Hz	6.9	11.6	19.2
12500Hz	4.8	8.5	16.0
16000Hz	2.2	5.0	12.0
20000Hz	-0.8	0.3	4.4

Appendix III. Acoustic metrics, HHH001, HHH002, ROBL001, ROBL002, SOCO001 (cont.).

Hourly Metrics, HHH001, weekend (84 hours).

Hour	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}
0	27.0	40.7	30.9	30.0	29.5	30.6
1	27.0	57.7	30.9	30.6	29.6	30.7
2	27.1	43.8	31.7	30.1	29.5	31.1
3	27.1	40.9	30.6	30.4	30.3	30.4
4	26.9	42.2	30.4	30.2	30.0	30.2
5	27.1	44.8	30.6	30.2	30.0	30.3
6	27.1	43.1	30.9	30.4	30.1	30.6
7	27.1	58.5	36.8	31.0	30.0	37.3
8	27.2	64.4	35.8	31.7	30.3	37.6
9	27.6	65.6	40.1	32.7	31.0	47.7
10	27.3	69.0	46.1	34.5	31.6	43.1
11	26.8	68.8	48.6	41.7	34.7	46.1
12	27.8	67.8	45.5	36.1	32.3	43.9
13	28.4	66.3	44.9	40.5	34.8	42.0
14	26.9	66.0	45.4	40.9	34.8	43.9
15	26.7	62.1	45.2	40.0	30.8	44.3
16	26.2	60.6	35.4	30.8	29.4	33.6
17	25.8	60.5	34.6	30.2	28.8	33.6
18	26.0	66.1	31.5	28.5	27.9	35.2
19	26.4	48.4	30.0	28.4	28.1	30.2
20	26.4	50.6	30.0	28.6	28.2	31.0
21	26.2	47.7	29.0	28.3	28.0	29.5
22	26.6	43.7	29.7	28.5	28.1	29.0
23	26.4	48.4	29.8	28.4	28.0	28.9

Appendix III. Acoustic metrics, HHH001, HHH002, ROBL001, ROBL002, SOCO001 (cont.).

Frequency Metrics, HHH001, weekend, 0000-2400 (84 hours)

Freq	L090	L050	L010
12.5Hz	30.6	34.2	37.7
15.8Hz	30.9	34.2	37.7
20Hz	29.7	32.9	36.9
25Hz	27.9	31.4	36.1
31.5Hz	26.5	30.3	35.1
40Hz	25.9	29.5	34.5
50Hz	24.3	28.0	33.7
63Hz	22.8	27.2	33.2
80Hz	21.4	25.5	32.8
100Hz	18.3	23.3	30.3
125Hz	15.8	19.8	27.7
160Hz	14.8	19.0	26.1
200Hz	16.4	19.7	25.1
250Hz	16.2	18.9	23.3
315Hz	16.6	18.2	22.9
400Hz	18.3	19.5	22.2
500Hz	19.4	20.6	22.0
630Hz	19.9	20.9	22.1
800Hz	20.1	21.0	22.0
1000Hz	20.6	21.4	22.3
1250Hz	20.5	21.2	22.1
1600Hz	20.1	21.0	21.9
2000Hz	18.6	19.4	20.4
2500Hz	16.4	17.4	19.2
3150Hz	14.1	15.4	19.8
4000Hz	11.3	13.4	19.2
5000Hz	9.1	10.1	15.7
6300Hz	6.8	7.7	12.9
8000Hz	5.8	6.9	12.4
10000Hz	5.1	5.9	8.6
12500Hz	3.7	4.3	6.4
16000Hz	1.3	1.8	3.4
20000Hz	-1.0	-0.8	-0.4

Appendix III. Acoustic metrics, HHH001, HHH002, ROBL001, ROBL002, SOCO001 (cont.).

Hourly Metrics, HHH002 , weekdays (96 hours)

Hour	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}
0	25.5	52.4	38.6	32.6	30.2	36.4
1	25.7	50.8	38.3	33.3	28.7	35.3
2	24.0	49.6	35.4	31.0	26.7	35.5
3	26.6	46.8	36.7	32.6	29.0	34.0
4	19.5	52.2	29.7	25.1	21.7	27.4
5	24.0	52.9	34.9	28.7	26.1	32.0
6	25.9	48.6	36.3	32.1	29.5	34.3
7	23.3	55.9	43.9	33.6	26.8	40.8
8	33.7	61.2	48.7	43.8	39.6	46.0
9	34.2	61.7	50.6	45.5	41.3	47.8
10	36.4	64.1	53.1	47.5	42.4	50.0
11	32.5	63.9	53.9	49.3	42.3	50.9
12	27.0	62.3	50.7	35.5	31.0	46.2
13	33.0	65.7	54.2	48.6	41.9	51.1
14	36.4	64.6	53.0	47.7	43.2	50.0
15	38.2	67.9	53.2	47.4	43.1	51.2
16	37.0	63.7	54.2	49.4	44.4	51.2
17	28.1	61.3	53.4	46.1	33.3	49.5
18	26.4	60.6	50.3	39.0	31.7	46.3
19	25.9	50.0	39.2	32.0	29.2	36.2
20	23.4	46.6	36.4	30.8	26.3	33.3
21	22.1	48.2	36.2	31.0	25.7	33.6
22	24.9	46.0	34.0	31.0	27.6	32.1
23	26.3	51.7	35.9	31.5	28.5	34.9

Appendix III. Acoustic metrics, HHH001, HHH002, ROBL001, ROBL002, SOCO001 (cont.).

Frequency Metrics, HHH002 (0000-2400 weekdays), 96 hrs.

Freq	L_{90}	L_{50}	L_{10}
12.5Hz	33.4	37.2	41.4
15.8Hz	34.6	38.2	42.6
20Hz	34.1	38.0	42.4
25Hz	33.7	38.0	42.4
31.5Hz	32.9	37.1	42.8
40Hz	31.8	36.5	41.1
50Hz	31.3	35.7	41.2
63Hz	31.0	36.2	41.3
80Hz	29.3	34.4	40.5
100Hz	26.1	31.7	39.1
125Hz	24.8	29.5	36.7
160Hz	22.9	28.1	34.5
200Hz	23.6	29.4	35.9
250Hz	24.1	29.9	37.2
315Hz	23.6	29.8	36.5
400Hz	22.1	28.5	35.7
500Hz	21.2	27.9	35.0
630Hz	21.4	28.1	34.6
800Hz	21.0	27.6	34.5
1000Hz	21.6	27.5	34.6
1250Hz	21.1	27.3	34.3
1600Hz	22.3	28.3	34.9
2000Hz	20.8	26.3	31.7
2500Hz	18.9	23.1	28.5
3150Hz	18.8	22.5	29.4
4000Hz	16.8	20.4	25.3
5000Hz	13.8	18.8	25.0
6300Hz	11.3	17.0	23.5
8000Hz	10.0	15.4	22.4
10000Hz	8.0	12.3	19.5
12500Hz	6.5	9.4	17.1
16000Hz	3.6	5.7	12.8
20000Hz	0.2	1.2	5.9

Appendix III. Acoustic metrics, HHH001, HHH002, ROBL001, ROBL002, SOCO001 (cont.).

Hourly Metrics, HHH002, weekends (76 hours)

Hour	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}
0	17.6	52.9	24.6	22.3	20.9	23.0
1	16.9	57.1	23.9	21.1	19.7	23.5
2	16.8	50.0	32.7	20.5	19.4	28.8
3	17.0	53.6	21.0	19.5	19.1	20.2
4	17.0	54.9	25.6	19.2	18.4	21.9
5	16.8	45.7	28.6	24.5	21.8	26.2
6	16.7	49.2	30.9	26.5	23.8	28.4
7	16.8	66.0	35.4	31.0	27.3	42.6
8	17.0	63.9	35.0	31.1	28.2	32.5
9	17.8	61.7	36.5	33.5	30.4	34.4
10	18.2	66.6	43.3	33.5	28.9	40.8
11	21.7	64.6	46.0	38.1	32.6	43.1
12	25.4	65.7	39.3	34.2	29.2	37.9
13	25.2	66.7	43.6	38.8	33.6	41.0
14	22.2	64.2	43.2	38.9	32.8	41.8
15	19.5	63.2	43.7	39.8	27.9	41.2
16	19.7	57.5	33.9	28.1	24.8	33.3
17	17.8	55.8	31.2	25.1	21.0	29.3
18	17.3	54.1	30.4	23.2	19.7	30.4
19	17.9	57.7	29.0	24.2	21.9	32.3
20	17.6	57.8	29.3	24.1	21.1	29.8
21	17.2	59.1	24.8	20.9	18.9	32.6
22	17.3	54.6	28.5	24.6	21.8	26.5
23	16.1	49.9	28.6	20.6	18.0	25.0

Appendix III. Acoustic metrics, HHH001, HHH002, ROBL001, ROBL002, SOCO001 (cont.).

Frequency Metrics, HHH002, weekends, 0000-2400 (76 hours)

Freq	L_{90}	L_{50}	L_{10}
12.5Hz	30.4	34.1	38.0
15.8Hz	30.6	34.0	38.1
20Hz	29.6	33.0	38.5
25Hz	28.9	32.4	38.8
31.5Hz	27.8	31.2	38.0
40Hz	27.0	30.2	37.2
50Hz	25.2	28.6	36.7
63Hz	24.9	29.0	36.8
80Hz	23.2	27.5	36.6
100Hz	19.3	24.4	33.7
125Hz	15.9	21.2	30.8
160Hz	12.5	17.5	28.1
200Hz	12.9	17.3	27.3
250Hz	12.8	17.2	25.2
315Hz	12.7	16.5	25.3
400Hz	11.4	14.9	23.1
500Hz	11.3	15.3	21.6
630Hz	11.9	15.2	21.5
800Hz	11.4	15.0	20.1
1000Hz	11.5	15.2	20.3
1250Hz	11.9	15.2	19.9
1600Hz	13.0	17.2	21.6
2000Hz	12.4	15.7	20.5
2500Hz	12.4	15.5	20.5
3150Hz	12.3	15.9	20.6
4000Hz	11.7	15.0	19.4
5000Hz	10.6	13.4	18.4
6300Hz	8.2	10.8	16.1
8000Hz	7.2	9.5	15.2
10000Hz	6.2	7.7	11.6
12500Hz	5.1	6.1	9.3
16000Hz	2.8	3.5	6.2
20000Hz	-0.1	0.2	1.3

Appendix III. Acoustic metrics, HHH001, HHH002, ROBL001, ROBL002, SOCO001 (cont.).

Hourly Metrics, ROBL001 (674 hours).

Hour	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}
0	25.2	69.7	44.2	39.5	36.2	41.1
1	25.7	77.1	45.4	40.8	36.7	42.3
2	24.7	68.5	47.6	43.7	39.1	44.8
3	24.5	66.1	46.2	42.0	38.2	43.5
4	24.2	69.2	46.5	42.1	38.2	43.7
5	24.4	69.0	45.6	40.2	37.6	43.0
6	23.6	69.1	43.7	38.9	36.7	40.6
7	23.0	72.9	45.3	40.5	37.1	42.6
8	22.3	67.3	44.6	40.1	37.1	41.6
9	22.2	94.3	45.6	40.8	37.1	42.7
10	22.7	72.5	45.6	39.9	36.4	42.7
11	22.5	71.1	42.9	37.8	34.5	40.9
12	22.8	67.9	42.4	35.5	33.6	39.6
13	24.6	72.7	42.1	37.4	35.0	39.5
14	23.6	69.9	43.5	37.3	33.8	40.3
15	23.5	74.1	42.9	38.4	35.2	42.0
16	24.2	67.7	41.9	36.9	33.3	39.4
17	21.9	67.8	42.9	38.1	34.7	40.4
18	24.6	68.1	39.6	36.3	34.5	37.6
19	24.9	63.2	41.5	37.5	34.6	38.9
20	24.7	69.9	41.6	37.6	35.3	39.8
21	25.2	66.9	43.7	39.6	36.2	40.6
22	25.3	69.4	44.0	40.1	36.6	41.8
23	25.3	73.6	45.2	40.5	37.4	42.3

Appendix III. Acoustic metrics, HHH001, HHH002, ROBL001, ROBL002, SOCO001 (cont.).

Frequency Metrics, ROBL001, 0000-2400 (674 hours).

Freq	L_{90}	L_{50}	L_{10}
12.5Hz	38.2	43.7	53.5
15.8Hz	37.9	42.4	50.5
20Hz	37.4	41.3	47.7
25Hz	36.7	40.4	45.8
31.5Hz	36.1	39.6	44.2
40Hz	35.7	38.9	43.4
50Hz	35	38.3	42.7
63Hz	34.3	37.4	41.4
80Hz	32.8	36	40
100Hz	31.1	34.4	38.6
125Hz	29.4	32.6	37.6
160Hz	28.8	32.2	37.8
200Hz	28.6	31.7	36.7
250Hz	28.2	31.2	35.2
315Hz	28.2	31.1	35.1
400Hz	28.9	31.5	35.2
500Hz	28.5	31.4	34.8
630Hz	28.3	31.1	34.9
800Hz	27.7	30.7	35.5
1000Hz	26.7	29.8	35.4
1250Hz	25.1	28.4	34.4
1600Hz	23.2	26.5	32.6
2000Hz	21.2	24.7	30.6
2500Hz	18.7	22.6	28.6
3150Hz	17.4	21.3	27.3
4000Hz	17	20.6	26.4
5000Hz	15.3	19.4	25.5
6300Hz	13.3	17.9	24.5
8000Hz	11.8	16.8	23.9
10000Hz	10	14.6	21.6
12500Hz	7.2	11.9	19
16000Hz	4.1	8.2	15.1
20000Hz	0.3	2.6	8.3

Appendix III. Acoustic metrics, HHH001, HHH002, ROBL001, ROBL002, SOCO001 (cont.).

Hourly Metrics, ROBL002 (478 hours)

Hour	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}
0	23.4	74.3	44.6	39.3	34.7	41.9
1	21.6	78.8	48.3	42.7	38.1	45.1
2	23.4	75.6	46.9	42.2	38.5	43.9
3	22.2	77.7	47.7	43.6	38.4	45.2
4	20.3	75.0	45.3	40.9	37.1	42.3
5	18.1	75.7	44.7	38.8	34.5	42.1
6	16.6	74.4	44.5	39.5	36.0	41.7
7	16.8	73.2	45.1	39.7	35.5	41.8
8	16.8	84.9	48.6	43.0	38.0	45.3
9	18.8	70.1	47.3	40.4	36.9	44.2
10	19.4	96.3	48.8	39.5	35.3	48.5
11	20.1	74.3	47.3	41.3	36.0	44.5
12	22.9	79.2	46.8	40.9	35.3	44.0
13	24.0	73.0	49.1	41.8	35.6	46.0
14	22.4	97.1	50.0	43.3	37.6	46.9
15	22.6	71.4	48.2	43.3	36.6	45.0
16	20.7	64.9	48.4	40.4	35.3	43.9
17	23.3	65.4	45.5	40.7	36.9	42.7
18	24.7	67.3	43.3	39.3	34.9	40.8
19	23.4	68.6	43.0	38.3	36.3	40.2
20	24.0	72.6	43.3	39.9	37.0	42.2
21	22.5	76.1	46.9	39.6	37.4	43.7
22	24.9	71.6	46.1	41.8	38.8	43.4
23	25.0	77.1	46.2	42.1	36.7	43.6

Appendix III. Acoustic metrics, HHH001, HHH002, ROBL001, ROBL002, SOCO001 (cont.).

Frequency Metrics, ROBL002, 0000-2400 (478 hours).

Freq	L_{90}	L_{50}	L_{10}
12.5Hz	39.3	44.3	51.5
15.8Hz	39.2	43.5	49.2
20Hz	38.7	42.8	47.8
25Hz	38.6	42.4	47
31.5Hz	38.4	42.1	46.6
40Hz	37.6	41.4	45.9
50Hz	36.5	40.2	44.8
63Hz	34.6	38.5	43.6
80Hz	32.9	37	42.1
100Hz	29.6	34.5	40.6
125Hz	28.4	33.4	40.1
160Hz	28.6	33.8	40.3
200Hz	29.7	34.5	40.3
250Hz	30	34.4	40.2
315Hz	29.3	33.7	39.2
400Hz	28.8	33.1	38.7
500Hz	27.8	32.2	37.4
630Hz	26.7	31.3	36.7
800Hz	25.9	30.5	35.7
1000Hz	25.2	29.6	34.8
1250Hz	24.2	28.6	34.1
1600Hz	23.3	27.6	33.3
2000Hz	22.8	26.9	32.7
2500Hz	21.5	26	32.3
3150Hz	20.7	25.5	32.1
4000Hz	20.4	25.1	31.5
5000Hz	19.5	25.1	31.3
6300Hz	18.2	24.1	30.3
8000Hz	16.8	22.8	29
10000Hz	15.1	21.1	27.3
12500Hz	12.5	18.1	24.5
16000Hz	7.6	13.1	19.7
20000Hz	1.3	5	11.1

Appendix III. Acoustic metrics, HHH001, HHH002, ROBL001, ROBL002, SOCO001 (cont.).

Hourly Metrics, SOCO001 (29 hours)

Hour	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}
0	51.8	89.7	64.0	57.6	54.9	67.5
1	51.7	91.2	63.4	57.4	54.5	67.4
2	51.8	91.2	61.3	57.0	54.5	66.2
3	51.9	91.9	62.5	57.6	54.8	67.1
4	51.6	89.0	64.0	57.8	54.9	67.8
5	51.6	91.2	61.7	57.6	54.8	65.7
6	51.8	92.5	63.7	57.9	54.9	68.8
7	52.8	88.1	64.1	59.4	56.5	66.9
8	53.7	85.3	61.8	58.6	56.3	60.5
9	53.5	89.4	61.9	58.6	56.2	62.3
10	53.5	92.2	67.7	60.4	56.7	69.9
11	53.1	92.3	69.4	60.7	56.8	70.8
12	53.9	92.7	73.4	64.4	57.9	73.1
13	51.9	92.3	69.3	59.3	55.5	70.8
14	54.1	92.3	74.8	62.0	58.0	74.1
15	55.4	92.0	79.7	70.8	59.8	76.8
16	55.5	92.4	72.6	62.3	58.6	72.7
17	55.9	91.9	77.5	69.7	59.5	74.7
18	52.0	92.4	68.8	57.9	53.8	71.4
19	52.3	89.3	65.1	58.3	55.8	69.2
20	55.3	90.5	69.2	64.7	59.8	70.9
21	54.7	92.3	70.4	60.4	57.5	71.8
22	54.6	91.9	71.3	60.6	57.5	72.2
23	52.6	92.0	65.2	57.4	54.8	67.9

Appendix III. Acoustic metrics, HHH001, HHH002, ROBL001, ROBL002, SOCO001 (cont.).

Frequency Metrics, SOCO001, 0000-2400 (29 hours).

Freq	L_{90}	L_{50}	L_{10}
12.5Hz	44.2	50.5	60.1
15.8Hz	47.6	52.9	62.4
20Hz	47.1	52.4	61.6
25Hz	47.6	53.1	62.7
31.5Hz	51.2	55.9	64.1
40Hz	50.6	55.2	64.9
50Hz	53.3	56.0	65.3
63Hz	56.7	60.0	70.0
80Hz	54.5	60.2	71.4
100Hz	54.5	57.7	66.4
125Hz	56.0	58.3	66.7
160Hz	45.7	51.3	64.7
200Hz	46.8	50.7	61.2
250Hz	45.1	48.8	58.3
315Hz	46.8	51.1	58.5
400Hz	48.1	51.6	57.7
500Hz	48.0	51.8	58.8
630Hz	47.8	51.3	57.7
800Hz	47.9	51.2	58.3
1000Hz	46.9	50.8	59.0
1250Hz	46.4	50.8	58.2
1600Hz	44.8	49.5	57.9
2000Hz	43.5	47.4	56.0
2500Hz	41.0	44.1	52.6
3150Hz	37.7	41.5	49.5
4000Hz	33.2	36.8	46.6
5000Hz	29.4	33.4	43.9
6300Hz	23.2	28.7	41.9
8000Hz	15.9	23.4	37.1
10000Hz	10.7	19.2	31.9
12500Hz	8.7	14.0	27.8
16000Hz	7.9	9.5	19.4
20000Hz	8.3	8.6	11.9

Appendix IV. Acoustic metrics, ELKV001 and SOCO002 (not Type 1 data).

Hourly Metrics, ELKV001 (139 hours). Note: Not Type 1 data.

Hour	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}
0	20.1	67.4	42.8	37.6	33.9	39.8
1	20.1	68.0	41.4	36.3	32.5	38.3
2	19.1	65.2	40.6	37.0	33.2	38.1
3	19.1	61.1	40.1	34.2	26.7	37.3
4	19.4	70.8	39.2	34.5	30.7	39.7
5	19.6	66.2	39.6	35.4	32.1	36.9
6	20.5	63.2	36.1	32.5	29.0	34.4
7	20.1	71.8	38.0	30.7	28.8	36.8
8	21.6	74.6	39.7	29.2	26.9	37.7
9	22.7	69.5	41.0	34.5	30.4	40.8
10	22.4	64.0	46.2	39.3	33.2	42.5
11	21.6	71.2	43.3	36.9	32.6	39.9
12	23.2	68.0	42.7	37.5	32.7	39.6
13	24.0	59.9	40.4	34.7	30.7	37.0
14	25.0	61.4	38.0	32.7	28.9	35.0
15	24.5	66.6	39.3	33.3	30.1	36.6
16	24.7	66.6	41.4	35.1	32.0	38.9
17	24.0	65.9	37.2	33.0	30.5	35.4
18	22.1	61.4	40.4	35.3	30.5	37.8
19	22.8	64.5	39.8	36.1	32.2	37.3
20	22.5	57.0	38.6	33.7	30.5	36.1
21	20.4	59.7	42.2	39.1	33.9	40.1
22	20.3	59.8	39.7	36.0	32.8	37.3
23	20.2	62.9	40.6	36.4	32.0	37.9

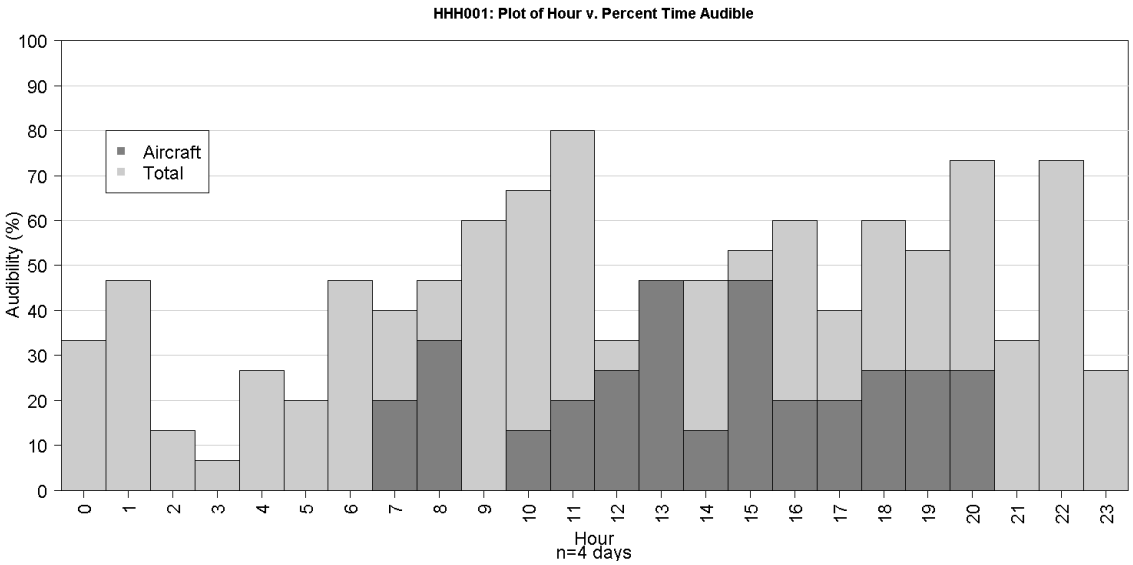
Appendix IV. Acoustic metrics, ELKV001 and SOCO002 (not Type 1 data) (cont.).

Hourly Metrics, SOCO002 (32 hours). Note: Not Type 1 data.

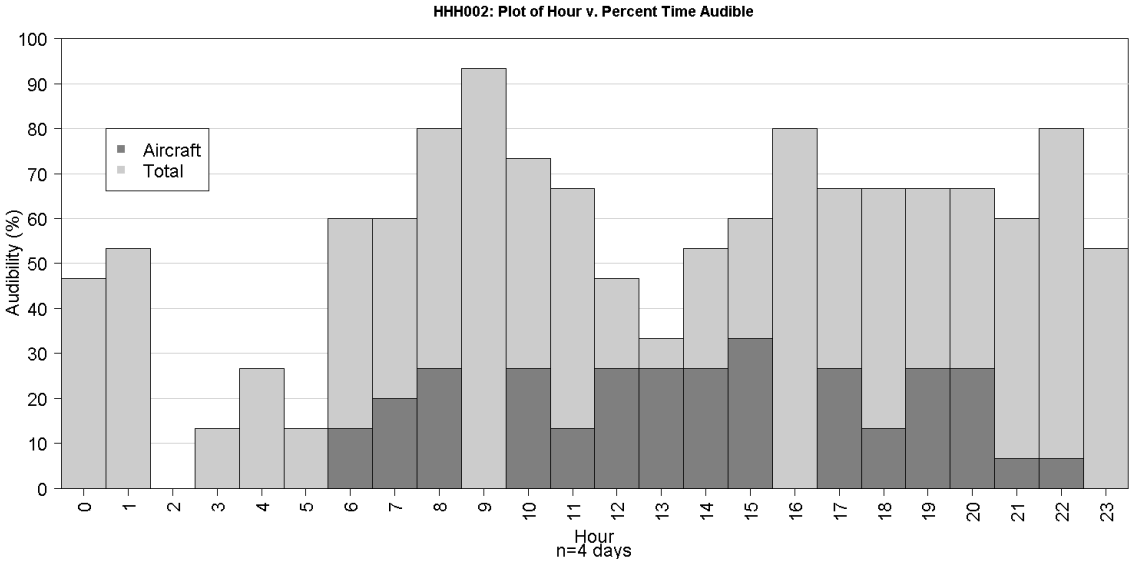
Hour	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}
0	28.6	37.6	32.4	30.8	29.9	31.1
1	29.5	42.5	34.3	32.1	30.8	32.9
2	28.3	39.2	31.8	30.2	29.3	30.6
3	27.9	69.5	32.6	30.3	29.0	39.8
4	28.1	70.2	33.5	31.1	29.2	41.2
5	29.7	74.6	36.9	33.1	31.4	49.2
6	29.0	74.5	43.6	32.1	30.3	52.4
7	29.1	81.3	47.9	36.3	31.5	59.7
8	31.7	80.2	50.9	40.6	34.3	59.7
9	33.5	81.5	50.9	40.4	36.6	60.4
10	35.9	78.4	57.5	42.1	38.5	61.3
11	33.0	83.4	61.5	41.0	35.5	63.0
12	32.9	81.6	58.6	39.8	35.7	61.3
13	30.2	83.0	57.8	39.3	34.1	62.1
14	32.3	80.0	58.2	41.5	35.2	59.6
15	28.7	79.0	64.6	50.4	38.5	63.3
16	33.4	77.7	64.6	52.2	42.6	65.0
17	37.0	79.5	64.5	43.8	39.2	62.8
18	45.1	75.8	61.9	51.4	48.4	63.7
19	25.9	70.8	33.5	29.2	27.2	44.4
20	25.4	62.4	29.7	27.4	26.3	35.2
21	26.3	53.7	30.2	27.8	27.0	32.2
22	26.9	83.8	31.5	28.6	27.7	58.2
23	27.5	74.3	32.4	30.2	28.9	46.6

Appendix V. Percent Time Audible, HHH001, HHH002, ROBL001, ROBL002.

HHH001 weekend

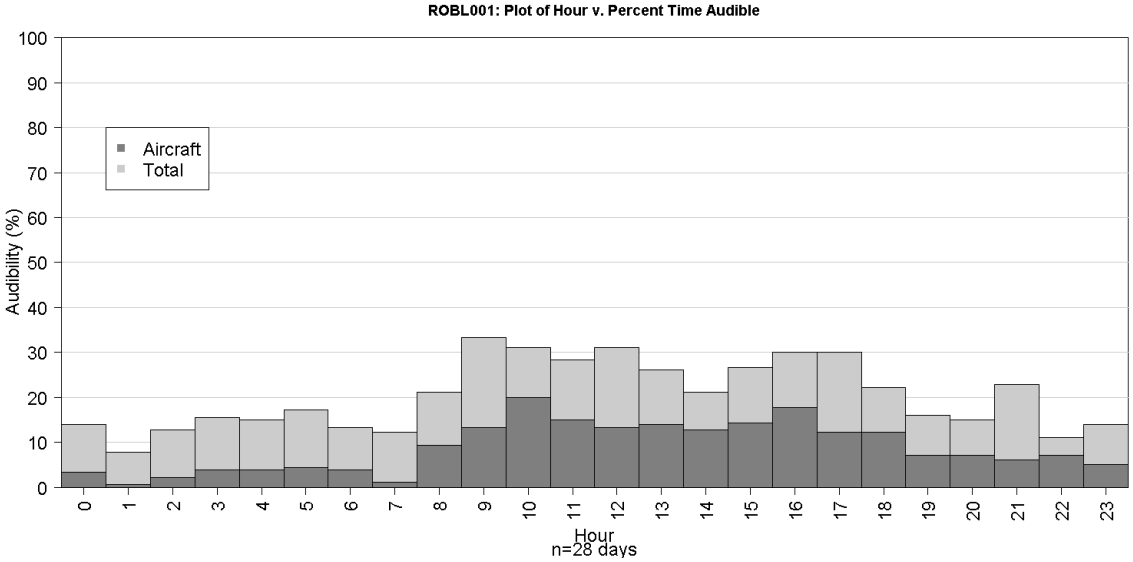


HHH002 weekend

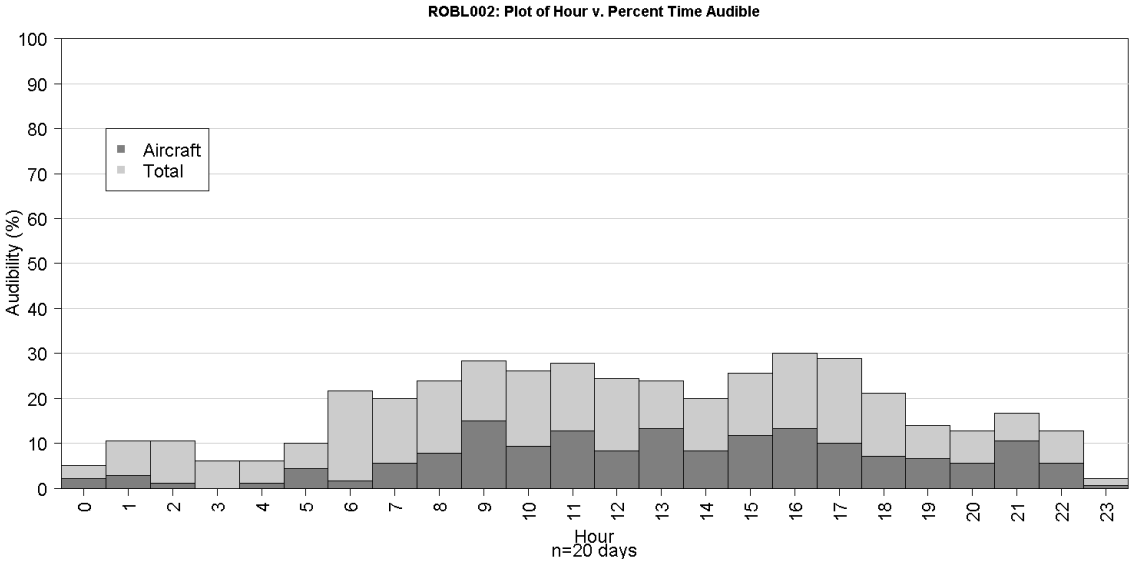


Appendix V. Hourly Percent Time Audible (cont.).

ROBL001



ROBL002



APPENDIX E: WATER RESOURCES

The following information is organized similarly to the water resources section in "Chapter 4: Affected Environment."

SURFACE WATER

The following is a list of named streams that occur in each of the watershed in the evaluation area. Emory Watershed – Named streams of the Emory subwatershed within the study area include:

- Alex Branch
- Bobs Creek
- Cane Branch
- Convict Branch
- Dry Branch
- Edmund Branch
- Emory River
- Flat Rock Branch
- Garrett Branch
- Greasy Creek
- Grimes Branch
- Hatmaker Branch
- Laurel Branch
- Little Creek
- Little Rock Creek
- Loudon Creek
- Maden Branch
- McCoy Branch
- Middle Branch
- Mill Branch
- Phoebe Branch
- Rock Creek
- Scutcheon Creek
- Snake Den Branch
- Whiteoak Creek

Upper Cumberland Watershed – Named streams of the Upper Cumberland subwatershed within the study area include:

- Barley Creek
- Bear Branch
- Big Branch
- Big Pigeon Branch
- Broyles Branch
- Davis Creek
- Elk Fork Creek
- Hickory Creek
- Horse Creek
- Hudson Branch
- Jackson Branch
- Jennings Creek
- Jim Branch
- Johnson Branch
- Laurel Branch
- Leonard Branch
- Lick Creek
- Major Branch
- Meadow Creek
- Pryor Meredith Branch
- Rock Creek
- Sand Branch
- Sharp Branch
- Shelton Branch
- Stell Branch
- Stinking Creek
- Terry Creek
- Tram Road Branch
- Waterfall Branch

South Fork Cumberland – Named streams of the South Fork Cumberland subwatershed located within the study area include:

- Adkins Branch
- Anderson Branch
- Asher Fork
- Barley Mouth Branch
- Beech Fork
- Big Branch
- Big Bull Creek
- Bills Branch
- Blue Hole Branch
- Bowling Branch
- Brimstone Creek
- Byrges Creek
- Cage Creek
- Calvin Branch
- Carroll Branch
- Cave Branch
- Charleys Branch
- Collins Branch
- Coon Pool Branch
- Cross Branch
- Cross Creek
- Davids Creek
- Double Camp Creek
- Dry Creek
- Dry Fork
- East Prong Nicks Creek
- Eli Branch
- Flatrock Branch
- Franks Branch
- Gladey Branch
- Gordon Branch
- Gosnell Branch
- Grave Branch
- Graves Gap Branch
- Green Branch
- Greens Branch
- Grissel Branch
- Gum Branch
- Hicks Branch
- Indian Creek
- Indian Fork
- Jack Branch
- Jake Branch
- Jenney Creek
- Jerry Creek
- Joe Branch
- Joe Creek
- Laurel Fork
- Lick Branch
- Lick Creek
- Ligias Fork
- Little Brimstone Creek
- Little Bull Creek
- Little Creek
- Long Branch
- Lost Branch
- Lowe Branch
- Lower Fork
- Macs Branch
- Marlow Branch
- Mart Branch
- Martha Branch
- McCoy Branch
- McKinney Fork
- Mill Creek
- Montgomery Fork
- Neal Branch
- Negro Branch
- New River
- Nicks Creek
- North Fork Montgomery Fork
- Oldhouse Branch
- Ova Branch
- Puncheon Camp Creek
- Reynolds Branch
- Rhoda Creek
- Roach Creek
- Roaring Creek
- Rockhouse Fork
- Round Rock Creek
- Second Laurel Branch
- Shack Creek
- Shoal Creek
- Simpson Branch
- Skull Branch
- Slick Rock Branch
- Smoky Creek
- South Fork Montgomery Fork
- Spring Branch
- Spring Rockhouse Branch
- Spruce Lick Creek
- Sprucepine Branch
- Stallion Branch
- Stone Coal Branch
- Stony Fork
- Straight Fork
- Sugarcamp Branch
- Tackett Branch
- Upper Fork
- Ursery Branch
- Wells Branch
- West Prong Davids Creek
- West Prong Nicks Creek
- Wheeler Creek
- Wild Sow Branch
- Wolfpen Branch
- York Branch

Upper Clinch Watershed – Named streams of the Upper Clinch subwatershed located within the study area include:

- Adkins Branch
- Asher Branch
- Bear Branch
- Bear Wallow Branch
- Cove Creek
- Duncan Branch
- Graves Branch
- Laurel Branch
- Lowe Branch
- Mill Branch
- Ollis Creek
- Rector Branch
- Smith Cove
- Swamp Branch
- Thompson Creek
- Titus Creek
- Turley Branch
- Whetstone Branch
- Yellow Branch

SURFACE WATER QUANTITY

The following flow characteristics were estimated using the Tennessee StreamStats (USGS 2007) and the associated stand-alone program. These programs were developed using current and historical flow data and basin characteristics collected by the US Geological Survey (Ladd and Law 2007; Law and Tasker 2003; Law, Tasker, and Ladd 2009; Bingham 1986) to estimate the mean annual flows, mean summer flows, flow durations, peak storm flows, and critical low flows for ungauged streams in Tennessee. These tables (tables E-1a and E-1b) include information on the watershed size; stream slope; 7-consecutive-day, 10-year recurrent-interval low flow (7Q10); the 30-consecutive-day 5-year recurrent-interval low flow (30Q5); the mean annual flow; the mean summer flow; the various flow durations from 99.5% to 10% (q99.5 – q10, as defined in the following paragraph) and the peak discharges for the flood frequencies with a recurrence interval of 2 through 500 years (PK2 – PK500). The q99.5 can be interpreted as meaning that 99.5% of the time, stream flow discharge is anticipated to equal or exceed the calculated values. It represents the lowest average discharges anticipated for a watershed. Likewise for a q10 estimate, only 10% of the values would be expected to ever exceed this discharge rate and represent the highest average flows for a watershed. The recurrence interval is based on the probability that the given event will be equaled or exceeded in any given year.

The 7Q10 value was 0 for all watersheds with a drainage area less than 50 square miles, while the 30Q5 discharges were 0 only for the two smallest watersheds, Bruce Creek and No Business Branch. Flow duration curves and calculations are commonly used to predict the distribution of future flows for water power, water supply, and pollution studies (Searcy 1959); they describe the cumulative distribution of daily mean discharges recorded at a stream gauge and show the percentage of time each daily mean discharge was equaled or exceeded (Law, Tasker, and Ladd 2009).

Surface Water Quality: Twenty-nine Office of Surface Mining Reclamation and Enforcement (OSMRE) ambient monitoring stations (trend stations) and 14 Tennessee Department of Environment and Conservation (TDEC) ambient and ecoregion monitoring stations were compiled and evaluated against the water quality criteria established for the various stream use classifications. The following tables (tables E-2, E-3a, E-3b, E-3c, E-4, E-5a, E-5b, E-6a, and E-6b) describe the results of the monitoring data.

TABLE E-1A: CALCULATED STREAM CONDITIONS FOR CUMULATIVE IMPACT SUBAREAS AND REFERENCE WATERSHEDS IN THE NORTH CUMBERLAND WILDLIFE MANAGEMENT AREA AND ADJACENT AREAS

Stream	Watershed Size (mi^2)	Stream Slope (ft/mi)	Stream Slope (%)	7Q10 (cfs)	30QS (cfs)	MAF (cfs)	MAF (cfs/mi^2)	MSF (cfs)	MSF (cfs/mi^2)	q99.5 (cfs)	q99 (cfs)	q98 (cfs)	q95 (cfs)	q90 (cfs)
No Business Branch[a]	1.7	655	12.4	0.00	0.00	2.98	1.74	1.43	0.84	0.00	0.00	0.00	0.00	0.00
Bruce Creek	2.7	189	3.6	0.00	0.00	4.77	1.74	2.31	0.84	0.00	0.00	0.00	0.00	0.29
Big Creek	7.5	58	1.1	0.00	0.39	12.96	1.72	5.04	0.67	0.00	0.00	0.00	0.39	0.59
Brimstone Creek[a]	8.4	151	2.9	0.00	0.24	15.92	1.90	5.30	0.63	0.00	0.00	0.00	0.23	0.40
Greasy Creek[a]	8.7	250	4.7	0.00	0.41	15.21	1.74	5.76	0.66	0.00	0.00	0.00	0.41	0.63
Stinking Creek[a]	12.5	95	1.8	0.00	0.31	25.69	2.06	7.53	0.60	0.00	0.00	0.00	0.34	0.58
Ollis Creek	16.1	83	1.6	0.00	0.55	28.84	1.79	9.59	0.60	0.00	0.00	0.00	0.61	0.93
Straight Fork	19.2	44	0.8	0.00	0.40	39.77	2.07	11.64	0.61	0.00	0.00	0.00	0.44	0.78
Upper Stinking Creek	19.3	70	1.3	0.00	0.39	39.55	2.05	11.40	0.59	0.00	0.00	0.00	0.43	0.76
New River at Braytown	19.4	142	2.7	0.00	0.39	38.78	2.00	11.43	0.59	0.00	0.00	0.00	0.43	0.77
Ligias Fork	20.4	111	2.1	0.00	0.55	39.56	1.94	12.43	0.61	0.00	0.00	0.00	0.61	1.02
Lick Fork	20.8	39	0.7	0.00	0.69	40.02	1.93	13.25	0.64	0.00	0.00	0.00	0.77	1.21
White Oak Creek	21.4	25	0.5	0.00	0.79	38.85	1.81	13.21	0.62	0.00	0.00	0.00	0.87	1.36
Montgomery Fork	22.2	142	2.7	0.00	0.42	46.36	2.09	13.42	0.61	0.00	0.00	0.00	0.47	0.84
Cove Creek	24.0	45	0.8	0.00	0.58	47.12	1.96	14.59	0.61	0.00	0.00	0.00	0.65	1.10
Upper Hickory Creek	24.8	77	1.5	0.00	0.56	51.92	2.09	15.73	0.63	0.00	0.00	0.40	0.64	1.09
Beech Fork	28.0	113	2.1	0.00	0.64	55.35	1.98	17.40	0.62	0.00	0.00	0.45	0.73	1.27
Upper Emory River	28.1	84	1.6	0.00	0.90	52.43	1.87	17.26	0.61	0.00	0.00	0.66	1.01	1.69
Rock Creek	31.3	24	0.4	0.00	0.97	56.92	1.82	19.00	0.61	0.00	0.00	0.72	1.11	1.80
Smoky Creek	33.5	38	0.7	0.00	0.51	71.02	2.12	20.95	0.63	0.00	0.00	0.35	0.60	1.15
Upper Brimstone Creek	36.8	45	0.8	0.00	0.53	75.44	2.05	21.97	0.60	0.00	0.00	0.36	0.64	1.23
Upper Elk Creek	37.0	17	0.3	0.00	0.77	84.55	2.28	25.09	0.68	0.00	0.00	0.51	0.86	1.58

Stream	Watershed Size (mi^2)	Stream Slope (ft/mi)	Stream Slope (%)	7Q10 (cfs)	30QS (cfs)	MAF (cfs)	MAF (cfs/mi^2)	MSF (cfs)	MSF (cfs/mi^2)	q99.5 (cfs)	q99 (cfs)	q98 (cfs)	q95 (cfs)	q90 (cfs)
Lower Stinking Creek	38.4	38	0.7	0.00	0.68	86.58	2.25	26.08	0.68	0.00	0.00	0.46	0.79	1.49
Buffalo Creek	43.6	12	0.2	0.00	0.70	87.89	2.02	26.78	0.61	0.00	0.00	0.47	0.82	1.57
New River at Stainville	45.4	37	0.7	0.00	0.83	92.78	2.04	28.89	0.64	0.00	0.00	0.55	0.95	1.83
Lower Brimstone Creek	48.8	32	0.6	0.00	0.72	98.07	2.01	30.18	0.62	0.00	0.00	0.48	0.85	1.66
Lower Emory River	91.7	20	0.4	0.83	2.48	172.09	1.88	56.53	0.62	0.48	1.22	1.79	2.93	5.04
Lower Hickory Creek	106.9	31	0.6	0.66	2.33	199.78	1.87	69.44	0.65	0.65	1.04	1.62	2.93	5.50
New River at Smoky Junction	111.9	19	0.4	0.44	1.85	212.24	1.90	72.07	0.64	0.43	0.73	1.22	2.38	4.81
New River at Cordell	198.5	11	0.2	0.73	3.21	362.27	1.83	137.94	0.69	0.74	1.29	2.17	4.31	8.80
New River at Winona	269.8	9	0.2	0.91	4.15	488.60	1.81	186.19	0.69	0.93	1.65	2.81	5.60	11.64
New River at Huntsville	306.5	8	0.2	0.93	4.40	559.51	1.83	212.42	0.69	0.93	1.68	2.92	6.00	12.71
New River at New River	371.5	7	0.1	1.31	5.86	674.81	1.82	253.52	0.68	1.28	2.25	3.89	7.97	16.43

Source: USGS 2007.

mi=miles; ft=feet; cfs=cubic feet per second; MAF=mean annual flow; MSF=mean summer flow.

[a]Reference stream.

TABLE E-1B: CALCULATED STREAM CONDITIONS FOR CUMULATIVE IMPACT SUBAREAS AND REFERENCE WATERSHEDS IN THE NORTH CUMBERLAND WILDLIFE MANAGEMENT AREA AND ADJACENT AREAS

Stream	q80 (cfs)	q70 (cfs)	q60 (cfs)	q50 (cfs)	q40 (cfs)	q30 (cfs)	q20 (cfs)	q10 (cfs)	PK2 (cfs)	PK5 (cfs)	PK10 (cfs)	PK25 (cfs)	PK50 (cfs)	PK100 (cfs)	PK500 (cfs)
No Business Branch[a]	0.29	0.48	0.80	1.27	1.75	2.35	3.50	6.50	430	719	933	1,220	1,440	1,660	2,190
Bruce Creek	0.47	0.78	1.27	2.01	2.78	3.82	5.55	10.25	274	441	570	747	886	1,040	1,430
Big Creek	0.98	1.63	2.69	4.52	7.09	10.92	16.34	29.16	533	845	1,080	1,400	1,650	1,940	2,630
Brimstone Creek[a]	0.77	1.45	2.68	4.98	8.21	13.21	19.16	34.93	1,210	1,970	2,530	3,290	3,880	4,450	5,890
Greasy Creek[a]	1.10	1.84	3.05	5.23	8.47	13.15	19.51	34.19	726	1,150	1,470	1,900	2,240	2,620	3,520
Stinking Creek[a]	1.12	2.10	3.75	7.13	13.13	21.83	32.74	59.03	1,540	2,500	3,200	4,150	4,890	5,610	7,430
Ollis Creek	1.71	2.93	4.84	8.59	15.28	24.44	38.14	67.19	1,020	1,590	2,030	2,610	3,070	3,580	4,810
Straight Fork	1.61	3.10	5.59	10.92	20.64	34.22	51.31	91.74	1,920	3,080	3,940	5,100	6,010	6,900	9,160
Upper Stinking Creek	1.56	3.01	5.45	10.65	20.12	33.46	51.03	91.91	2,070	3,340	4,280	5,530	6,510	7,470	9,880
New River at Braytown	1.63	3.10	5.62	10.98	20.62	34.04	51.58	90.73	2,310	3,750	4,810	6,220	7,310	8,380	11,000
Ligias Fork	2.00	3.61	6.24	11.65	21.32	34.52	52.40	91.98	2,320	3,750	4,810	6,210	7,310	8,380	11,100
Lick Fork	2.23	3.92	6.75	12.12	21.53	33.07	50.83	87.51	2,010	3,230	4,130	5,330	6,280	7,210	9,580
White Oak Creek	2.47	4.18	6.90	12.19	21.28	33.49	51.38	89.63	1,920	3,070	3,920	5,060	5,970	6,860	9,130
Montgomery Fork	1.79	3.51	6.45	12.65	23.82	39.51	59.35	106.85	2,560	4,150	5,320	6,870	8,090	9,260	12,200
Cove Creek	2.21	4.11	7.26	13.59	24.64	39.91	60.79	108.64	1,320	2,050	2,600	3,330	3,900	4,530	6,060
Upper Hickory Creek	2.22	4.21	7.68	14.72	27.32	43.35	65.71	115.53	2,560	4,120	5,280	6,810	8,010	9,180	12,100
Beech Fork	2.61	4.90	8.76	16.45	29.86	47.25	71.32	127.64	2,980	4,810	6,160	7,950	9,340	10,700	14,100
Upper Emory River	3.23	5.56	9.17	16.35	28.97	45.97	70.94	123.15	1,640	2,550	3,220	4,120	4,820	5,590	7,430
Rock Creek	3.41	5.93	9.96	17.69	30.84	48.56	75.38	132.04	1,560	2,410	3,040	3,880	4,530	5,250	6,990
Smoky Creek	2.64	5.45	10.31	20.35	38.52	61.02	91.87	166.70	2,920	4,660	5,960	7,690	9,040	10,400	13,700

Stream	q80 (cfs)	q70 (cfs)	q60 (cfs)	q50 (cfs)	q40 (cfs)	q30 (cfs)	q20 (cfs)	q10 (cfs)	PK2 (cfs)	PK5 (cfs)	PK10 (cfs)	PK25 (cfs)	PK50 (cfs)	PK100 (cfs)	PK500 (cfs)
Upper Brimstone Creek	2.91	6.00	11.26	21.75	40.93	64.69	99.38	180.35	3,210	5,140	6,570	8,460	9,950	11,400	15,100
Upper Elk Creek	3.49	7.01	12.94	25.11	47.33	73.10	107.10	188.25	2,800	4,450	5,670	7,310	8,600	9,880	13,100
Lower Stinking Creek	3.41	6.98	13.24	25.91	48.38	74.53	110.10	194.42	3,240	5,180	6,620	8,530	10,000	11,500	15,200
Buffalo Creek	3.68	7.45	13.87	26.25	47.85	74.86	115.01	210.44	2,990	4,730	6,030	7,770	9,140	10,500	14,000
New River at Stainville	4.19	8.32	15.21	28.45	51.70	80.01	122.30	222.89	3,680	5,870	7,500	9,650	11,300	13,000	17,200
Lower Brimstone Creek	4.00	8.22	15.57	29.59	53.60	83.37	128.36	235.31	3,820	6,080	7,760	9,990	11,700	13,500	17,800
Lower Emory River	10.11	18.10	31.04	55.21	96.11	146.80	225.65	402.60	3,630	5,520	6,890	8,700	10,100	11,600	15,300
Lower Hickory Creek	11.83	22.14	38.82	68.48	116.26	173.81	263.97	470.95	7,050	11,200	14,200	18,200	21,400	24,400	32,200
New River at Smoky Junction	11.13	21.75	38.96	70.32	122.25	183.72	279.48	502.98	6,780	10,700	13,600	17,400	20,400	23,400	30,900
New River at Cordell	20.86	42.21	77.97	132.99	208.59	303.87	467.19	847.20	9,750	15,200	19,300	24,700	29,000	33,200	43,900
New River at Winona	27.78	57.10	106.44	181.53	284.53	413.72	633.74	1149.80	12,200	19,000	24,100	30,800	36,000	41,200	54,400
New River at Huntsville	30.97	64.65	121.68	208.85	327.18	474.69	725.62	1315.72	13,100	20,400	25,800	33,000	38,600	44,100	58,300
New River at New River	39.29	80.75	150.48	257.33	399.85	579.34	880.77	1590.02	14,900	23,100	29,200	37,200	43,500	49,800	65,800

Source: USGS 2007.

cfs=cubic feet per second.

[a]Reference stream.

TABLE E-2: STREAM USE CLASSIFICATIONS FOR SELECTED STREAMS WITHIN THE STUDY AREA

Stream	Domestic Water Supply	Industrial Water Supply	Fish and Aquatic Life	Recreation	Livestock Watering and Wildlife	Irrigation	Navigation	Trout Stream	Naturally Reproducing Trout Stream
Emory River Watershed									
Emory River	X	X	X	X	X	X			
All other Emory River watershed surface waters			X	X	X	X			
Upper Cumberland River Watershed									
Elk Fork Creek (Mile 1.8 (KY Line) to Origin)	X		X	X	X	X			
Hickory Creek			X	X	X	X		X	
All other Upper Cumberland River watershed surface waters			X	X	X	X			
Big South Fork Cumberland Watershed									
Laurel Fork (Upper 4.9 miles)			X	X	X	X		X	
New River (Mile 15.0 to Origin)	X		X	X	X	X			
All other Big South Fork Cumberland watershed surface waters			X	X	X	X			
Clinch River Watershed									
Cove Creek (Mile 16.1 to Origin)	X	X	X	X	X	X			
Ollis Creek	X	X	X	X	X	X			
All other Clinch River watershed surface waters			X	X	X	X			

Source: TDEC 2013.

TABLE E-3A: OFFICE OF SURFACE MINING AND TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION AMBIENT MONITORING DATA AND SUMMARY OF MEASURED WATER QUALITY CRITERIA THRESHOLD EXCEEDANCES AND DETECTION LIMIT ISSUES

Stream	Station	Number of samples	pH	DO	Sulfate[a]	TDS[a]	Al (CMC/CCC)
			6-9 units	>5.0 mg/L	250 mg/L	500 mg/L	0.75/0.87 mg/L
Rock Creek near Lancing	06-01	3	0	0	0	0	0/3
Upper Emory	06-09A	3	0	0	0	0	0/3
Lower Emory River	06-09B	3	0	0	0	0	0/3
New River at Smoky Junction	08-01A	5	0	0	0	0	0/4
New River at Stainville	08-01B	5	0	0	0	0	1/4
Ligias Fork at Stainville	08-01C	5	0	0	0	0	0/3
New River near Braytown	08-01D	4	0	0	0	0	0/4
Beech Fork at Shea	08-02	5	0	0	0	0	0/3
Smoky Creek at Smoky Junction	08-03A	5	0	0	0	0	0/3
Montgomery Fork	08-04	5	0	0	0	0	0/5
New River at Cordell	08-05	5	0	0	0	0	0/4
New River at Huntsville	08-05B	3	0	0	0	0	0/1
New River at Winona	08-06	3	0	0	0	0	0/3
Buffalo Creek	08-06A	5	0	0	0	0	0/3
Straight Fork	08-06B	5	0	1	0	0	0/4
Lower Brimstone Creek	08-08	4	0	0	0	0	0/3
Upper Brimstone Creek	08-08A	4	0	0	0	0	0/2
New River at New River	08-09	3	0	0	0	0	1/3
White Oak Creek at Hambright	08-25	3	0	0	0	0	0/3
Cove Creek at Caryville	09-03	5	0	0	0	0	0/4
Ollis Creek	09-05	5	0	0	0	0	0/5
Big Creek	09-05A	5	0	0	0	0	0/5
Bruce Creek	09-12	3	0	0	0	0	0/2
Lower Stinking Creek	10-03	5	0	0	0	0	0/5
Upper Stinking Creek	10-03A	4	0	0	0	0	0/3
Lick Creek	10-04	5	0	0	0	0	0/3

Stream	Station	Number of samples	pH	DO	Sulfate[a]	TDS[a]	Al (CMC/CCC)
			6-9 units	>5.0 mg/L	250 mg/L	500 mg/L	0.75/0.87 mg/L
Upper Hickory Creek	10-05A	5	0	0	0	0	0/5
Upper Elk Creek	10-06B	5	0	0	0	0	0/5
Lower Hickory Creek	10-16	3	0	0	0	0	0/2
Stinking Creek[b]	SC-Ref	3	0	0	0	0	0/3
Brimstone Creek[b]	BC-Ref	3	0	0	0	0	0/1
Greasy Creek[b]	GC-Ref	3	0	0	0	0	0/1
Indian Fork upstream of Joe Branch	INDIA001.0AN	5	1	0	1	0	1/3
New River at Stainville	NEW045.0AN	4	0	0	0	0	1/0
Ligias Fork at Stainville	LIGIA000.SAN	4	0	0	0	0	0/2
Beech Fork at Shea	BEECH000.2SC	4	0	0	0	0	0/1
Smoky Creek near Smoky Junction	SMOKY000.8SC	4	0	0	0	0	0/2
Montgomery Fork at Montgomery	MONTG000.5SC	4	0	0	0	0	0/2
New River at New River	NEW08.8SC	4	0	0	0	0	0/2
Paint Rock Creek at Newtown	PROCK001.0SC	4	0	0	0	0	0/1
Buffalo Creek upstream of BC Church	BUFFA004.2SC	4	0	0	0	0	0/1
Straight Fork at Norma Bridge	STRAI001.9SC	4	0	0	0	0	0/2
New River control at Fork Mtn.	FECO69D01	5	3	0	0	0	0/3
Bear Branch	FECO69D03	2	2	0	0	0	0/2
Unnamed Tributary to Titus Creek	FECO69E01	5	4	0	0	0	0/0
Unnamed Tributary to Davis Creek	FECO69E02	1	1	0	0	0	0/0

Source: OSMRE n.d.

Notes: mg/L-milligrams per liter; CMC-criterion maximum concentration; CCC- criterion continuous concentration.

[a]OSMRE threshold levels used for analysis of cumulative hydrologic impact assessment.

[b]Reference stream.

TABLE E-3B: OSMRE AND TDEC AMBIENT MONITORING DATA AND SUMMARY OF MEASURED WATER QUALITY CRITERIA THRESHOLD EXCEEDANCES AND DETECTION LIMIT ISSUES

Stream	Fe[a]	Mn[a]	As[b] (CMC/CCC)	Hg[b] (CMC/CCC)	Se (CMC/CCC)	Cd[c] (CMC/CCC)
	1 mg/L	1 mg/L	0.34/0.15 mg/L	0.0014/0.00077 mg/L	0.02/0.005 mg/L	HD mg/L
Rock Creek near Lancing	0	0	0/0	0/0	0/0	0/2
Upper Emory	0	0	0/0	0/0	0/0	1/2
Lower Emory River	0	0	0/0	0/0	0/0	0/1
New River at Smoky Junction	0	0	0/0	0/0	0/0	0/0
New River at Stainville	1/0	0	0/0	0/0	0/0	0/1
Ligias Fork at Stainville	0	0	0/0	0/0	0/0	0/0
New River near Braytown	0	0	0/0	0/0	0/0	0/0
Beech Fork at Shea	0	0	0/0	0/0	0/0	0/2
Smoky Creek at Smoky Junction	0	0	0/0	0/0	0/0	0/1
Montgomery Fork	0	0	0/0	0/0	0/0	0/0
New River at Cordell	0	0	0/0	0/0	0/0	0/1
New River at Huntsville	0	0	0/0	0/0	0/0	0/0
New River at Winona	0	0	0/0	0/0	0/0	0/0
Buffalo Creek	0	0	0/0	0/0	0/0	0/0
Straight Fork	1/0	0	0/0	0/0	0/0	0/2/1-DL
Lower Brimstone Creek	0	0	0/0	0/0	0/0	0/0
Upper Brimstone Creek	0	0	0/0	0/0	0/0	0/0
New River at New River	0	0	0/0	0/0	0/0	0/1
White Oak Creek at Hambright	1/1	0	0/0	0/0	0/0	0/2
Cove Creek at Caryville	0	0	0/0	0/0	0/0	0/2/2-DL
Ollis Creek	0	0	0/0	0/0	0/0	0/2/2-DL
Big Creek	0	0	0/0	0/0	0/0	0/2
Bruce Creek	0	0	0/0	0/0	0/0	0/0
Lower Stinking Creek	0	0	0/0	0/0	0/0	0/2
Upper Stinking Creek	0	0	0/0	0/0	0/0	0/2
Lick Creek	0	0	0/0	0/0	0/0	0/0
Upper Hickory Creek	0	0	0/0	0/0	0/0	0/0
Upper Elk Creek	0	0	0/0	0/0	0/0	0/0
Lower Hickory Creek	0	0	0/0	0/0	0/0	0/1
Stinking Creek[d]	0	0	0/0	0/0	0/0	0/2
Brimstone Creek[d]	0	0	0/0	0/0	0/0	0/2
Greasy Creek[d]	0	0	0/0	0/0	0/0	0/2
Indian Fork upstream of Joe Branch	1	0	0/0	0/0	0/0	0/0
New River at Stainville	1	0	0/0	0/0	0/0	0/0
Ligias Fork at Stainville	0	0	0/0	0/0	0/0	0/0
Beech Fork at Shea	0	0	0/0	0/0	0/0	0/0

Stream	Fe[a]	Mn[a]	As[b] (CMC/CCC)	Hg[b] (CMC/CCC)	Se (CMC/CCC)	Cd[c] (CMC/CCC)
	1 mg/L	1 mg/L	0.34/0.15 mg/L	0.0014/0.00077 mg/L	0.02/0.005 mg/L	HD mg/L
Smoky Creek near Smoky Junction	0	0	0/0	0/0	0/0	0/0
Montgomery Fork at Montgomery	0	0	0/0	0/0	0/0	1-DL
New River at New River	1	0	0/0	0	0/0	2-DL
Paint Rock Creek at Newtown	0	0	0/0	0	0/0	4-DL
Buffalo Creek upstream of BC Church	0	0	0/0	0	0/0	3-DL
Straight Fork at Norma Bridge	0	0	0/0	0	0/0	1-DL
New River control at Fork Mtn.	0	0	0/0	0	0/0	5-DL
Bear Branch	0	0	0/0	0	0/0	0/1/1-DL
Unnamed Tributary to Titus Creek	0	0	0/0	0	0/0	8-DL
Unnamed Tributary to Davis Creek	0	0	0/0	0	0/0	2-DL

Source: OSMRE n.d.

Notes: mg/L-milligrams per liter; CMC-criterion maximum concentration; CCC- criterion continuous concentration,

[a]OSMRE threshold levels used for analysis of cumulative hydrologic impact assessment,

[b]TDEC/EPA water quality criteria based on dissolved fraction of the sample.

[c]TDEC/EPA water quality criteria based on dissolved fraction of the sample and calculated as a function of water hardness.

[d]Reference stream.

TABLE E-3C: OSMRE AND TDEC AMBIENT MONITORING DATA AND SUMMARY OF MEASURED WATER QUALITY CRITERIA THRESHOLD EXCEEDANCES AND DETECTION LIMIT ISSUES

Stream	Cr[a] (CMC/CCC)	Cu[b] (CMC/CCC)	Pb[b] (CMC/CCC)	Ni[b] (CMC/CCC)	Ag[b] (CMC)	Zn[b] (CMC/CCC)
	0.016/0.011 Cr(IV)[a] HD mg/L Cr(III)[a]	HD mg/L	HD mg/L	HD mg/L	HD mg/L	HD mg/L
Rock Creek near Lancing	0/0	1/2	0/1	0/0	3-DL	1/1
Upper Emory	0/0	0/0	0/0	0/0	0/0	1/1
Lower Emory River	0/0	0/2	0/0	0/0	1-DL	1/1
New River at Smoky Junction	0/0	0/0	0/0	0/0	0/0	1/1
New River at Stainville	0/0	0/0	0/0	0/0	0/0	1/1
Ligias Fork at Stainville	0/0	0/0	0/0	0/0	0/0	1/1
New River near Braytown	0/0	0/0	0/0	0/0	0/0	1/1
Beech Fork at Shea	0/0	0/1	0/0	0/0	0/0	1/1
Smoky Creek at Smoky Junction	0/0	0/1	0/0	0/0	0/0	1/1
Montgomery Fork	0/0	0/0	0/0	0/0	0/0	1/1
New River at Cordell	0/0	0/1	0/0	0/0	0/0	1/1
New River at Huntsville	0/0	0/0	0/0	0/0	0/0	1/1
New River at Winona	0/0	0/0	0/0	0/0	0/0	1/1
Buffalo Creek	0/0	0/0	0/0	0/0	0/0	2/2
Straight Fork	0/0	0/0	0/0	0/0	0/0	1/1
Lower Brimstone Creek	0/0	0/1	0/0	0/0	1-DL	1/1
Upper Brimstone Creek	0/0	0/0	0/0	0/0	1-DL	1/1
New River at New River	0/0	0/0	0/0	0/0	0/0	1/1
White Oak Creek at Hambright	0/0	2/2	0/1	0/0	1-DL	1/1
Cove Creek at Caryville	0/0	1/1	0/0	0/0	3-DL	1/1
Ollis Creek	0/0	0/0	0/1-DL	0/0	1-DL	1/1
Big Creek	0/0	1/1	0/0	0/0	0/0	1/1
Bruce Creek	0/0	0/0	0/0	0/0	0/0	1/1
Lower Stinking Creek	0/0	0/0	0/0	0/0	1-DL	1/1
Upper Stinking Creek	0/0	0/1	0/0	0/0	1-DL	1/1
Lick Creek	0/0	0/0	0/0	0/0	0/0	1/1

Stream	Cr[a] (CMC/CCC)	Cu[b] (CMC/CCC)	Pb[b] (CMC/CCC)	Ni[b] (CMC/CCC)	Ag[b] (CMC)	Zn[b] (CMC/CCC)
	0.016/0.011 Cr(IV)[a] HD mg/L Cr(III)[a]	HD mg/L	HD mg/L	HD mg/L	HD mg/L	HD mg/L
Upper Hickory Creek	0/0	0/0	0/0	0/0	0/0	1/1
Upper Elk Creek	0/0	0/0	0/0	0/0	0/0	1/1
Lower Hickory Creek	0/0	0/0	0/0	0/0	0/0	1/1
Stinking Creek[c]	0/0	0/0	0/0	0/0	0/0	1/1
Brimstone Creek[c]	0/0	1/1	0/0	0/0	2-DL	1/1
Greasy Creek[c]	0/0	1/1	0/1	0/0	3-DL	1/1
Indian Fork upstream of Joe Branch	0/0	0/0	0/0	0/0	0/0	0/0
New River at Stainville	0/0	0/0	0/0	0/0	0/0	0/0
Ligias Fork at Stainville	0/0	0/0	0/0	0/0	0/0	0/0
Beech Fork at Shea	0/0	0/0	0/0	0/0	0/0	0/0
Smoky Creek near Smoky Junction	0/0	0/0	0/0	0/0	0/0	0/0
Montgomery Fork at Montgomery	0/0	0/0	0/0	0/0	0/0	0/0
New River at New River	0/0	0/0	0/0	0/0	0/0	0/0
Paint Rock Creek at Newtown	0/0	0/0	0/0	0/0	0/0	0/0
Buffalo Creek upstream of BC Church	0/0	0/0	0/0	0/0	0/0	0/0
Straight Fork at Norma Bridge	0/0	0/0	0/0	0/1	0/0	1/1
New River control at Fork Mtn.	0/0	0/0	0/0	0/0	0/0	0/0
Bear Branch	0/0	0/0	0/2	0/0	0/0	0/0
Unnamed Tributary to Titus Creek	0/0	4-DL	5-DL	0/0	0/0	2/2
Unnamed Tributary to Davis Creek	0/0	2-DL	1-DL	0/0	0/0	0/0

Source: OSMRE n.d.

Notes: mg/L-milligrams per liter; CMC-criterion maximum concentration; CCC- criterion continuous concentration.

[a]These values are based on total chromium while TDEC and US Environmental Protection Agency (EPA) criteria are based on dissolved species of Cr(III) and Cr(IV) with Cr(III) criteria also being a function of hardness. As long as total chromium does not exceed either the CMC or CCC for Cr(III) or Cr(IV), no exceedances exit.

[b]TDEC/EPA water quality criteria based on dissolved fraction of the sample and calculated as a function of water hardness.

[c]Reference stream.

TABLE E-4: SURFACE MINING DISTURBANCES IN THE OFFICE OF SURFACE MINING CUMULATIVE HYDROLOGIC IMPACT ASSESSMENT AND REFERENCE WATERSHEDS

Number	Trend Station	Stream Name	Acres	Miles^2	Mining Acres	Percent Mined
1	06-01	Rock Creek near Lancing	20,035	31.3	25	0.1
2	08-25	White Oak Creek near Sunbright	13,712	21.4	238	1.7
3	06-09B	Lower Emory River at Nemo	58,693	91.7	1482	2.5
4	10-03A	Upper Stinking Creek	12,361	19.3	344	2.8
5	09-03	Cove Creek	15,386	24.0	632	4.1
6	10-03	Lower Stinking Creek	24,582	38.4	1492	6.1
7	06-09A	Upper Emory at Elizabeth	17,982	28.1	1171	6.5
8	08-06A	Buffalo Creek upstream of confluence with Straight Fork	27,903	43.6	1947	7.0
9	08-08A	Brimstone Creek at Hughett	23,525	36.8	1737	7.4
10	08-08	Brimstone Creek at Walker Bridge	31,225	48.8	2365	7.6
11	09-05	Ollis Creek	10,289	16.1	868	8.4
12	08-09	New River at New River	237,719	371.4	23943	10.1
13	10-06B	Upper Elk Creek	23,682	37.0	2414	10.2
14	08-05B	New River at Huntsville	196,134	306.5	21068	10.7
15	08-06B	Straight Fork upstream of confluence with Buffalo Creek	12,272	19.2	1393	11.3
16	08-06	New River at Winona	172,682	269.8	19591	11.3
17	08-03A	Smoky Creek at Smoky Creek Junction	21,423	33.5	2672	12.5
18	09-12	Bruce Creek	1,756	2.7	226	12.9
19	08-05	New River at Cordell	127,026	198.5	16132	12.7
20	09-05A	Big Creek	4,817	7.5	635	13.2
21	08-01D	New River near Braytown	12,423	19.4	1717	13.8
22	08-01C	Ligias Fork at Stainville	13,067	20.4	1794	13.7
23	10-16	Hickory Creek at Morley	68,397	106.9	9638	14.1
24	08-01B	New River at Stainville	29,078	45.4	4159	14.3

Number	Trend Station	Stream Name	Acres	Miles^2	Mining Acres	Percent Mined
25	08-01A	New River upstream of Smoky Creek	71,590	111.9	10303	14.4
26	08-04	Montgomery Fork at Montgomery	14,174	22.1	2128	15.0
27	08-02	Beech Fork at Shea	17,898	28.0	3128	17.5
28	10-05A	Hickory Creek upstream of confluence with Stinking Creek	15,898	24.8	3175	20.0
29	10-04	Lick Creek at Habersham	13291	20.8	2974	22.4
30	NB-Ref	No Business Creek[a]	1,096	1.7	0	0.0
31	GC-Ref	Greasy Creek[a]	5,369	8.4	63	1.2
32	BC-Ref	Brimstone Creek[a]	5,382	8.4	110	2.1
33	SC-Ref	Stinking Creek[a]	8,269	12.5	320	3.9

Source: OSMRE n.d.

[a]Reference stream.

TABLE E-5A: SUMMARY OF PRIMARY AND SECONDARY MAXIMUM CONTAMINANT LEVEL THRESHOLD EXCEEDANCES FOR DOMESTIC WATER SUPPLY STREAMS

Stream			Upper Emory River	Lower Emory River	New River at Braytown	New River at Stainville	New River at Smoky Junction	New River at Cordell	New River at Winona	New River at Huntsville
L			06-09A	06-09B	08-01D	08-01B	08-01A	08-05	08-06	08-05B
# of Samples			3	3	4	5	5	5	3	3
Parameter		**MCL (mg/L)**								
pH[a]		6.5-8.5	0	0	0	0	0	0	0	0
SO_4	Secondary Standards	250	0	0	0	0	0	0	0	0
TDS	Secondary Standards	500	0	0	0	0	0	0	0	0
Fluoride	Secondary Standards	2	0	0	0	0	0	0	0	0
Chloride	Secondary Standards	250	0	0	0	0	0	0	0	0
Aluminum	Secondary Standards	0.05-0.2	1/0	1/0	1/1	3/1	1/0	3/1	1/0	0/1
Iron	Secondary Standards	0.3	1/0	0	1/0	2/0	0	2/0	0	1/0
Manganese	Secondary Standards	0.05	1/0	0	1/1	0	0	0	0	1/0
Silver	Secondary Standards	0.1	0	0	0	0	0	0	0	0
Zinc	Secondary Standards	5	0	0	0	0	0	0	0	0
NO_2+NO_3	Primary Standards	10	0	0	0	0	0	0	0	0
Antimony	Primary Standards	0.006	0	0	0	0	0	0	0	0
Arsenic	Primary Standards	0.01	0	0	0	0	0	0	0	0
Barium	Primary Standards	2	0	0	0	0	0	0	0	0
Beryllium	Primary Standards	0.004	0	0	0	0	0	0	0	0
Cadmium	Primary Standards	0.005	1/0	0	0	0	0	0	0	0
Chromium	Primary Standards	0.1	0	0	0	0	0	0	0	0
Copper	Primary Standards	1.3/1.0	0	0	0	0	0	0	0	0
Lead	Primary Standards	0.015	0	0	0	0	0	0	0	1/0
Mercury	Primary Standards	0.002	0	0	0	0	0	0	0	0
Nickel[b]	Primary Standards	0.1	0	0	0	0	0	0	0	0
Selenium	Primary Standards	0.05	0	0	0	0	0	0	0	0
Thallium	Primary Standards	0.002	0	0	0	1/1	1/1	1/1	0	1/0

Source: OSMRE n.d.

[a]pH measured in units (L=below minimum pH; H=above maximum pH).

[b]Nickel MCL was remanded by EPA on February 9, 1995 but is listed here for reference level.

TABLE E-5B: SUMMARY OF PRIMARY AND SECONDARY MAXIMUM CONTAMINANT LEVEL THRESHOLD EXCEEDANCES FOR DOMESTIC WATER SUPPLY STREAMS

Stream			New River at New River	Cove Creek	Ollis Creek	Upper Elk Creek	New River at Fork Mountain	New River at Stainville	New River at New River
Station			08-09	09-03	09-05	10-06B	FECO69D01	NEW045.0AN	NEW08.8SC
# of Samples			3	5	5	5	4	4	4
Parameter		**MCL (mg/L)**							
pH[a]		6.5-8.5	0	1-H	1-L	0	3-L	0	0
SO_4	Secondary Standards	250	0	0	0	0	0	0	0
TDS	Secondary Standards	500	0	0	0	0	0	0	0
Fluoride	Secondary Standards	2	0	0	0	0			
Chloride	Secondary Standards	250	0	0	0	0	0	0	0
Aluminum	Secondary Standards	0.05-0.2	2/1	2/2	2/2	0	4/1	2/1	3/1
Iron	Secondary Standards	0.3	1/0	2/0	1/0	4/0	2	1	3
Manganese	Secondary Standards	0.05	1/0	1/0	4/3	1/0	0	0	0
Silver	Secondary Standards	0.1	0	0	0	0	0	0	0
Zinc	Secondary Standards	5	0	0	0	0	0	0	0
NO_2+NO_3	Primary Standards	10	0	0	0	0			
Antimony	Primary Standards	0.006	0	0	0	0			
Arsenic	Primary Standards	0.01	0	0	0	0	0	0	0
Barium	Primary Standards	2	0	0	0	0			
Beryllium	Primary Standards	0.004	0	0	0	0			
Cadmium	Primary Standards	0.005	0	0	0	0	0	0	0
Chromium	Primary Standards	0.1	0	0	0	0	0	0	0
Copper	Primary Standards	1.3/1.0	0	0	0	0	0	0	0
Lead	Primary Standards	0.015	0	0	0	0	0	0	0
Mercury	Primary Standards	0.002	0	0	0	0	0	0	0
Nickel[b]	Primary Standards	0.1	0	0	0	0	0	0	0
Selenium	Primary Standards	0.05	0	0	0	0	0	0	0
Thallium	Primary Standards	0.002	0	1/0	1/1	1/1	0	0	0

Source: OSMRE n.d.

[a]pH measured in units (L=below minimum pH; H=above maximum pH).

[b]Nickel MCL was remanded by EPA on February 9, 1995 but is listed here for reference level.

TABLE E-6A: SUMMARY STATISTICS OF LOW FLOW SPECIFIC CONDUCTIVITY SITES

Site ID	Stream	Start Date	End Date	Watershed Size (Miles^2/Acres)	Surface Mining Disturbance (Acres/%)[a]	Max (µS/cm)	Min (µS/cm)
1	No Business Branch	8/16/2011	8/29/2011	1.7 (1,094)	0 (0.0)	27.7	24.8
2	Cane Branch	9/19/2011	10/4/2011	1.2 (762)	0 (0.0)	55.5	32.9
3	Rock Creek near Lancing and Highway 127	9/19/2011	10/4/2011	31.3 (20,058)	25 (0.1)	77.0	51.2
4	Greasy Creek downstream of Mill Branch	9/19/2011	10/4/2011	13.3 (8,480)	64 (0.8)	43.7	34.8
5	Titus Creek just upstream of Cove Creek	10/7/2011	10/21/2011	8.2 (5,222)	67 (1.3)	273.0	92.7
6	White Oak Creek at Hambright Bridge	9/19/2011	10/4/2011	21.4 (13,715)	238 (1.7)	115.7	51.9
7	Upper Brimstone reference section	9/19/2011	10/4/2011	8.1 (5,171)	111 (2.1)	144.8	33.0
8	Cove Creek near Red Ash	8/16/2011	8/29/2011	20.8 (13,318)	462 (3.5)	352.3	179.0
9	Lower Emory River	7/27/2011	8/9/2011	49.0 (31,386)	1,260 (4.0)	84.5	66.3
10	Upper Stinking Creek at TWRA ATV area	8/16/2011	8/29/2011	12.2 (7,808)	318 (4.1)	136.0	74.2
11	Bull Creek upstream of New River	10/25/2011	11/8/2011	10.5 (6,714)	295 (4.4)	100.2	69.1
12	Lower Stinking Creek at National Coal haulroad	8/16/2011	8/28/2011	33.7 (21,555)	1,060 (4.9)	323.1	196.1
13	Upper Cove Creek	10/7/2011	10/21/2011	4.7 (3,027)	169 (5.6)	247.7	93.9
14	Macs Branch at Hughett	9/19/2011	10/4/2011	2.4 (1,562)	98 (6.3)	155.8	103.5
15	Upper Emory River at Trendstation	7/27/2011	8/9/2011	28.1 (17,978)	1,168 (6.5)	109.7	73.5
16	Bowling Branch upstream of Smoky Creek	10/25/2011	11/8/2011	3.0 (1,914)	132 (6.9)	49.7	36.6
17	Lower Buffalo Creek at Buffalo Bridge	10/7/2011	10/21/2011	42.6 (27,232)	1,917 (7.0)	236.9	101.9
18	Upper Straight Fork near Turley Mountain	10/7/2011	10/21/2011	0.9 (544)	39 (7.2)	55.6	32.2
19	Elk Fork Creek	10/7/2011	10/21/2011	7.2 (4,627)	341 (7.4)	268.4	127.3
20	Upper Buffalo Creek	10/7/2011	10/21/2011	28.4 (18,182)	1,389 (7.6)	202.0	130.2
21	New River at Fork Mountain	6/28/2011	7/13/2011	4.2 (2,662)	210 (7.9)	316.2	52.2
22	Paint Rock Creek at Newtown	10/7/2011	10/21/2011	21.5 (13,766)	1,118 (8.1)	208.3	42.6
23	Rockhouse Fork to Buffalo Creek	10/7/2011	10/21/2011	6.3 (4,026)	363 (9.0)	204.7	101.0
24	Mill Creek upstream at Lone Mountain	9/19/2011	10/7/2011	10.9 (6,963)	655 (9.4)	199.6	153.1
25	Terry Creek	10/7/2011	10/21/2011	5.1 (3,270)	320 (9.8)	158.1	91.8

Site ID	Stream	Start Date	End Date	Watershed Size (Miles^2/Acres)	Surface Mining Disturbance (Acres/%)[a]	Max (µS/cm)	Min (µS/cm)
26	Big Creek downstream of Ollis Creek confluence	8/17/2011	8/29/2011	23.6 (15,130)	1,499 (9.9)	296.9	129.3
27	Edmunds Branch tributary to Emory River	7/27/2011	8/9/2011	1.7 (1,069)	108 (10.1)	93.6	50.6
28	Laurel Fork upstream of low-water crossing	6/28/2011	7/13/2011	7.2 (4,582)	498 (10.9)	272.4	110.7
29	Emory River upstream of Edmunds Branch	7/27/2011	8/9/2011	10.9 (7,002)	854 (12.2)	149.7	86.5
30	Straight Fork (lower at Norma road bridge)	10/7/2011	10/21/2011	17.0 (10,893)	1,358 (12.5)	415.3	112.2
31	New River at Cordell	10/25/2011	11/8/2011	198.5 (127,034)	16,127 (12.7)	211.3	158.1
32	Cage Creek	11/2/2011	11/18/2011	6.0 (3,808)	509 (13.4)	205.5	107.6
33	New River downstream of Baldwin Tipple	6/28/2011	7/13/2011	19.4 (12,422)	1,709 (13.8)	293.3	82.2
34	Lower Ligias Fork near Stainville	11/2/2011	11/22/2011	20.3 (12,973)	1,790 (13.8)	318.1	110.0
35	New River at Stainville	6/28/2011	7/4/2011	45.4 (29,082)	4,155 (14.3)	361.1	205.0
36	Montgomery Fork upstream of Roach Creek	10/25/2011	11/8/2011	18.5 (11,853)	1,701 (14.4)	173.9	153.2
37	Straight Fork upstream of Neal Branch	10/7/2011	10/21/2011	8.4 (5,395)	800 (14.8)	377.3	183.6
38	Charleys Branch	6/28/2011	7/11/2011	1.5 (966)	148 (15.4)	420.2	112.9
39	Upper Ligias Fork upstream of Graves Gap Br.	11/2/2011	11/22/2011	9.0 (5,779)	901 (15.6)	361.3	70.6
40	Round Rock Creek at Stony Fork School	11/2/2011	11/22/2011	15.9 (10,144)	1,803 (17.8)	248.6	114.3
41	Hickory Creek just upstream of Rock Creek	8/16/2011	8/29/2011	19.7 (12,595)	2,433 (19.3)	539.0	314.1
42	Cable Branch	11/2/2011	11/18/2011	0.4 (262)	52 (19.8)	545.1	149.1
43	Roach Creek just upstream of Montgomery Fork	10/25/2011	11/8/2011	3.2 (2,042)	416 (20.4)	171.1	106.2
44	Nicks Creek	10/25/2011	11/8/2011	4.8 (3,066)	631 (20.6)	154.5	124.0
45	Emory River headwater	7/27/2011	8/9/2011	2.6 (1,683)	352 (20.9)	302.0	104.4
46	Indian Fork at Braytown	6/28/2011	7/13/2011	4.8 (3,053)	713 (23.4)	591.8	80.8
47	Rock Creek upstream of lower waterfall	8/16/2011	8/29/2011	4.0 (2,579)	648 (25.1)	489.9	271.9
48	Neal Branch	10/7/2011	10/21/2011	1.4 (883)	226 (25.6)	1318.0	293.2

Source: OSMRE n.d.

µS/cm-microsiemens per centimeter.

[a]The percent of surface area that is considered to be disturbed by mining is based on surface disturbance areas and does not include underground mine areas.

TABLE E-6B: SUMMARY STATISTICS OF LOW FLOW SPECIFIC CONDUCTIVITY SITES

Site ID	Stream	Mean (µS/cm)	Median (µS/cm)	Range (µS/cm)	Rainfall (inches)
1	No Business Branch	26.3	26.2	2.9	2.47
2	Cane Branch	44.0	43.9	22.6	2.12
3	Rock Creek near Lancing and Highway 127	59.5	59.4	25.8	2.12
4	Greasy Creek downstream of Mill Branch	39.9	39.7	8.9	2.12
5	Titus Creek just upstream of Cove Creek	222.0	242.8	180.3	6.21
6	White Oak Creek at Hambright Bridge	78.2	74.8	63.8	2.12
7	Upper Brimstone reference section	56.8	52.8	111.8	2.12
8	Cove Creek near Red Ash	204.8	201.1	173.3	2.47
9	Lower Emory River	77.3	76.7	18.2	2.5
10	Upper Stinking Creek at TWRA ATV area	115.5	115.9	61.8	2.47
11	Bull Creek upstream of New River	78.3	76.3	31.1	2.13
12	Lower Stinking Creek at National Coal haulroad	253.1	250.0	127.0	2.47
13	Upper Cove Creek	215.1	235.8	153.8	6.21
14	Macs Branch at Hughett	133.7	132.8	52.3	2.12
15	Upper Emory River at Trendstation	91.6	91.8	36.2	2.5
16	Bowling Branch upstream of Smoky Creek	43.3	43.2	13.1	2.13
17	Lower Buffalo Creek at Buffalo Bridge	162.9	166.5	135.0	6.21
18	Upper Straight Fork near Turley Mountain	45.2	46.2	23.4	6.21
19	Elk Fork Creek	221.0	231.2	151.1	6.21
20	Upper Buffalo Creek	179.4	179.0	71.8	6.21
21	New River at Fork Mountain	217.3	229.5	264.0	8.11
22	Paint Rock Creek at Newtown	176.8	188.8	165.7	6.21
23	Rockhouse Fork to Buffalo Creek	174.9	186.1	103.7	6.21
24	Mill Creek upstream at Lone Mountain	172.9	172.0	46.5	2.12
25	Terry Creek	126.4	132.4	66.3	6.21

Site ID	Stream	Mean (µS/cm)	Median (µS/cm)	Range (µS/cm)	Rainfall (inches)
26	Big Creek downstream of Ollis Creek confluence	226.8	226.3	167.6	2.47
27	Edmunds Branch tributary to Emory River	77.2	77.5	43.0	2.5
28	Laurel Fork upstream of low-water crossing	192.6	197.4	1661.7	8.11
29	Emory River upstream of Edmunds Branch	131.5	128.9	63.2	2.5
30	Straight Fork (lower at Norma Road bridge)	323.8	363.9	303.1	6.21
31	New River at Cordell	187.6	189.5	53.2	2.13
32	Cage Creek	177.9	181.4	97.9	2.9
33	New River downstream of Baldwin Tipple	238.4	245.9	211.1	8.11
34	Lower Ligias Fork near Stainville	229.1	223.4	208.1	4.15
35	New River at Stainville	285.2	288.6	156.1	131
36	Montgomery Fork upstream of Roach Creek	162.6	162.2	20.7	2.13
37	Straight Fork upstream of Neal Branch	318.6	338.9	193.7	6.21
38	Charleys Branch	320.0	339.3	3307.3	6.8
39	Upper Ligias Fork upstream of Graves Gap Br.	245.1	259.5	290.7	4.15
40	Round Rock Creek at Stony Fork School	198.2	199.0	134.3	4.15
41	Hickory Creek just upstream of Rock Creek	471.1	482.8	224.9	2.47
42	Cable Branch	462.9	478.1	396.0	2.9
43	Roach Creek just upstream of Montgomery Fork	145.0	146.3	64.9	2.13
44	Nicks Creek	139.7	139.2	30.5	2.13
45	Emory River headwater	204.0	208.7	197.6	2.5
46	Indian Fork at Braytown	408.9	436.6	511.0	8.11
47	Rock Creek upstream of lower waterfall	429.5	433.5	217.9	2.47
48	Neal Branch	982.4	993.4	1024.8	6.21

Source: OSMRE n.d.

µS/cm-microsiemens per centimeter.

GROUNDWATER QUANTITY

TABLE E-7: WELL STATISTICS FOR THE COUNTIES COMPRISING THE NORTH CUMBERLAND WILDLIFE MANAGEMENT AREA AND PETITION AREA

County	Anderson		Campbell		Morgan		Scott	
Total wells	1,789		1,973		1,712		759	
Wells with known locations	945		519		357		147	
NCWMA area wells	17		30		29		6	
Well Statistics	**County**	**NCWMA**	**County**	**NCWMA**	**County**	**NCWMA**	**County**	**NCWMA**
Max. well depth (feet)	3,458	250	1,000	505	1,647	775	900	106
Min. well depth (feet)	5	50	25	85	17	10	16	48
Mean well depth (feet)	236	125	243	232	156	163	106	76
Median well depth (feet)	200	108	222	193	125	109	82	79
Max. well yield (gpm)	1,250	50	2,200	300	150	50	350	12
Min. well yield (gpm)	0	0	0	0	0	0	0	1
Mean well yield (gpm)	16	18	15	26	11	12	11	7
Median well yield (gpm)	6	20	5	10	8	8	5	8
Max. casing length (feet)	910	63	346	105	718	69	147	25
Min. casing length (feet)	5	20	3	20	2	11	2	3
Mean casing length (feet)	63	29	63	40	24	30	21	16
Median casing length (feet)	42	22	42	41	21	22	20	17
Max. depth to WBZ (feet)	725	230	800	360	550	280	485	74
Min. depth to WBZ (feet)	3	34	6	10	4	38	6	33
Mean depth to WBZ (feet)	171	83	170	130	96	94	65	47
Median depth to WBZ (feet)	140	77	150	100	80	70	45	40

Source: Ewing pers. comm. 2012.

NCWMA-North Cumberland Wildlife Management Area; Max.-maximum; Min.-minimum; gpm-gallons per minute; WBZ-water-bearing zone.

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APPENDIX F: TERRESTRIAL SPECIES DOCUMENTED IN THE EVALUATION AREA

The following tables list those terrestrial species documented as occurring in or near the evaluation area.

TABLE F-1: BIRD SPECIES OCCURRING WITHIN THE FROZEN HEAD STATE PARK AND ROYAL BLUE WILDLIFE MANAGEMENT AREA

Common Name	Scientific Name
Cooper's Hawk	*Accipiter cooperii*
Sharp-shinned Hawk	*Accipiter striatus*
Wood Duck	*Aix sponsa*
Golden Eagle	*Aquila chrysaetos*
Ruby-throated Hummingbird	*Archilochus colubris*
Great Blue Heron	*Ardea herodias*
Tufted Titmouse	*Baeolophus bicolor*
Cedar Waxwing	*Bombycilla cedrorum*
Ruffed Grouse	*Bonasa umbellus*
American Bittern	*Botaurus lentiginosus*
Canada Goose	*Branta canadensis*
Red-tailed Hawk	*Buteo jamaicensis*
Red-shouldered Hawk	*Buteo lineatus*
Broad-winged Hawk	*Buteo platypterus*
Green Heron	*Butorides virescens*
Northern Cardinal	*Cardinalis cardinalis*
Turkey Vulture	*Cathartes aura*
Turkey Vulture	*Cathartes aura*
Veery Bird	*Catharus fuscescens*
Chimney Swift	*Chaetura pelagica*
Killdeer	*Charadrius vociferus*
Yellow-billed Cuckoo	*Coccyzus americanus*
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Northern Flicker	*Colaptes auratus*
Northern Bobwhite	*Colinus virginianus*
Rock Pigeon	*Columba livia*
Eastern Wood-Pewee	*Contopus virens*
Black Vulture	*Coragyps atratus*
American Crow	*Corvus brachyrhynchos*
Blue Jay	*Cyanocitta cristata*

Common Name	Scientific Name
Blackburnian Warbler	*Dendroica fusca*
Black-throated Golden Warbler	*Dendroica virens*
Pileated Woodpecker	*Dryocopus pileatus*
Gray Catbird	*Dumetella carolinensis*
Least Flycatcher	*Empidonax minimus*
Acadian Flycatcher	*Empidonax virescens*
American Kestrel	*Falco sparverius*
Common Loon	*Gavia immer*
Sandhill Crane	*Grus canadensis*
Worm-eating Warbler	*Helmitheros vermivorum*
Wood Thrush	*Hylocichla mustelina*
Red-bellied Woodpecker	*Melanerpes carolinus*
Wild Turkey	*Meleagris gallopavo*
Black-and-white Warbler	*Mniotilta varia*
Brown-headed Cowbird	*Molothrus ater*
Great Crested Flycatcher	*Myiarchus crinitus*
Yellow-crowned Night-Heron	*Nyctanassa violacea*
Kentucky Warbler	*Oporornis formosus*
Louisiana Water thrush	*Parkesia motacilla*
Indigo Bunting	*Passerina cyanea*
Double-crested Cormorant	*Phalacrocorax auritus*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
Eastern Towhee	*Pipilo erythrophthalmus*
Scarlet Tanager	*Piranga olivacea*
Summer Tanager	*Piranga rubra*
Carolina Chickadee	*Poecile carolinensis*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Eastern Phoebe	*Sayornis phoebe*
American Woodcock	*Scolopax minor*
Ovenbird	*Seirurus aurocapilla*
Black-throated Blue Warbler	*Setophaga caerulescens*
Cerulean Warbler	*Setophaga cerulea*
Yellow-throated Warbler	*Setophaga dominica*
Chestnut-sided Warbler	*Setophaga pensylvanica*
American Redstart	*Setophaga ruticilla*

Common Name	Scientific Name
Eastern Bluebird	*Sialia sialis*
White-breasted Nuthatch	*Sitta carolinensis*
American Goldfinch	*Spinus tristis*
Chipping Sparrow	*Spizella passerina*
Barred Owl	*Strix varia*
Carolina Wren	*Thryothorus ludovicianus*
Brown Thrasher	*Toxostoma rufum*
Winter Wren	*Troglodytes hiemalis*
American Robin	*Turdus migratorius*
Yellow-throated Vireo	*Vireo flavifrons*
Red-eyed Vireo	*Vireo olivaceus*
Blue-headed Vireo	*Vireo solitarius*
Canada Warbler	*Wilsonia canadensis*
Hooded Warbler	*Wilsonia citrina*
Mourning Dove	*Zenaida macroura*

TABLE F-2: MAMMALS PRESENT IN THE CUMBERLAND MOUNTAIN PLATEAU

Common Name	Scientific Name	Native/Nonnative
Northern Long Eared Shrew	*Blarina brevicauda*	Native
Domestic dog	*Canis familiaris*	Nonnative
Coyote	*Canis latrans*	Native
Beaver	*Castor Canadensis*	Native
Elk	*Cervus elaphus*	Native
Eastern Big-Eared Bat	*Corynorhinus rafinesquii*	Native
Least Shrew	*Cryptotis parva*	Native
Nine-banded armadillo	*Dasypus novemcinctus*	Nonnative
Virginia opossum	*Didelphis virginiana*	Native
Northern flying squirrel	*Glaucomys sabrinus*	
Southern flying squirrel	*Glaucomys volans*	Native
Silver-haired bat	*Lasionycteris noctivagans*	Native
Red Bat	*Lasiurus borealis*	Native
Hoary Bat	*Lasiurus cinereus*	Native
River Otter	*Lontra candensis*	Native
Bobcat	*Lynx rufus*	Native
Woodchuck	*Marmota monax*	Native

Common Name	Scientific Name	Native/Nonnative
Striped Skunk	*Mephitis mephitis*	Native
Prairie Vole	*Microtus ochrogastor*	Native
Woodland vole	*Microtus pinetorum*	Native
House mouse	*Mus musculus*	Nonnative
Long-tailed weasel	*Mustela frenata*	
Mink	*Mustela vison*	
Little Brown Bat	*Myotis septentrionalis*	Native
Northern long-eared bat	*Myotis septentrionalis*	Native
Golden mouse	*Ochrotomys nuttalli*	Native
White-tailed deer	*Odocoileus virginianus*	Native
Muskrat	*Ondatra zibethicus*	Native
Hairy-tailed mole	*Parascalops breweri*	
Tricolored Bat	*Perimyotis subflavus*	Native
White-footed mouse	*Peromyscus leucopus*	Native
Eastern pipistrelle	*Pipistrellus subflavus*	
Raccoon	*Procyon lotor*	Native
Norway rat	*Rattus norvegicus norvegicus*	Nonnative
Eastern Harvest Mouse	*Reithrodontomys humulis*	Native
Eastern Mole	*Scalopus aquaticus*	Native
Eastern Grey Squirrel	*Sciurus carolinensis*	Native
Hispid Cotton Rat	*Sigmodon hispidus*	Native
Smoky Shrew	*Sorex fumeus*	Native
Pygmy Shrew	*Sorex hoyi*	Native
Eastern spotted skunk	*Spilogale putorius*	
Feral hog	*Sus Scrofa*	Nonnative
Eastern Cottontail	*Sylvilagus floridanus*	Native
Eastern Chipmunk	*Tamias striatus*	Native
Gray Fox	*Urocyon cinereoargenteus*	Native
Black Bear	*Ursus americanus*	Native
Red Fox	*Vulpes vulpes*	Native

TABLE F-3: REPTILE SPECIES OCCURRING WITHIN THE FROZEN HEAD STATE PARK

Common Name	Scientific Name
Northern copperhead	*Agkistrodon contortrix mokasen*
Eastern spiny softshell	*Apalone spinifera spinifera*
Eastern wormsnake	*Carphophis amoenus*
Snapping turtle	*Chelydra serpentina*
Northern black racer	*Coluber constrictor constrictor*
Timber rattlesnake	*Crotalus horridus*
Northern ring-neck snake	*Diadophis punctatus edwardsii*
Corn snake	*Elaphe guttata guttata*
Black rat snake	*Elaphe obsoleta obsoleta*
Five-lined skink	*Eumeces fasciatus*
Northern water snake	*Nerodia sipedon sipedon*
Rough green snake	*Opheodrys aestivus*
Northern fence lizard	*Sceloporus undulatus hyacinthinus*
Redbelly Snake	*Storeria occipitomaculata*
Eastern box turtle	*Terrapene carolina carolina*
Eastern garter snake	*Thamnophis sirtalis sirtalis*

TABLE F-4: AMPHIBIAN SPECIES OCCURRING WITHIN THE FROZEN HEAD STATE PARK

Common Name	Scientific Name
Northern Cricket Frog	*Acris crepitans*
American Toad	*Bufo americanus*
Fowler's Toad	*Bufo fowleri*
Southern Two-lined Salamander	*Eurycea cirrigera*
Four-toed Salamander	*Hemidactylium scutatum*
Cope's Gray Treefrog	*Hyla chrysoscelis*
Green Treefrog	*Hyla cinerea*
Gray Treefrog	*Hyla versicolor*
Eastern Newt	*Notophthalmus viridescens*
Spring Peeper	*Pseudacris crucifer*
Southeastern Chorus Frog	*Pseudacris feriarum*
Red Salamander	*Pseudotriton ruber*
American Bullfrog	*Rana catesbeiana*
Green Frog	*Rana clamitans*
Pickerel Frog	*Rana palustris*
Southern Leopard Frog	*Rana pipiens*

TABLE F-5: TERRESTRIAL INVERTEBRATE NON-NATIVE SPECIES OCCURRING WITHIN OR NEAR THE EVALUATION AREA

Common Name	Scientific Name
Emerald Ash Borer	*Agrilus planipennis*
Partially-Africanized Bees	*Apis mellifera scutellata*
Camphor Shot Borer	*Cnestus mutilatus*
Walnut Twig Beetle	*Pityophthorus juglandis*
Fire Ant	*Solenopsis spp.*

APPENDIX G: EMERGENCY SERVICES

This appendix lists the emergency services available in the four counties of the evaluation area.

Anderson County emergency services include the following:

- Lake City Fire Department
- Lake City Police Department
- Medford Volunteer Fire Department
- Briceville Volunteer Fire Department
- Marlow Volunteer Fire Department – Donovan Station
- Marlow Volunteer Fire Department – Marlow Station
- Oliver Springs Fire Department Station 2

Campbell County emergency services include the following:

- Jellico Police Department
- Jellico Fire Department
- Jellico Life Saving and Rescue Squad Incorporated
- Caryville Volunteer Fire Department
- Jacksboro Fire Department
- Lafollette Fire Department
- Ridgewood Volunteer Fire Department
- Stoney Fork Volunteer Fire Department
- Campbell County Rural Fire Service Station 1 - Headquarters
- Tennessee Department of Agriculture, Division of Forestry - Campbell County
- White Oak Volunteer Fire Department
- Cove Lake State Park Ranger Station
- Caryville Police Department
- Jacksboro Police Department
- Indiana Mountain State Park Ranger Station
- Jellico Police Department
- Norris Dam State Park Ranger Station
- Campbell County Sherriff's Department
- Cumberland Trail State Park Ranger Station

Morgan County emergency services include the following:

- Wartburg Police Department
- Wartburg Volunteer Fire Department
- Morgan County Volunteer Fire Department
- Burrville Volunteer Fire Department
- Deer Lodge Volunteer Fire Department
- Chestnut Ridge Volunteer Fire Department
- Coalfield Volunteer Fire Department
- Joyner Volunteer Fire Department
- Petros Volunteer Fire Department

- Frozen Head State Park and Natural Area – Ranger Station
- Morgan County Sheriff's Department

Scott County emergency services include the following:

- Scott County Sheriff Department
- Pine Hill Volunteer Fire Department
- Winfield Fire Department
- Winfield Police Department
- Paint Rock Volunteer Fire Department
- East 63 Volunteer Fire Department
- Huntsville Fire Department
- Mid-County Volunteer Fire Department
- South Scott County Volunteer Fire Department

APPENDIX H: INDEX OF BIOTIC INTEGRITY ASSESSMENT DATA

Index of Biotic Integrity assessments are a method used to assess aquatic environments using invertebrate assemblages as a proxy for overall stream health (Wittman and Mundahl 2003). Below are the results of Index of Biotic Integrity assessment surveys conducted by Tennessee Wildlife Resources Agency between 1994 and 2012 which covered streams throughout eastern Tennessee including portions of the Clinch, Powell, and Cumberland River watersheds including Big South Fork (Carter et al. 2012). These Index of Biotic Integrity assessments used multiple metrics to rate and monitor stream health over time and assigned a numerical value to each surveyed stream or segment which corresponds to a stream health category ranging from "very poor" to "excellent". The data presented below are presented in chronological order and are limited streams within the four Tennessee counties which contain a portion of the evaluation area (Anderson, Campbell, Morgan, and Scott). All data are summarized from Carter et al. 2012 and include but are not limited to streams within the evaluation area.

Water Body	Watershed	Year Surveyed	County	Index of Biotic Integrity Score	Benthic Biotic Integrity Score
Capuchin Creek	Cumberland River	1994	Campbell	44 (Fair)	3 (Fair/Good)
Trammel Branch	Cumberland River	1994	Campbell	36 (Poor/Fair)	3 (Fair/Good)
Hatfield Creek	Cumberland River	1994	Campbell	42 (Fair)	3 (Fair/Good)
Baird Creek	Cumberland River	1994	Campbell	38 (Poor/Fair)	3 (Fair/Good)
Clear Fork (Site 1)	Cumberland River	1994	Campbell	52 (Good)	3 (Fair/Good)
Elk Fork Creek	Clear Fork	1994	Campbell	40 (Fair)	2 (Fair)
Fall Branch	Clear Fork	1994	Campbell	28 (Poor)	1 (Poor)
Crooked Creek	Clear Fork Cumberland River	1994	Campbell	38 (Poor/Fair)	2 (Fair)
Burnt Pone Creek	Clear Fork Cumberland River	1994	Campbell	38 (Poor/Fair)	2 (Fair)
Whistle Creek	Clear Fork Cumberland River	1994	Campbell	38 (Poor/Fair)	2 (Fair)
Little Elk Creek	Clear Fork Cumberland River	1994	Campbell	40 (Fair)	2 (Fair)
Lick Fork	Clear Fork Cumberland River	1994	Campbell	38 (Poor/Fair)	2 (Fair)
Terry Creek	Clear Fork Cumberland River	1994	Campbell	48 (Good)	2 (Fair)
Crouches Creek	Clear Fork Cumberland River	1994	Campbell	28 (Poor)	1 (Poor)
Hickory Creek (Site 1)	Clear Fork Cumberland River	1994	Campbell	46 (Fair/Good)	3 (Fair/Good)
Hickory Creek (Site 2)	Clear Fork Cumberland River	1994	Campbell	48 (Good)	2 (Fair)
White Oak Creek	Clear Fork Cumberland River	1994	Campbell	30 (Poor)	2 (Fair)

Water Body	Watershed	Year Surveyed	County	Index of Biotic Integrity Score	Benthic Biotic Integrity Score
No Business Branch	Clear Fork Cumberland River	1994	Campbell	30 (Poor)	3 (Fair/Good)
Laurel Fork	Clear Fork Cumberland River	1994	Campbell	52 (Good)	3 (Fair/Good)
Lick Creek	Clear Fork Cumberland River	1994	Campbell	44 (Fair)	3 (Fair/Good)
Davis Creek	Clear Fork Cumberland River	1994	Campbell	38 (Poor/Fair)	2 (Fair)
Rock Creek	Clear Fork Cumberland River	1994	Campbell	54 (Good/Excellent)	3 (Fair/Good)
Rose Creek	Clear Fork Cumberland River	1994	Campbell	36 (Poor/Fair)	2 (Fair)
Hinds Creek	Clinch River	1996	Anderson	36 (Poor/Fair)	3 (Fair/Good)
Cove Creek	Clinch River	1996	Campbell	28 (Poor)	3 (Fair/Good)
Titus Creek	Clinch River	1996	Campbell	42 (Fair)	3 (Fair/Good)
Stony Fork	Big South Fork	1996	Campbell	38 (Poor/Fair)	4 (Good)
Stinking Creek	Cumberland River	2002	Campbell	42 (Fair)	4.5 (Good)
Straight Fork	Cumberland River	2002	Campbell	18 (Very Poor)	3.0 (Fair/Good)
Montgomery Fork	Cumberland River	2002	Campbell	48 (Good)	3.5 (Fair/Good)
New River (Site 1)	Big South Fork Cumberland River	2004	Anderson	30 (Poor)	4.2 (Good)
New River (Site 2)	Big South Fork Cumberland River	2004	Campbell	42 (Fair)	3.5 (Fair/Good)
Indian Fork	Big South Fork Cumberland River	2004	Anderson	41 (Fair)	3.8 (Fair/Good-Good)
Poplar Creek	Clinch River	2009	Anderson	30 (Poor)	3.7 (Fair/Good-Good)
Titus Creek	Clinch River	2009	Campbell	-	4.5 (Good)
Smoky Creek	New River	2010	Scott	37 (Fair)	3.5 (Fair/Good)
Beech Fork	New River	2010	Campbell	47 (Good)	-
Cove Creek	Clinch river	2012	Campbell	32 (Poor)	-
Capuchin Creek	Clear Fork Cumberland River	2012	Campbell	38 (Poor/Fair)	-
Little Elk Creek	Clear Fork Cumberland River	2012	Campbell	42 (Fair)	-

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APPENDIX I: AIR EMISSIONS METHODOLOGY

This appendix documents the methods, models and assumptions used to develop the surface coal mining $PM_{2.5}$ and PM_{10} emission estimates presented in chapter 6.

FUGITIVE DUST

The fugitive dust emission factors for coal mining operations was obtained from the US Environmental Protection Agency (EPA) 2011 National Emissions Inventory, specifically the technical documentation for the source Mining and Quarrying (2325000000) (EPA 2015). EPA National Emissions Inventory emission factor is in turn based on AP-42 equations developed for western surface coal mines (which are substantially larger than the coal mines in the project area). No useable Tennessee or Appalachia-specific emission factor sources were located. The western surface coal mining-based emissions factors are considered to provide a conservative basis for evaluating emissions given that the arid conditions of the west would be expected to result in higher fugitive dust generation than in the evaluation area.

The National Emissions Inventory particulate matter fugitive dust emissions factors for coal mining include overburden removal, drilling and blasting, loading and unloading and overburden replacement activities (EPA 2015). The amount of overburden material handled is assumed to equal ten times the quantity of coal mined and coal unloading is assumed to be split evenly between end-dump and bottom-dump operations. The National Emissions Inventory emission factor does not include transfer and conveyance operations, crushing and screening operations, and storage since the dust emissions from these activities are assumed to be well controlled. The PM_{10} emissions factor equation for coal mining is (EPA 2015):

$$EF_c = (10 \times (EF_{to} + EF_{or} + EF_{dt})) + EF_v + EF_r + EF_a + (0.5 \times (EF_e + EF_t))$$

where, EF_c = coal mining fugitive dust emissions factor (lbs/ton)

EF_{to} = PM_{10} emission factor for truck loading overburden at western surface coal mining operations (lbs/ton of overburden)

EF_{or} = PM_{10} emission factor for overburden replacement at western surface coal mining operations (lbs/ton of overburden)

EF_{dt} = PM_{10} emission factors for truck unloading: bottom dump-overburden at western surface coal mining operations (lbs per ton of overburden)

EF_v = PM_{10} open pit overburden removal emission factor at western surface coal mining operations (lbs per ton)

EF_r = PM_{10} drilling/blasting emission factor at western surface coal mining operations (lbs per ton)

EF_a = PM_{10} loading emission factor at western surface coal mining operations (lbs per ton)

EF_e = PM_{10} truck unloading: end dump-coal emission factor at western surface coal mining operations (lbs per ton)

EF_t = PM_{10} truck unloading: bottom dump-coal emission factor at western surface coal mining operations (lbs per ton).

Applying the PM_{10} emissions factors developed for western surface coal mining operations yields the following coal mining fugitive dust emissions factor (EPA 1998):

$$EF_c = (10 \times (0.015 + 0.001 + 0.006)) + 0.225 + 0.00005 + 0.05 + (0.5 \times (0.0035 + 0.033)) = 0.513 \text{ lbs/ton}$$

In 2006, the EPA adopted new $PM_{2.5}$ and PM_{10} ratios for several fugitive dust categories and concluded that the $PM_{2.5}$ and PM_{10} ratios for fugitive dust categories should be in the range of 0.1 to 0.15 (Midwest Research Institute (2006). Consequently, a ratio of 0.125 was applied to the PM_{10} emissions factors to estimate $PM_{2.5}$ emissions factors (EPA 2015).

The resulting National Emissions Inventory coal mining fugitive dust emission factors are as follows:

- 0.513 lbs PM_{10} per ton of coal produced
- 0.064 lbs $PM_{2.5}$ per ton of coal produced.

OFF-ROAD EQUIPMENT EMISSIONS MODELING

The off-road equipment sources were based on the typical mining scenario discussed above, and include excavators, off-highway trucks, a drill rig, grader and dozer. Equipment is not assumed to be operating in any particular location, but is of sufficient quantity to achieve the maximum possible production in the evaluation area. The following inputs were used in modeling off-road equipment through MOVES2014:

Model Selection: Nonroad.

Domain/Scale: National (the only option for nonroad modeling).

Calculation Type: Inventory.

Analysis Year: 2024 (to match on-road analysis).

Month: January.

Day: Weekdays.

Geographic Bounds: Anderson County, Tennessee (single county used to represent the four counties in the evaluation area).

Nonroad Equipment Selection: Diesel construction equipment.

Pollutants And Processes: $PM_{2.5}$ (running exhaust), PM_{10} (running exhaust).

Output Units: Mass- grams, energy- joules, distance- miles.

EPA default values were used for all other nonroad modeling inputs. The resulting output database was post-processed using an EPA-developed Mysql script that converts the calculated emissions quantities to emissions factors by equipment horsepower in units of grams per horse-power hour. Table I-1 summarizes the resulting emissions factors.

TABLE I-1: NON-ROAD EQUIPMENT ASSUMPTIONS AND EMISSION FACTORS

	Number	HP	Total Operating Hours Per Day	PM_{10} Emission Factor (grams/HP-hr)	$PM_{2.5}$ Emission Factor (grams/HP-hr)
Excavators	3	600	30	16.31	15.82
Off-Highway Trucks	3	600	30	7.45	7.23
Drill Rig	1	400	10	41.42	40.18
Dozer	1	500	10	12.84	12.45
Grader	1	300	10	2.99	2.90

ON-ROAD SOURCES

The on-road analysis addresses emissions associated with the transportation of coal from the mine to a rail line or other distribution point and employee commutes to/from the mine site. The analysis was conducted using EPAs mobile source emissions model, MOVES2014.

For coal haul trucks, it was assumed 5-axle coal haul tractor trailers with a capacity of 40 tons would be utilized. Based on the range in annual coal production in the evaluation area, this results in 1,350 to 6,000 truck trips per year. A travel distance of 50 miles (roundtrip) was assumed, leading to an estimate of 67,500 to 300,000 vehicle miles traveled per year for haul trucks. For emissions modeling, the diesel combination long-haul truck source type was used.

For employee commutes, a range of 20 to 50 mining employees was assumed depending on the level coal production. The analysis assumed a roundtrip travel distance of 50 miles and 270 workdays per year. This resulted in 270,000 to 675,000 vehicle miles traveled for employee commutes. For emissions modeling, this travel was assumed to all be from gasoline-powered passenger trucks.

The MOVES2014 input assumptions are detailed below.

Model: On-road.

Domain/Scale: Project-level.

Calculation Type: Emission rates (e.g., grams/vehicle mile traveled).

Year: 2024 (to coincide with an analysis year used by the Knoxville MPO transportation conformity determination).

Month: January.

Days: Weekdays.

Hour: 7 a.m. to 8 a.m.

Geographic Bounds: Anderson County, Tennessee (used to represent all counties in evaluation area).

On-Road Equipment: Diesel combination long-haul truck (e.g., tractor trailer) and gasoline passenger trucks.

Road Type: Rural unrestricted access (for running emissions) and off-network (for start emissions).

Pollutants and Processes: $PM_{2.5}$ and PM_{10}, including tirewear and brakewear processes. Emissions associated with extended idle mode (e.g., long haul truck "hoteling") or auxiliary power units were not included.

Output Units: Mass- grams, energy- joules, distance- miles.

Output Emissions Detail: All default options, plus disaggregate by source use type.

Project Data Manager:

- Age distribution, meteorology, fuels: obtained from Knoxville Regional Transportation Planning Organization to match inputs to regional MOVES modeling for the Long Range Mobility Plan Amendments
- Source type distribution- 100% long-haul trucks (in one MOVES run) and 100% passenger trucks (in a separate MOVES run)
- Average Speed- 45 mph
- Average grade- 0%
- Link length- 1 mile (the link length is not relevant because the model was set to calculate emission rates rather than quantities).

The resulting emissions factors are shown in table I-2.

TABLE I-2: HAUL TRUCK AND PASSENGER 2024 EMISSION FACTORS

	Haul Truck		Passenger Truck	
Pollutant	Start Emissions (grams/vehicle-start)	Running Emissions (grams per vehicle-mile)	Start Emissions (grams/vehicle-start)	Running Emissions (grams per vehicle-mile)
$PM_{2.5}$	0.0093	0.0960	0.1218	0.0148
PM_{10}	0.0102	0.2187	0.1377	0.0454

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U.S. Department of the Interior
Office of Surface Mining
Reclamation and Enforcement