ENVIRONMENTAL ASSESSMENT

Bledsoe Coal Lease
KYES-53865

Submitted To: Bureau of Land Management
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and

United States Forest Service
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Environmental Assessment
Bledsoe Coal Lease KYES-53865

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List of Acronyms

ABA	Acid Base Accounting
AMD	Acid Mine Drainage
amsl	above mean sea level
BA	Basal Area
BAE	Biological Assessment and Evaluation
BLM	Bureau of Land Management (Department of Interior)
BMP	Best Management Practices
CAA	Clean Air Act
CEQ	Council on Environmental Quality
cfm	cubic feet per minute
cfs	cubic feet per second
CFR	Code of Federal Regulations
cm	centimeters
CMHSA	U.S. Coal Mine Health and Safety Act
CRA	Cultural Resource Analysts, Inc.
CWA	Clean Water Act
CY	Calendar Year
DBNF	Daniel Boone National Forest
DMRE	Division of Mine Reclamation and Enforcement (Environmental and Energy Cabinet)
DOT	Department of Transportation
DRCC	Dream Ridge Coal Company
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FCLAA	Federal Coal Leasing Amendment Act
FEIS	Final Environmental Impact Statement
FSVeg	Field Sampled Vegetation (database)
ft	feet
GHG	Greenhouse Gas
GIS	Geospatial Information System
GW	Groundwater (usually for monitoring well identification)
Hp	horsepower
HWA	Hemlock Woolly Adelgid
ICPP	Intergovernmental Panel on Climate Change
ID	Interdisciplinary (agencies)
KAR	Kentucky Administrative Regulation(s)
KDAQ	Kentucky Division of Air Quality
KDEP	Kentucky Division of Environmental Protection
KDFWR	Kentucky Department of Fish and Wildlife Resources
KDMP	Kentucky Division of Mining Permits
KDMRE	Kentucky Division of Mine Reclamation and Enforcement
KDOW	Kentucky Division of Water (Division of Water)
KDMRE	Kentucky Division of Mine Reclamation and Enforcement
km	kilometer
KRADD	Kentucky River Area Development District

KRCC	Kentucky River Coal Corporation
KWh	kilowatt-hours
KY	Kentucky
KYES	Kentucky Land Office Code (Bureau of Land Management)
LECO	Laboratory Equipment Company (furnace)
LRMP	Land and Resource Management Plan
MBI	Macroinvertebrate Bioassessment
mg/l	milligrams per liter
MIS	Management Indicator Species
ml	milliliters
MLA	Mineral Leasing Act
MMBtu/hr	million metric British thermal units per hour
MOU	Memorandum of Understanding
MPA	Maximum Acid-Producing Potential
MSHA	Mining Safety and Health Act
msl	mean sea level
NAAQS	National Ambient Air Quality Standards
NAS	No Action (Development) Scenario
NCB	National Coal Board (United Kingdom)
NEPA	National Environmental Policy Act
NFS	National Forest Service
NP	Acid-Neutralizing Potential
NNP	Net Neutralization Potential
NO_2	Nitrogen Dioxide
NOx	Nitrogen Oxide Compounds
NRP	Net Potential Ratio
OSM	Office of Surface Mining
PCR	Primary Commercial Recreation
PDS	Proposed Development Scenario
PETS	Proposed, Endangered, Threatened, and Sensitive (species)
PM	Particulate Matter (associated with the particulate size either 2.5 or 10 microns)
ppm	parts per million
psi	pounds per square inch
ROD	Record of Decision (Revised Land and Resource Management Plan)
ROS	Recreation Opportunity Spectrum (model)
RRD	Redbird Ranger District
S	Sulfur
SCR	Secondary Commercial Recreation
SMA	Surface Management Agency
S_{max}	Maximum Subsidence
SME	Society for Mining, Metallurgy, and Exploration (Mining Engineering Handbook)
SSFO	Southeastern States Field Office
SO_2	Sulfur Dioxide
T&E	Threatened and Endangered (species)
TDS	Total Dissolved Solids
TSS	Total Suspended Solids

UK	United Kingdom
US	United States
USACE	United States Army Corp of Engineers (United States Army)
USGS	United States Geological Survey (Department of Interior)
USFS	United States Forest Service (Department of Agriculture)
USFWS	United States Fish and Wildlife Service (Department of Interior)
USSCS	United States Soil Conservation Service (Department of Agriculture)
VOC	Volatile Organic Compounds
WAH	Warm Water Aquatic Habitat
µS/cm	microSiemens per centimeter

1.0 INTRODUCTION

1.1 Background

This *Bledsoe Coal Lease Environmental Assessment* (*Bledsoe Coal Project EA*) presents an analysis of the environmental, social, and economic effects of the Proposed Action, which is to offer KYES-53865 for leasing by the U.S. Department of the Interior Bureau of Land Management (BLM), with consent by the U.S. Department of Agriculture Forest Service (USFS) Daniel Boone National Forest (DBNF) (Figure 1.1-1). The No Action Alternative is to not lease the federal coal. The environmental analysis presented in this document is project-specific. The *Bledsoe Coal Lease EA* was tiered to the analyses presented in the following programmatic documents: *2004 Final Environmental Impact Statement, Land and Resource Management Plan, Daniel Boone National Forest* (2004 LRMP FEIS, USFS 2004a) and the *Record of Decision for the Revised Land and Resource Management Plan, DBNF* (2004 ROD). The 2004 LRMP and 2004 ROD together are known as the 2004 *Forest Plan*. The environmental analysis presented in the *Bledsoe Coal Lease EA* is consistent with the 2004 *Forest Plan*.

The BLM, in cooperation with the USFS and the U.S. Department of the Interior Office of Surface Mining (OSM), conducted the environmental analysis for the *Bledsoe Coal Lease EA*. The *Bledsoe Coal Lease EA* specifically addresses the potential consequences of implementing the Proposed Action and the No Action Alternative. The analysis was initiated by the agencies in response to an application to lease federal coal beneath the USFS tract by competitive leasing protocol, submitted to the BLM Southeastern States Field Office. A description of the federal coal leasing process, decisions to be made, and authorizing actions are described in Sections 1.5 and 1.8.

The BLM is the lead federal agency in charge of the preparation of the *Bledsoe Coal Lease EA*. The USFS and the OSM are cooperating agencies.

1.2 Purpose

The purpose of the project is to respond to an application to lease (KYES 053865) federal coal located in the Forest Service tract by Bledsoe Coal Leasing Company, and to evaluate the potential environmental consequences associated with mining that lease. Mitigation of any identified environmental consequences will also be addressed. Private and federal coal reserves adjoin the federal coal underlying the Forest Service tract.

Coal leasing in this area helps meet the national growing demand for energy in the generation of electricity for residential and industrial uses. It also supports the President's Energy Initiative and the 1984 Memorandum of Understanding on Energy Leasing. Mining of this coal would provide economic returns to the national, state, and local economies.

The leasing of Federal coal at this point in time would allow for the extraction of private and Federal coal reserves in the safest, most economic and efficient manner and maximize the recovery of both the private

and Federal coal. Not developing the proposed lease now, which is adjacent to other Federal and private leases, may make it economically infeasible to return to it later.

Accessing federal coal now as part of a logical mining plan would create a safer work environment to extract the coal. As coal adjacent to the proposed lease is removed, access to the proposed lease may become hazardous and be lost. The mining of coal in the proposed lease along with other coal adjacent to the proposed lease must occur on a timely basis, otherwise the window of opportunity is closed in the future, leaving needed coal reserves inaccessible.

1.3 Need

The need for the project is to assist in addressing the national need for coal. When coal is available, is of adequate quality and in a large enough deposit to be economically viable, a coal lease proposal is within the National Minerals Policy to "Facilitate orderly exploration, development and production of mineral resources within the National Forest System on lands open to these activities." The leasing of the federal coal would allow for the extraction of the private and federal coal resources in the most economic and efficient manner and maximize the recovery of both the private and federal coal.

The Mining and Minerals Policy Act of 1970 defines the federal government's policy for minerals resource management as fostering and encouraging the development of economically sound and stable industries, and the orderly and economic development of domestic resources to help assure satisfaction of industrial, security, and environmental needs. Based on the Mining and Minerals Policy of 1970, the Forest Service developed its Minerals Program Policy to address its ecosystem management responsibility with regard to exploration, development, and production of mineral and energy resources and reclamation of those activities. Also, the Forest Service coordinates and cooperates with other federal and state agencies having authority and expertise in mineral-related activities. For the *Bledsoe Coal Lease EA* process, the following specific Forest Service Minerals Program Policy (USFS 1995) objectives are relevant:

- Ensure that exploration, development, and production of mineral and energy resources are conducted in an environmentally sensitive manner and that these activities are integrated with the planning and management of other resources using the principles of ecosystem management.
- Maintain opportunities to access mineral and energy resources, which are important to sustain viable rural economies, and to contribute to the national defense and economic growth
- Ensure that land disturbed by mineral and energy activities, both past and present, is reclaimed using the best scientific knowledge and principles and returned to other productive uses.

To meet those objectives, the *Bledsoe Coal Lease EA* has been prepared in accordance with environmental analysis processes outlined in the National Environmental Policy Act (NEPA) and the Council on Environmental Quality guidelines for preparing NEPA documents.

The BLM manages federal leasable minerals and geothermal resources under authority of the Mineral Leasing Act of 1920, as amended by the Federal Coal Leasing Amendments Act of 1976 (FCLAA); the Mineral Leasing Act for Acquired Lands of 1947; Section 402 of Reorganization Plan No. 3 of 1946; and various other Acts. The Mineral Leasing Act of 1920 (MLA) provided for the leasing of federal coal in tracts that allow the mining of all economically extractable coal. Subsequently, the Mineral Leasing Act for Acquired Lands of 1947 extended provisions of the MLA to acquired National Forest Service lands and required the consent of the Secretary of Agriculture prior to leasing.

1.4 General Location

The USFS tract associated with the Proposed Action is located on Beech Fork, Fern Branch, and Cawood Creek drainages in southern Leslie County, within the DBNF Redbird Ranger District (Figure 1.1-1). The area is approximately 97 over land/140 driving miles southeast of Lexington, Kentucky; 75 over land/160 driving miles northeast of Knoxville, Tennessee; and 15 miles south of Hyden, the county seat of Leslie County, Kentucky. The USFS tract associated with the Proposed Action is accessed from Cawood Branch Road off of U.S. Highway Route 421 (US 421), which runs in a north/south orientation between Hyden and the community of Bledsoe, Kentucky.

1.5 Leasing Process

1.5.1 Federal Coal Leasing Process

The federal government maintains a policy of encouraging private industry to explore and develop federal minerals, to help satisfy local and national need. The issuance of a coal lease is a legal contract between the federal government and the lessee. This contract grants the lessee the exclusive rights to explore and develop the coal resources in their lease. In order for a mining company to access federal coal reserves, the company must apply to lease the federal lands for development of the coal resource. A lease application is submitted to the BLM, which administers the federal mineral estate. The BLM assesses the priority of applications and initiates the lease consideration process, which includes ensuring that a NEPA analysis is completed. Where necessary, the BLM cooperates with the Surface Management Agency (SMA). For the *Bledsoe Coal Lease EA* process, the USFS is the SMA and the BLM is the lead agency.

1.5.2 Unsuitability Criteria

Prior to issuing a lease, the BLM or surface management agency (in this case, the Forest Service) shall, using the unsuitability criteria set out in 43 CFR Subpart 3461, assess whether there are areas unsuitable for all or certain methods of mining (43 CFR 3420.1-4(e)(2)). The BLM or other federal agency that is the SMA describes the results of the application of each unsuitability criterion. The plan or analysis results in the identification of lands that could be leased only subject to stipulations to conform to the application of the criteria. Such areas may be leased if these conditions or stipulations are contained in the lease.

The results of the analysis are presented in Appendix A.

1.5.3 Proposed Bledsoe Coal Lease

The USFS tract associated with the proposed Bledsoe Coal Lease is located on the DBNF. Proposed mining would be by underground methods. Based on information in the DBNF Forest Plan and the *Bledsoe Coal Lease EA,* the USFS and BLM will decide on the Proposed Action (Section 1.8). If the decisions result in consent to offering the tract proposed for leasing, the BLM will proceed with a competitive leasing process, which is a three-step process that involves preparation of geologic, engineering, and maximum economic recovery information; preparation for and conduct of a lease sale; review of received bids, consultation with the Attorney General, and issuance of lease(s). Before any mining can take place on a federal coal lease, a mine permit must be obtained by the lessee or operator.

1.6 Regulatory Authority

Regulatory authority for the project comes from several different agencies and regulations. BLM is authorized to lease federal lands for coal extraction under the authority of the following:

- The Mineral Leasing Act of 1920 as amended
- The Mining and Minerals Policy Act of 1970
- The Federal Land Policy and Management Act of 1976
- The National Materials and Minerals Policy
- Research and Development Act of 1980

The proposed coal lease would be extracting BLM leased minerals, so the mineral extraction would be subject to the following:

- Leasing through the BLM Lease by Application process
- Analysis under the NEPA
- A Surface Mining Control and Reclamation Act (SMCRA, 1977) permit administered through the Federal Office of Surface Mining and through primacy granted to the State of Kentucky

The USFS would establish the terms and Conditions of Approval for the coal lease with their required approval (43 CFR 3400.3-1) because the coal extraction would occur beneath National Forest Service land. The Office of Surface Mining (OSM) has regulatory authority for the surface aspects of mining (roads, ponds, facilities) and the BLM has regulatory authority for the actual mining of the coal.

1.7 Conformance with the Land and Resource Management Plan for the Daniel Boone National Forest

Coal reserves adequate for economically feasible extraction are only available on certain portions of the DBNF. Leasing these coal lands contributes to the goal of the 2004 *Forest Plan* to provide mineral commodities for current and future generations (Chapter 2, p. 15). The proposed activities would be

implemented in accordance with the objectives and standards provided for in the Forest Plan. Applicable Forest Plan standards and objectives include:

- DB-MIN-3 – No drilling or mining is allowed into known cave voids (systems) where federal leasing is authorized
- DB-MIN-4 – New federal mineral leases must contain a controlled-surface use stipulation for the scoured ephemeral stream zone

This project would help to achieve the desired future conditions described in the 2004 *Forest Plan* (USFS Forest Service, 2004b, pp. 2-16), which reflect the following goals:

- Goal 3 – Manage and/or restore watersheds to ensure the quality and quantity of water necessary to protect ecological functions, aquatic species and habitats, and support state designated beneficial uses
- Goal 7 – Provide a sustainable mix of desired uses, valued characteristics, and services to improve the long-term benefit to local communities and the public
- Goal 9 – Provide mineral commodities for current and future generations commensurate with the need to sustain the long-term health and biological diversity of ecosystems
- Goal 9.1 – Facilitate federal mineral development in a timely manner while protecting other resources
- 1.K-Goal 3 – For projects that will increase the production, transmission, or conservation of energy, evaluate federal mineral project proposals in a timely manner while addressing safety, public health, and environmental protection considerations

1.8 Decisions to Be Made

The BLM Deciding Official is the Eastern States, State Director. The BLM is the leasing authority for all federal coal reserves under the Mineral Leasing Act of 1920 (MLA). The BLM Southeastern States Field Office (SSFO) Field Manager must decide:

- Whether to issue a Finding of No Significant Impact Whether to offer the USFS tract for competitive leasing and what terms, conditions, and stipulations are needed on the lease to ensure compliance with the MLA. If the SSFO Manager makes an affirmative judgment, he or she will recommend to the State Director that the coal lease, as delineated, should be offered for sale through the competitive bidding process. The State Director ultimately decides if the lease should be offered for sale.

The Forest Service Deciding Official is the Forest Supervisor for the Daniel Boone Forest, who will determine whether to consent to the lease and under which conditions the lease should occur. The Forest Service is the surface management agency, and the Forest Supervisor must decide:

- Whether the action is consistent with the *Forest Plan* or an amendment is needed
- Whether to issue a Finding of No Significant Impact
- Whether to consent to leasing by the BLM, under authority of the Mineral Leasing Act of 1920 and special coal lease stipulations, if any, that would be needed for the protection of non-mineral resources

If consent to lease is given, the Forest Supervisor also would be consenting to underground mining consistent with the lease stipulations imposed for the protection of National Forest resources. The Forest Service would provide the BLM with a consent letter, in which the additional stipulations would be described.

The Office of Surface Mining (OSM) has permitting jurisdiction by law for the surface aspects of mining (roads, ponds, facilities). BLM has leasing authority for the actual mining of the coal and must make the decision on whether to offer for lease the requested tract of coal. OSM and the BLM are responsible for providing recommendations to the Secretary of the Interior regarding approval, disapproval, or conditional approval of mine plans on lands contained within federal lease areas. In this regard, the BLM reviews mining plans and OSM reviews potential surface impacts prior to submittal of recommendations to the Secretary of the Interior. OSM, with input from the BLM and the Forest Service, would be responsible for providing recommendations to the Secretary of the Interior concerning the issuance of findings as to whether the proposed lease and mining areas contain significant recreational, timber, economic or other values that may be incompatible with the proposed mining activities.

1.9 Public Involvement

The following sections provide a summary of the public involvement opportunities undertaken for the *Bledsoe Coal Lease EA* process.

1.9.1 Agency Scoping

An agency scoping meeting was held on August 16, 2011 at the Redbird Ranger Station in Big Creek, Kentucky. The purpose of the meeting was to gather information on issues and concerns of the agency personnel in order to focus the EA on the primary issues. Representatives from the USFS, BLM, and OSM were present, as well as many agency interdisciplinary (ID) team members.

The discussions resulted in a determination that the NEPA process for this action should focus on the following resources:

- Socio-economics (Socio-economic Resources)
- Subsidence (Geologic Resources)
- Groundwater (Water Resources)
- Surface Water (Water Resources)
- Threatened & Endangered Species (Biological Resources)

The NEPA and CEQ guidelines require that all resources be analyzed during the environmental analysis process. This NEPA document addresses all resources, but has been focused on those resources identified above.

1.9.2 Public Involvement

Public involvement began with a scoping letter posted on the DBNF planning website and sent to the Redbird Districts NEPA mailing list. The public scoping period was from Jan 27, 2012 to Feb 24, 2012. During the public scoping period, two letters were received. The comments generally indicated concern related to public safety, water quality, and biological resources.

A summary table of all comments received is provided in Appendix B.

Based on these comments, as well as those from the agency scoping process, the focus of the EA was shifted toward evaluating potential impacts on the cultural, hydrologic (ground and surface water), federally listed Threatened and Endangered (T&E) species and other wildlife resources, and subsidence (geologic resources).

2.0 ISSUES AND ALTERNATIVES

2.1 Introduction

The following sections describe the Proposed Action and associated Proposed Development Scenario (PDS); as well as the No Action Alternative and associated No Action Development Scenario (NAS).

2.2 Alternatives Considered in Detail

2.2.1 Alternative 1 (Proposed Action)

In order to achieve the needs identified for the Bledsoe Coal Lease Project, the Forest Service proposes to consent to lease and the BLM proposes to offer for lease approximately 174.36 acres of federal coal from Tract 3094bd. Underground mining on federal land is proposed, with no new surface disturbance. No new facilities would be constructed as part of the PDS. Existing and permitted surface facilities would be used to support underground mining activities for the PDS. There would be no surface occupancy on National Forest System lands.

If the Proposed Action is selected and the tract is leased, the PDS associated with the Proposed Action would involve underground mining of the federal coal. The PDS is based on the *Application for Amendment to Mining Permits submitted to the Kentucky Division of Mine Permits (KDMP) (Shamrock 2011)*. The Beech Fork coal-mining complex is located adjacent to the USFS tract and is an existing permitted facility, which is not a part of this NEPA evaluation.

2.2.1.1 Proposed Action Development Scenario

The PDS would involve driving tunnels, called main haulage drifts (mains), and tributary or submain haulage drifts (submains), into the USFS tract, and extracting the coal through room-and-pillar techniques (Figure 2.2-1). In contrast, under the NAS (Section 2.2.2), the federal coal beneath the USFS tract would not be mined, but private reserves adjoining the tract would continue to be mined.

2.2.1.1.1 Background

Historically, surface mining near the USFS tract was active but sparse, due primarily to the federal coal reserve boundaries that divided and precluded large continual mining operations. No active surface mining operations exist within the USFS tract. Underground mining has occurred at numerous locations along Beech Fork during the past century. However, there are no known underground mine openings within the proposed lease area.

An existing underground, room-and-pillar mine, known as the Beech Fork Mine, is located on private lands adjacent to the USFS tract. The operator of this mine has applied for amendment No. 4 to Permit 866-5130 (Shamrock 2011) from KDMP to expand the permitted mine southward and eastward into the adjoining, privately held coal reserves and existing federal coal lease. These private and federal reserves adjoin the USFS tract. The BLM manages the mineral rights of the USFS tract, and the USFS manages

the surface rights of the tract. In 2005, the operator of the Beech Fork Mine submitted an application to lease mineral rights within the USFS tract (Bledsoe Coal 2005) to the BLM, in accordance with BLM regulations pertaining to competitive leasing and coal management provisions and limitations. The application requested a lease for the mineral rights to the USFS tract, so that underground, room-and-pillar coal mining could be performed to extract the federal coal that underlies the USFS tract.

Within this lease application, the applicant provided legal descriptions of the USFS tract, which encompass 174.4 acres; summarized the mining methods and sequence, adjacent mining, existing land use, fire, erosion and pollution control and social impact; provided a sole party and qualification statement; and presented an initial *Resource Recovery and Protection Plan* (Bledsoe Coal 2005). The applicant also has submitted an application to KDMP Amendment #4 to Permit #866-5130, addressing mining of the adjacent federal and private land.

If the Field Office Manager issues a Decision Notice and FONSI approving the Proposed Action, the competitive coal lease process would be largely completed. Following the lease sale, approval by the Department of Justice and establishment of a proper bond, the successful bidder would be required to secure an operating permit from KDMP prior to underground mining of the federal coal beneath the USFS tract.

2.2.1.1.2 Mining Plan

Under the PDS, commercial extraction of coal from the federal reserves would involve underground, room-and-pillar mining methods, with removal of pillars on retreat (Figure 2.2-1). A schematic drawing of a typical room-and-pillar mine is shown on Figure 2.2-2. Initially, mains and submains would be driven into the coal seam. Subsequently, rectangular shaped rooms or entries would be mined in a series of panels developed off the mains and submains. The coal would be extracted from these rooms in the coal seam, leaving equally spaced pillars of coal to support the roof. Typical entry panel extraction rate determinations are shown on Figure 2.2-3. The final step for mining each selected portion or block of the reserves would be retreat mining, or second mining, which would consist of extracting the pillars left in place when rooms, submains, or mains were initially advanced. Leaving pillars in place would decrease the overall recovery rate. As far as possible, pillars would be mined, or “pulled” on the retreat, although 100% resource recovery is not possible to achieve. The extraction process would be in accordance with mining plans approved by the BLM, the U.S. Department of Labor Mine Safety and Health Administration (MSHA), and Kentucky Environmental Cabinet, Division of Mine and Reclamation and Enforcement (KDMRE). As described in more detail below, mining below sensitive structures, including streams, would be limited in order to reduce the potential for subsidence.

Some reserves would be left intact for several reasons, which would be determined on a case-by-case basis depending on any challenges encountered during the mining process. Possible reasons to leave intact reserve include:

- Presence of adverse ground conditions, such as coal seam splits or bad roof conditions
- Need for retention of the coal to provide support for "bleeder" entries, which are entries surrounding an area being mined or which has been mined out which need to be supported to allow continued ventilation
- Presence of a separating layer between splits of coal, referred to as a "middleman," that is too thin for safe extraction
- Presence of water
- MSHA Safety requirements

Modern mining equipment, including continuous mining machines, shuttle cars, or continuous face haulage systems, roof bolting machines, belt conveyor systems, and auxiliary equipment would be used to extract the coal. Mining rates would be as high as 25,000 clean tons per month when a section is mining exclusively on the leased property. An average annual production of 150,000 tons per year is projected for the leased area. Actual quantities would depend on resource conditions. Mining rates also may be impacted by other factors such as coal price and alternate coal sources. Coal extracted from the mine face would be placed on an underground conveyor system assembled in the mains and submains, which would transport the coal from the active face to an existing surface portal. The coal then would be loaded directly into trucks and hauled to an existing, permitted coal preparation plant, or temporarily stockpiled at the existing, permitted stockpile area near the portal opening. Runoff from both of these areas is monitored under an existing permit. Coal waste would be transported to existing, permitted facilities on private land, in accordance with KDMP requirements. Existing facilities near the USFS tract have adequate capacity to safely and effectively accommodate and contain the additional waste from the federal coal, and would continue to operate at the same production rates and volumes regardless of the outcome of this proposal. These facilities all operate under approved KDMP permits that require water quality protection and erosion and sediment control protection plans.

The 1969 U.S. *Coal Mine Health and Safety Act* (CMHSA) contains provisions that affect ventilation of room-and-pillar mines. The ventilation system would be designed to provide healthy and safe atmospheric working conditions at all times. The main purposes of ventilation are to provide adequate quantities of fresh air to the miners in the workings and to render toxic, noxious, and explosive gases and dusts harmless through dilution by fresh air and carry them out of the mine. There has been no detectable methane at the adjacent Beech Fork Mine (Blackburn-Lynch 2012). Based on the lack of methane in the adjacent mine, which mines the same seam, the mine is expected to be non-gassy (e.g., no methane).

A major provision of the CMHSA is the requirement for bleeder entries and systems. The purpose of bleeder entries is to bleed methane and other explosive gases from the gob area (the part of the mine from which the coal has been removed) and into the main mine return airways, using a controlled filter of intake air. Bleeding requires maintenance of an air pressure differential between the intake and return airways across the gob so that gases flow into the return airway. With the room-and-pillar retreat mining

method to be employed under the PDS, each working space would be ventilated with a minimum of 9,000 cubic feet per minute (cfm) of air to the last open crosscut. At least 3,000 cfm would reach each working face where coal is being mined. The air would contain more than 19.5% oxygen and less than 0.5% carbon dioxide. There should be sufficient flow through the caved area to bleed. No mechanical gas extraction is planned. Ventilation would be enhanced by natural airflow provided by the mains and portal openings on Beech Fork on the west. If necessary, bleeder entries would be maintained on private lands for access.

2.2.1.2 Design Criteria

Design criteria (Forest Plan standards and best management practices (BMP)) are practices implemented to protect resources during the implementation of proposed activities. Table 2.2-1 displays the design criteria applied to the Bledsoe Coal Lease Proposed Action. The application area is within the Upper Kentucky River Management Area and Prescription Areas: cliffline communities, riparian corridor, developed recreation and habitat diversity emphasis as delineated by the 2004 *Forest Plan*. In some cases, Forest Plan standards listed below may not apply to the proposal since not all resource conditions are proposed in the project area.

Table 2.2-1 Bledsoe Proposed Action Design Criteria

Design Criteria	Standard[1]	Forest Plan Reference
Within 200 feet of any cave openings associated with karst systems: the surface is not to be disturbed during any federal mineral exploration or development activity; development of federally owned oil and gas is subject to the No-Surface-Occupancy stipulation.	Forest standard – Minerals. DB-MIN-2	p. 2-20
No drilling or mining is allowed into known cave voids (systems) where federal leasing is authorized.	Forest standard – Minerals. DB-MIN-3	p. 2-20
New federal mineral leases must contain a controlled-surface-use stipulation for the scoured ephemeral stream zone.	Forest standard – Minerals. DB-MIN-4	p. 2-20
In the area above the cliffline, the surface is not to be disturbed during any federal mineral exploration or development activity; development of federally owned oil and gas is subject to the No-Surface-Occupancy stipulation. In the area below the cliffline, surface occupancy is authorized only when these activities will not negatively impact PETS species, habitat for Conservation species, or heritage resources listed or potentially eligible for listing on the National Register of Historic Places; in addition, development of federally owned oil and gas is subject to the controlled surface use stipulation.	Cliffline Community Prescription Area Standard – Minerals 1.C-Min-1	p. 3-6
All federal mineral activity will be implemented in accordance with the Desired Future Condition and Standards of this Prescription Area; and, depending on site-specific determination, the Forest Service may specify that the surface is not to be disturbed during mineral exploration or development. New federal oil and gas leases will contain either a No-Surface-Occupancy stipulation or a Controlled-Surface-Use stipulation.	Riparian Prescription Area Standard – Minerals 1.E-Min-1	p. 3-14
The surface is not to be disturbed during any federal mineral exploration or development activity; development of federally owned oil and gas is subject to the No-Surface-Occupancy stipulation.	Developed Recreation Prescription Area Standard – Minerals 3.A-MIN-1	p. 3-49

Notes:
1. Standard – Requirement found in a Forest Plan, which govern actions taken to meet objectives. Standards often preclude or impose limitations on management activities or resource uses, generally for environmental protection or public safety. Standards are mandatory, and deviation from a standard requires a Forest Plan amendment.

The PDS includes environmental protection measures that mitigate potential impacts of the PDS and facilitate compliance with the Design Criteria in Table 2.2-1. Table 2.2-2 provides a summary of the mitigation measures. These measures are described in more detail in the following sections. These mitigation measures are considered when evaluating potential effects (Section 3).

Table 2.2-2 Environmental Protection Measures in the PDS

Environmental Protection Measure
No surface facilities or surface disturbance
Subsidence control plan
No mining zone adjacent to Beech Fork and recharge area.
Partial mining zone (58% recovery) adjacent to Cawood Branch and recharge area
Subsidence mitigation plan (repair of damage and replacement of water supply).
No mining zone in all areas where the distance from the coal bed to the stream channel is 100 feet or less.

2.2.1.3 Subsidence

A survey was conducted in support of the PDS (Shamrock 2011) to identify any structures or renewable resources that are located above the proposed underground mining areas or within the area of influence, a 35-degree angle of draw from the edge of the underground boundary. A map of known dwellings, cemeteries or other structures, stream crossings and protected zones on the USFS tract is presented in Figure 2.2-1**,** and the results are described below:

- Structures: There are no dwellings, commercial or public buildings, nor other facilities such as pipelines, oil or gas wells, etc., located on the surface area overlying the proposed underground mining areas.
- Aquifers: It was determined during reconnaissance of the area above the proposed underground workings that there are no extensive aquifers located above the proposed underground mining areas that could be affected by subsidence, including the angle of draw. The aquifers in the vicinity are in the colluvium, alluvium, and valley floor stress relief fracture systems associated with drainages. The fractures systems are confined to 50 feet below the surface (Minns 1993).
- Streams and Recharge Areas: Cawood Branch is located within the proposed underground mining areas. Beech Fork is located adjacent to the USFS tract.

2.2.1.3.1 Subsidence Control Plan

A Subsidence Control Plan was developed for the PDS and would be implemented in accordance with 405 KAR 18:040 Section 26. The Subsidence Control Plan would include the protection measures described below to prevent potential subsidence effects.

2.2.1.3.2 Cawood Branch and Recharge Areas

The USFS tract underlies Cawood Branch. Under the subsidence control plan for the Proposed Action, a “58% Recovery Zone” (first mining only) would be maintained using 15-degree angle of draw method to a maximum of 300 feet of cover above the coal seam where the distance from the coal bed to the stream channel along Cawood Branch is 100 feet to 300 feet. No areas have been identified on the USFS tract with less than 100 feet of cover; however, if such areas are identified, there will be no mining in these

zones. The typical protection area design is shown on Figures 2.2-3 and 2.2-4. Both zones listed above would be projected at a 15-degree angle of draw from the surface to intersect the coal bed. The aerial extent of these zones is shown on Figure 2.2-1. The typical panel layout is shown on Figure 2.2-3.

2.2.1.3.3 Beech Fork and Recharge Areas

Part of the proposed underground area is adjacent to Beech Fork. Although the Hazard #4 Coal bed underlies Beech Fork in this area, underground mining below Beech Fork is not a part of the Proposed Action. To protect stream flow and recharge area of the stress relief fracture system along Beech Fork from potential subsidence effects, a "No Mining Zone" would be maintained using a 35-degree angle of draw from the coal seam to the surface adjacent to Beech Fork. The aerial extent of this zone is located along the outer edge of the Proposed Action area boundary as shown on the Figure 2.2-1.

2.2.1.3.4 Structures

Several structures are located along Beech Fork and adjacent to (and outside) the lease boundary as shown on Figure 2.2-1. To protect structures from potential subsidence effects, a "No Mining Zone" would be maintained in all areas where the distance from the coal bed to the structure is 100 feet or less. A "No Mining Zone" would be maintained using a 35-degree angle of draw from the coal seam to the surface adjacent to Beech Fork. The aerial extent of this zone is located along the outer edge of the Proposed Action area boundary as shown on the Figure 2.2-1.

2.2.1.3.5 Subsidence Damage Mitigation Plan

Although there are no structures above the proposed mining area, there are some located adjacent to the lease boundary along Beech Fork. As stated above, the Subsidence Control Plan is designed to prevent any effects to these surface lands, buildings, residential dwellings or other structures due to subsidence; however, a damage plan would also be implemented, in accordance with 405 KAR 18:210, to further address potential subsidence effects. The Subsidence Damage Plan includes the following measures that would be implemented if the subsidence were a result of the Proposed Action.

- Repair for damage to surface lands. Any material damage resulting from subsidence caused to surface lands, to the extent technologically and economically feasible, would be corrected by restoring the land to a condition capable of maintaining the value and reasonably foreseeable uses that it was capable of supporting before subsidence damage.
- Repair or compensation for damage to noncommercial buildings and occupied residential dwellings and related structures existing at the time of mining. The lessee would promptly repair or compensate the owner for material damage resulting from subsidence caused to any noncommercial building or occupied residential dwelling or structure that existed at the time of mining.
- Repair or compensation for damage to other structures. The lessee would, to the extent required under applicable provisions of state law, either correct material damage resulting from subsidence caused to any structures or facilities not protected above by repairing the damage, or compensate the owner of the structures or facilities for the full amount of the decrease in value resulting from the subsidence.

2.2.1.3.6 Mitigation Plan -Replacement of Water Supply

For the PDS, the KDMP requires that alternate water supply sources be identified. If replacement of a domestic water supply is required by KDMP, a water supply would be provided on a temporary and permanent basis as follows:

- Within forty-eight (48) hours after receiving notice from KDMP that the water supply was adversely impacted by mining, drinking water would be provided on an emergency basis.
- Within two (2) weeks after receiving notice from KDMP that the water supply was adversely impacted by mining, a temporary water supply connected to the existing plumbing would be provided, if any, that provides water for all ordinary household purposes including drinking, cooking, bathing, sanitation and laundry and drinking water for poultry, livestock and domestic animals and water for noncommercial domestic agricultural and horticultural activities.
- Within two (2) years after receiving notice from the Cabinet that the water supply was adversely impacted by mining, a satisfactory permanent water supply would be provided.

The following sources of water could be developed to replace any source of water that might be adversely affected by operation:

- Cisterns: Individual residences could be provided with cisterns of adequate capacity to provide ample water supply. There is adequate rainfall within this area to allow the use of cisterns.
- Deep Wells: The existing wells or new wells could be drilled to lower depths. The casings in these wells could be extended and the outside of the well casing could be grouted to seal off any water from seeping down into the well.
- A chemical treatment system to clarify contaminated water could be provided for any source of water that might be adversely affected by this operation.
- A municipal water system currently serves a large portion of the water users near the USFS tract and would be a replacement option.

2.2.2 Alternative 2 (No Action Alternative)

The No Action Alternative is to not lease the federal coal at this time. Under the No Action Alternative, the federal coal reserves would remain in place and the current land uses would continue.

Retreat mining activities performed under adjoining private and federal lands would render the federal coal reserves difficult to access through the surrounding mined-out and collapsed areas, and expensive to mine. Future mining of the federal coal would be infeasible and the federal resource would be foregone (made inaccessible to future mining, or sterilized).

A subsidence control plan would be developed as part of the NAS, in accordance with KDMP and all other applicable regulations. Under the NAS subsidence control plan, subsidence protection zones similar to those shown on Figure 2.2-4 would be established along the edges of the USFS tract, and along streams adjoining the USFS tract. Coal situated within those subsidence protection zones would be inaccessible and lost or sterilized.

2.3 Alternatives Considered but Eliminated from Detailed Study

No other alternatives were considered in this EA process. The Proposed Action represents the alternative for accessing and extracting the minerals within KYES-53865.

2.4 Past, Present, and Reasonably Foreseeable Future Actions

2.4.1 Historical Mining

The CEQ's regulations for implementing NEPA define cumulative effects as: "…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions…" (40 CFR 1508.7). As shown on Figure 2.4-1, past mining activities have taken place near the USFS tract. These sites will be evaluated for cumulative effects as appropriate for each resource, as described in Chapter 3. The following, excerpted from Campbell (2002), provides a summary of historical mines and activities near the USFS tract.

According to the 1954 edition of the U.S. Department of the Interior Geological Survey (USGS) topographical quadrangle map of Bledsoe, Kentucky, mine openings already existed along the valley floor of the Laurel Fork of Greasy Creek in 2 places: just below the mouth of Trace Fork and at the mouth of Lower Double Branch. These appear to be in either the Hazard No. 4 seam or the Hazard No. 4 Rider seam. This map also shows at least ten (10) other locations along Greasy Creek where at least one of these seams was opened. On the same map, approximately 3000 feet southeast of the Bledsoe post office at the mouth of Rueben Branch, another seam was opened in 2 places near the top of a large knob. This seam was possibly the Hazard No. 10 seam or the "Knob" seam.

On the Helton, KY quadrangle – which adjoins Bledsoe to the west – the Hazard No. 4 coal seam had been opened in several places along the valley floor of Beech Fork. There were two openings on Stone Coal Branch, one opening at the mouth of Dug Fork of Peters Branch, another one on Beech Fork about 2000 feet east of the mouth of Trace Branch, and two more north of the mouth of Peters Branch. Along the Middle fork to the west, this seam was opened at the mouth of Mudlick Branch, the mouth of Hurricane Branch, and the mouth of Turkey Branch.

At the same time, Hoskin Branch was the scene of some intense mining activity. Two seams, evidently, were opened at three different places and a large clearing was labeled: "Strip Mine." One of these openings was probably in the Hazard No. 5A seam and the other two were possibly in the Hazard No. 9 or No. 10 seam. Another seam – possibly the Hazard No. 5A seam, again - was opened on the Left Fork of Reuben Branch.

According to the geologic map of the Bledsoe quadrangle (GQ-889) by Bela Csejtey published in 1971, the Hazard No. 4 coal had been opened in two more places near the mouth of Dug Fork of Elk Creek, as well as on White Oak Creek, Upper Double Branch of Laurel Fork and several more openings along

Greasy Creek. The No. 5A seam had two openings approximately 1000 feet south of the mouth of Daws Branch of the Beech Fork. An unnamed seam – possibly the Hazard No. 7 or 8 – had been opened near the head of Peters Branch. Another unnamed seam – again, possibly the No. 7 or 8 – had been opened about 3000 feet south of Opossum Hollow of the Laurel Fork.

Upon examination of the geologic map of the Helton quadrangle (GQ-1227) by Dudley Rice published in 1975, the Hazard No. 4 continued to be worked on Middle Fork and Beech Fork. Rice observed an additional opening near Dug Fork of Peters Branch of Beech Fork. Along the Middle Fork, he observed two additional openings near the mouth of Ginseng Branch, two more near the mouth of Rye Cove Branch, two more at Buck Hollow, another one on Whitehead Branch, and one at Roark Branch.

An unnamed seam – possibly the Copeland – was opened on Apple Orchard Branch and near the mouth of the Mare Branch of the Beech Fork. The No. 5A seam had another opening on the Middle Fork of Reuben Branch. The No. 8 seam had been surface mined extensively in the southwest portion of the quadrangle. An unnamed seam (again, probably the No. 7 or 8) had been opened twice approximately 4000 feet east of the mouth of Oldhouse Branch. The 1974 edition of the USGS topographical map refers to this operation as a "Strip Mine." This was done through a lease from DRCC to a predecessor to what is currently Nally & Hamilton Enterprises. They also had a small lease in the Hazard No. 4 seam, but did not mine very much (if at all).

The No. 9 seam was mined extensively on this quadrangle. Locations include: Fern Branch of Beech Fork, Hoskin Branch/Onemile Branch/Big Branch of Beech Fork, and Spruce Pine Creek, among others. The No. 10 seam had also been mined in the Hoskin Branch/Onemile Branch/Big Branch of Beech Fork area. This latter seam was surface mined extensively in the southwest portion of the quadrangle, around the Potato Knob area, and 4000 feet southeast of the mouth of Elk Branch of the Middle Fork. An entire mountaintop of this seam, albeit a small one, was removed approximately 3000 feet northwest of the mouth of Lizzie Hollow of Stone Coal Branch. The uppermost seam ("Knob") experienced surface mining in the southwest portion of the quadrangle, as well as on Hoskin Branch.

On the 1980 edition of the Helton USGS map, the south side of Peters Branch had a prominent highwall from a contour surface mine. This same seam (Hazard No. 7/No. 8) was also being surface mined near Peters Gap. An upper seam – probably the Hazard No. 9 – had been mined south of Peters Branch, also. The upper seams were mined somewhat extensively in the upper Beech Fork area on Fern Branch, Chumney Branch, Oldhouse Branch, and Daws Branch.

In 1982, most of the upper seams on KRCC property (Hazard No. 9 and above) were leased to various parties, including: Lewis & Joseph Coal Company, predecessors to Horizon Natural Resources, predecessor to James River). Much of the mining had already taken place, and had been completed by the late 1980s. A large mining operation also occurred in these upper seams on Shell Branch of Laurel Fork, which has been reclaimed for quite some time.

About this time, Clover Coal Company (a subsidiary of Shamrock Coal Company) began to lease the Hazard No. 4 coal in the general area, as they were nearing exhaustion of their Red Bird boundary and were looking elsewhere to mine. By the time of their original lease from KRCC (June 5, 1980), they were already operating mines on Greasy Creek – some of which are still active. Clover operated several mines along Beech Fork and Middle Fork, culminating in the longwall mine, which is no longer active. Predecessors to Horizon began large mines in this seam – as well as the Copeland seam – on Laurel Fork of Greasy Creek at about this same time frame, some of which are also still active. In addition, the No. 60 room-and-pillar mine, and the No. 61 Preparation Plant, east of the USFS tract (Figure 2.4-1), are operated on an occasional basis.

2.4.2 Past, Present and Reasonably Foreseeable Future Actions within the Proposed Action Area of Influence

Because the mountainous terrain near the USFS tract has been mined extensively, impacts from specific historical actions are difficult to discern. In order to identify and evaluate potential cumulative effects of past projects that are close enough and recent enough to have discernible remaining potential environmental impacts when considered in conjunction with the Proposed Action, a three-mile radius around the USFS tract was selected as a perimeter, inside of which any identified historical projects were considered (Figure 2.4-2). The three-mile radius was chosen to include projects that are within the drainage basin for the upper Beech Fork contributing area above the confluence with Middle Fork Kentucky River. As the cumulative effects area Increases, effects become dispersed and it becomes more difficult to determine cumulative effects, as the effects become dispersed over a larger area. We reviewed the surrounding area for each resource and determined that the three-mile buffer includes projects that have the potential to combine with the proposed action, while not including a larger area that would dilute the potential effects.

For consideration of present and reasonably foreseeable future projects, the three-mile radius was extended or retracted, as necessary, for each resource under analysis. Furthermore, with regard to past actions, only those actions that have occurred within the past 10 years have been included in the cumulative effect analysis. Environmental impacts from historical projects older than 10 years are not readily discernible from background conditions. The results of the cumulative effects evaluations are presented in Chapter 3 under each resource.

Identified past, present, and foreseeable future actions that may occur within this area of influence and that have the potential to produce effects that could combine with the identified potential effects of the Proposed Action or No Action Alternative to become significant effects include:

2.4.2.1 Beech Fork Mine

North of the USFS tract, Bledsoe Coal operates the Beech Fork room-and-pillar mine (Shamrock, KDMP Operating Permit No. 866-5130). The Beech Fork Mine is one component of an existing underground

coal mining and processing complex located in an area known as Mozelle, approximately 1.8 miles north of the town of Helton, Leslie County, Kentucky. The complex has been active since 1987, and currently involves room-and-pillar mining north of the proposed lease area, in the Beech Fork Mine, the Abner Branch Mine northeast of Beech Fork and the Oldhouse Branch Mine west of Beech Fork. In 2004, the Beech Fork Mine was expanded into permitted private reserves, and the surrounded federal reserves (Tract No. 3094Be, 3094Bb, and 3094Az). Based on current information, it is anticipated that reserves will be exhausted by the end of February 2013.

Figure 2.4-2 and Table 2.4-1 show the location of these projects in relation to the USFS tract. These projects will be considered in the cumulative effects analysis for each resource.

Table 2.4-1 Surrounding Mining Activity

State File Number (SFN)	Mine Status	Mine Type	Most Recent Year of License Issued	Last Company Name	Mine Name	Seam(s)	Approximate Distance (miles) from Proposed Action to Lease Boundary
18655	Active	Coal-Auger-Strip	2011	Infinity Energy, Inc.	Infinity 1	Hazard No. 10, Hazard No. 11, Hazard No. 9	2.0
18749	Active	Coal-Auger-Strip	2011	Infinity Energy, Inc.	Infinity 3	Hazard No. 5A, Hazard No. 7, Hazard No. 8	2.3
18841	Active	Coal-Auger	2011	Frank Parks Contract Augering, Inc.	1	Hazard No. 7	2.1
15737-14	Active	Coal-Underground	2011	Bledsoe Coal Corp.	Oldhouse Branch	Hazard No. 4,	2.9
18351-2	Active	Coal-Auger-Strip	2011	W & F Contract Augering, Inc.	3	Hazard No. 7, Hazard No. 7 Rider	2.2
18407-1	Active	Coal-Underground	2011	Bledsoe Coal Corp.	Beechfork	Hazard No. 4, Hazard No. 4	0.2
18655-1	Active	Coal-Auger-Strip	2011	Infinity Energy, Inc.	Infinity 2	Hazard No. 10, Hazard No. 7, Hazard No. 9	2.1
18749-1	Active	Coal-Underground	2011	Infinity Energy, Inc.	Infinity 4	Hazard No. 5A	2.3
15737-23	Active	Coal-Underground	2010	Shamrock Coal Co. Inc.	Shamrock 18 Series	Hazard No. 4,	0.1
18461-6	Abandoned	Coal-Auger-Strip	2008	ROCO Enterprises, Inc.	ROCO 7	Hazard No. 5A	2.1

Notes:
1. Source: Kentucky Mine Mapping Information System. Mine maps.ky.gov. November 11, 2011.
2. Table includes mining activity within a 3-mile radius occurring in the last 10 years.
3. Mining locations are shown on Figure 2.4-2.

2.4.2.2 BLM Lease KYES 51005

The portion of USFS Tract 3094Bd, adjacent and east of the proposed lease area, is leased to Shamrock Coal ((KYES-51005). Shamrock Coal Corp. has submitted an application for Amendment 4 to Permit 8665130 to expand the Beech Fork Mine onto the lease. The tract could be subject to underground coal mining in the future. Mining of this tract would be subject to a permit issued by KDMP and required to meet regulations at 405 KAR Chapter 8 (Permits) and 405 KAR 18 (Performance Standards for Underground Mining Activities).

2.4.2.3 Suppression of Hemlock Woolly Adelgid Infestations

The hemlock woolly adelgid (*Adelges tsugae*) is a non-native insect pest that attacks and ultimately kills hemlock trees. This pest has expanded its range and infestations have been identified throughout the DBNF. DBNF has prepared an Environmental Assessment for this action, and a decision to implement chemical and biological treatment methods was signed into action in March 2011. Treatment areas are located nearby and within the Proposed Action project area (Figure 2.4-3); soil injections, using the insecticide imidacloprid has occurred.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Introduction

Chapter 3 presents a description of the affected environment; the anticipated direct and indirect environmental consequences resulting from the implementation of each alternative; and an analysis of cumulative effects.

The Proposed Action and associated PDS, and the No Action Alternative and associated NAS are described in Chapter 2. As part of the PDS or the NAS, certain measures such as a subsidence control plan and other mitigation measures that would reduce potential environmental impacts would be developed in accordance with KDMP and other regulating entities. Implementation of these measures, which would be requirements of any mining activity undertaken in the region, has been taken into consideration in this environmental analysis.

Thirteen general environmental resource categories have been evaluated in the *Bledsoe Coal Lease EA*:

- Topography and geologic resources
- Soils
- Vegetation
- Wildlife and fisheries
- Proposed, Endangered, Threatened, and proposed and designated critical habitats
- Regional Forester's Sensitive Species
- Water resources
- Air quality
- Visual resources and noise
- Socio-economic resources, coal recoverability, and environmental justice
- Land use
- Cultural, historical, and paleontological resources
- Transportation resources, and
- Recreation resources

For each resource, the following aspects are summarized:

- The affected environment
- The environmental consequences (including the direct and indirect impacts) of both the PDS and the NAS on the affected environment
- Cumulative effects, if any

In the case of resources such as land use or cultural resources that are unlikely to be appreciably affected by the underground mining scenarios, descriptions of the latter aspects have been simplified or omitted.

In accordance with CEQ guidelines, evaluation or analysis of environmental consequences involves the initial determination of the types of impacts resulting from each alternative. Impacts may be positive (beneficial) or negative (adverse) and may occur as a direct result of the alternative (direct impacts) or as a secondary or subsequent result of the alternative (indirect impacts). The importance of impacts is determined by a set of significance criteria. These criteria are resource-specific and define the threshold, type, or quantity of impact that would warrant special attention, such as special mitigation. The criteria are based on government regulatory standards and management directives, best available scientific documentation, previously prepared environmental documents, and/or the professional judgment of resource specialists. The duration of environmental modification also is very important to impact analysis. Impacts that would occur over a long period or would be permanent are considered long-term impacts and can be more significant, while impacts that would be temporary are considered short-term impacts and may not be as significant.

In addition to the impact analysis described above, an analysis of cumulative effects must be performed. For each alternative, cumulative effects are considered to be the combined effects of the identified impacts of the alternative, in conjunction with impacts resulting from other projects and activities in the vicinity of the Proposed Action. These activities and projects may have taken place in the past, be concurrent with implementation of the alternative, or be scheduled to take place in the reasonably foreseeable future. Evaluation of cumulative effects is essential to ascertaining the overall type, range, and importance of potential impacts of the Proposed Action and No Action alternatives. Identifying cumulative effects can be difficult, given the range of activities that are conducted within any given area in even the less industrial, more rural portions of our country, such as Leslie County. Even in these rural areas, multiple land uses are the rule rather than the exception, thus making land use planning a challenge for any land management agency, be it federal, state, or local. For this environmental analysis, potential impacts of the alternatives were considered in combination with impacts of other actions that have occurred or are foreseen to occur on the USFS tract or in proximity to the USFS tract. The 13 resources addressed in this document have been evaluated for cumulative effects. Where appropriate, a more in-depth description of cumulative effects is provided in specific resource descriptions.

3.2 Topography and Geologic Resource

3.2.1 Environmental Baseline

3.2.1.1 Topography and General Background

The PDS is located approximately 0.04 miles north of Fern Branch County Road's junction with US 421 in Leslie and Harlan Counties, Kentucky, on the USGS Cutshin, Hoskinston, Helton, and Bledsoe 7½-minute quadrangle maps. The PDS is near the community of Bledsoe along the Beech Fork drainage of the Kentucky River. This region is hilly, with narrow winding ridges, V-shaped valleys, and high topographic relief. Surface elevations on the USFS tract range from approximately 1,400 feet (ft) to 2,200 ft above mean sea level (amsl) as shown on Figure 3.2-1.

Underground mining of the Hazard 4 coal seam is proposed under the Cawood Branch, a first order stream channel that is approximately 8 to 12 ft wide. Although the Hazard 4 Coal seam underlies Beech Fork in the area, no underground mining is proposed under this drainage. There are no surface water users on the USFS tract or within an area five times greater than the affected watershed. Surface water sites shown on Figure 3.2-1 are located downstream of the USFS tract and would be monitored as part of the surface water monitoring program discussed in Section 3.4.

The watersheds potentially affected by the PDS include a small portion of the Cawood Branch and Beech Fork recharge area. The aquifers in the vicinity are in the colluvium, alluvium, and valley floor stress relief fracture system; however, the underground mine workings are not below any aquifers or below the valley floor where any significant recharge is anticipated. Groundwater users are located on Beech Fork (Figure 2.2-1). Groundwater sampling sites shown on Figure 3.2-2 are located down dip of the proposed underground mining activity along Beech Fork, and would be monitored as part of the groundwater-monitoring program. Groundwater use, sampling and monitoring are discussed in more detail in Groundwater Section 3.4.

Structures in the area are located along Beech Fork in and around the town of Bledsoe. There are no dwellings, commercial or public buildings, nor other facilities such as pipelines, oil or gas wells, etc., located on the surface area overlying the proposed underground mining areas. There is a utility line that runs along Cawood Branch, which would be protected by maintaining a 58% recovery zone as shown on Figure 2.2-1.

3.2.1.2 Regional Geology

The USFS tract is within the Bledsoe and Helton United States Geologic Survey (USGS) 7.5-minute quadrangle maps (USGS 1971 and USGS 1975) and lies within the Cumberland Plateau of Eastern Kentucky. The surface geology consists of interbedded deltaic sandstones, shales, siltstones, and coal of the Middle Pennsylvanian Breathitt Formation as shown in Figure 3.2-3. Regionally, the internal stratigraphy is complex as depositional environments changed rapidly, both vertically and horizontally. Portions of the Lower, Middle and Upper Formations are represented in the area.

The Hazard No. 4 coal seam and the Hazard No. 4 Rider coal seam are at the base of the Breathitt Formation. The Hazard No. 4 coal seam contains a distinctive flint-clay parting as much as 6 inches thick at its base. Throughout the area, the two splits of the Hazard No. 4 are interbedded with shale of varying thickness.

The Magoffin Beds of Morse is a contact bed between the Lower and Middle Breathitt Formation. It is a fossiliferous marine zone about 5 ft thick and is found primarily along stream cuts in the area. It consists of dark-gray, calcareous, partly sandy shale and a dark-gray fossiliferous limestone bed as much as 20 inches thick.

Above the Magoffin Beds of Morse and within the Middle Breathitt Formation are unnamed coal beds. The Upper Formation is represented by the Hindman coal bed and an unnamed coal bed. The Upper Formation is topographically the highest unit and occurs on hilltops within the area.

Based upon the Geologic Maps of the Helton and Bledsoe Geologic Quadrangles, the structural dip of the strata is very gentle and trends less than 0.50 degrees toward the north-northwest. No structural features are known to exist in the vicinity of the USFS tract. The Pine Mountain Overthrust Fault (Paleozoic) occurs more than four miles south of Helton. Historical seismic records and data on active faults in Kentucky indicate no active faulting and no moderate-to-strong seismic activity in the vicinity of the USFS tract.

3.2.1.3 Local Geology

Bore logs located in the vicinity of the Proposed Action area are presented in Appendix C and were used to describe the local strata surrounding the PDS area above and below the Hazard No. 4 coal seam. The location of the boreholes is shown on Figure 3.2-1. Locally, the mine floor is composed of approximately 20 ft of sandstone, sandstone with shale and sandy shale. Fireclay was not found in these boreholes above or beneath the coal seam; however, fireclays are known to be present in the area. Approximately 70 ft-125 ft of sandstone and interbedded sandstone and shales overly the Hazard No. 4 coal seam. All of this material is reported to be hard and strong in the permit application for the PDS based on previous mining experience in the vicinity of the USFS tract. Limey shales of the Magoffin unit overlie these strata and the Hazard No. 7 and the Hazard No. 9 coal seams overlie the Mogoffin unit.

Surface elevations within the USFS tract range from 1,400 to 2,200 ft amsl. Available coal seam depths from adjacent Beechfork mining activities were used to estimate overburden (material above the coal seam) depths under the USFS tract as shown in Figure 3.2-4. The Hazard No. 4 coal seam is gently dipping in the northwest direction with a coal seam elevation estimated between 1,200 to 1,230 ft amsl and overburden thickness between 140 to 1,290 ft amsl. Shallow overburden depths are located beneath Cawood Branch and Beech Fork; however, there is no indication that the Hazard No. 4 coal seam outcrops within the USFS tract or would be less than 100 ft thick. Protective barriers are planned in shallow overburden areas as described in Section 2.2.1.3 and shown on Figure 2.2-1 and Figure-3.2-4.

3.2.1.4 Acid Mine Drainage (AMD)

Geochemistry is the study of the chemical species, reactions, and processes in soils and rocks and their interactions with atmosphere, surface water, and groundwater. Underground mining activity can result in potential geochemical impacts to local and regional water quality due to the exposure of potentially acid-generating materials and/or the potential leaching of soluble metals. When these impacts occur, the resultant impacted groundwater is generally referred to as acid mine drainage (AMD). The magnitude of these impacts depends on the chemical properties of the coal seam and overburden rocks being mined. The Hazard No. 4 coal seam is a low sulfur seam that has been extensively mined in the vicinity of the

project area with no significant adverse effects on the pH or water quality of surface waters. A geologic sampling program conducted by Bledsoe Coal has not characterized significant acid-generating strata associated with the Hazard No. 4 coal seam.

Available information from exploration drill holes pertaining to the geochemistry of the Hazard No. 4 seam and the adjacent strata has been reviewed. The information review focused on geology, mineralogy, characterization of the Acid Base Accounting (ABA) data and identifying potential impacts of mining activities.

The baseline information used to prepare this section was developed from the following studies:

- *Bledsoe Coal's Core Drilling and Geochemical Characterization Program for the Beech Fork Mine* (Shamrock 2002)
- *The Use of Acid-Base Accounting to Predict Post-mining Drainage Quality on West Virginia Surface Mines* (Skousen and others 2001)
- *Static-Test Methods Most Commonly Used to Predict Acid-Mine Drainage: Practical guidelines for Use and Interpretation (*White and others 1999*)*
- *Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia* (Price 1997)

In addition, a portion of the archived core samples from the exploration drill holes related to areas of potential acid generation (e.g., highly mineralized zones, alteration, high pyrite content) were reviewed.

A geochemical characterization program has been completed for the Hazard No. 4 coal seam, to evaluate the potential for AMD. The processes of AMD are well documented in numerous texts (e.g. Nordstrom and Alpers 1999). Acid mine drainage generally forms due to the oxidation of sulfide minerals, such as pyrite and includes the following chemical reactions:

- $2FeS_2 + 7O_2 + 2H_2O \leftrightarrows 2Fe^{2+} + 4SO_4^{2-} + 4H^+$
- $4Fe^{2+} + O_2 + 10H_2O \leftrightarrows 4Fe(OH)_3 + 8H^+$
- $2Fe^{2+} + O_2 + 3H^+ \leftrightarrows 2Fe^{3+} + 3H_2O$
- $FeS_2 + 14Fe^{3+} + 8H_2O \leftrightarrows 15Fe^{2+} + 2SO_4^{2-} + 16H^+$

Acidity is generated through sulfide oxidation by processes involving oxygen, water, and ferric iron. In addition, sulfide oxidation may be accelerated by biotic factors. The presence of acidity in mine waters generally also results in metal leaching. The oxidation of mined rock and formation of acidity by itself does not necessarily constitute an environmental impact. Environmental impacts associated with AMD require water to contact the acid-generating materials and transport the acidity and metals to surface water and groundwater. Acid mine drainage becomes a risk to the environment as the quantity of water and metal leaching becomes significant enough to migrate to contact surface water or groundwater beyond the limits of the mine. Underground mining can result in increased capture of surface and

groundwater thereby increasing contact with acid-generating material. Subsidence and the AMD potential of the subsided materials; location of the groundwater table relative to the mining level; and the quantities and discharge location of water moving through the subsided mine all contribute to whether the mine would generate AMD over short-term or long-term. These issues are explored in the following sections.

Materials from exploration core drill holes in the area were analyzed using standard ABA testing methods. Results of ABA testing methods provide information on the potential acidity of samples, determined by the total sulfur content of the minerals, and neutralization potential of samples, related to the carbonates in the sample, determined by a titration method. Actual acid formation would depend on groundwater movement, surface area, weathering reactions, and other factors. Skousen and others (2001) have found that ABA is an appropriate analytical tool for the prediction of post-mining drainage quality.

3.2.1.4.1 Test Methods

Acid Base Accounting is conducted to determine the acid generation potential of the geologic materials by assessing the balance between the maximum acid-producing potential (MPA) and acid-neutralizing potential (NP) of each sample. The MPA is determined by total sulfur assay and represents the sulfur contained in acid-generating iron-sulfide minerals and other non-acid-generating sulfur minerals in the sample. The NP is determined by subjecting the sample to acid-digestion in order to react to a measurable amount of acid-neutralizing carbonate minerals. The method for determining NP involves titration with sulfuric acid as described by Sobek and others (1978). An alternative method for NP is the theoretical calculation of carbonate in the sample by determination of total carbon content. For instance, the bulk NP analysis may reflect the presence of silicate minerals, which dissolve during the NP determination but are not likely to contribute buffering capacity under ambient conditions.

Both MPA and NP are reported in units of tons of calcium carbonate per thousand tons of rock (t $CaCO_3$/1000 t rock). There are a number of standard protocols used for the determination of ABA as summarized in Price (1997). The standard ABA method is often referred to as the Sobek method and determines total sulfur by use of a LECO furnace or sequential wet-chemical leach (Sobek et al. 1978) for calculation of MPA. This method can overestimate the acid potential if other forms of sulfur exist in the sample. To address this issue, there is also a modified Sobek method that includes a sulfate sulfur (SO_4 sulfur) determination, which then allows the calculation of sulfide sulfur (-S_2 sulfur) content. Sulfate-sulfur and sulfide-sulfur analytical results provide the actual weight percentage of sulfur present within the sample for each of the compounds. The sulfide sulfur content of the sample is of particular interest because it can react to form sulfuric acid. The MPA and NP results also can be combined to establish the net neutralization potential (NNP of a sample, where a negative number indicates that a sample has the potential to generate AMD.

3.2.1.4.2 Use of ABA Results

There are a variety of approaches by which acid generation potential can be evaluated (Skousen et al. 2001). For the purposes of this investigation, the Price (1997) method has been adopted for preliminary comparison and result tabulation. This approach, although promulgated for the Province of British Columbia (Canada), has found worldwide application and regulatory acceptance.

The method makes use of the ratio of the NP and MPA values. The calculated ratios of NP:MPA or net potential ratio (NPR) are then compared to the criteria shown below (Table 3.2-1 to determine their potential to generate AMD.

Table 3.2-1 Acid Base Accounting AMD Potential

Potential for AMD	NPR (NP/MPA)	Notes
Likely	< 1	Likely AMD generating unless sulfide minerals are non-reactive.
Uncertain	1 to 2	Possibly AMD generating if NP is insufficiently reactive or is depleted at a faster rate than sulfides.
Low	2 to 4	Not potentially AMD generating unless significant preferential exposure of sulfides occurs (i.e., along fractures) or there are extremely reactive sulfides in combination with insufficiently reactive NP.
Unlikely	> 4	Not expected to generate acidity.

Following Price (1997), NPR values were calculated using the sulfide sulfur content as well as the NP. Price (1997) indicated that materials with a sulfide content less than 0.3% by weight is generally non-acid-generating. Given that the majority of the rock types have less than 0.3% pyrite, this criteria indicates that AMD is not likely to occur.

3.2.1.4.3 ABA Tests in Boreholes

Results from ABA testing in five exploration core drill holes (LE-281-00, LE-282-00, LE-197-92, LE-198-92, and LE-207-93) in the general area were analyzed for this study. Five drill holes located on private land are shown on Figure 3.2-1. These drill holes are considered representative of the geology and material types to be mined within the private coal tracts and the project area. The sampling has been comprehensive on a lithologic composite basis. Original laboratory ABA data sheets were reviewed in conjunction with the stratigraphic column figures (Appendix D-1). Table 3.2-2 through Table 3.2-6 summarize the ABA results. Shaded values on Table 3.2-2 through Table 3.2-6 indicate AMD potential (total sulfur greater than 0.3% and negative NNP values and NPR values less than 1). The Hazard No. 4 is denoted in italics and in all boreholes, these coal seams have negative NNP values and NPR values below one.

Table 3.2-2 Acid Base Accounting Data for Geologic Corehole LE-282-00

Unit	Rock Code	Unit Thickness (feet)	Top of Unit (feet)	Bottom of Unit (feet)	Maximum Potential Acidity tCaCO3/1000t	Neutralization Potential tCaCO3/1000t	Net Neutralizing Potential tCaCO3/1000t	Pyritic Sulfur Dry Basis %	Neutralization Potential Ratio (NPR)	Total Sulfur Dry Basis %
Dark Gray Shale with Sandstone Streaks	323	1.50	434.30	435.80	1.25	11.50	10.25	--	9.2	0.040
Dark Gray Shale	124	0.83	435.80	436.63	1.25	5.00	3.75	--	4.0	0.040
Dark Gray Shale with Sandstone Streaks	323	3.57	436.63	440.20	1.56	11.75	10.19	--	7.5	0.050
Gray Sandstone with Shale Streaks	543	3.26	440.20	443.46	0.06	17.00	16.94	--	274.2	0.002
Dark Gray Shale	124	1.34	443.46	444.80	1.25	7.50	6.25	--	6.0	0.040
Dark Gray Shale	124	1.50	444.80	446.30	0.94	11.25	10.31	--	12.0	0.030
Coal--HAZARD #4 RIDER	*22**	*2.46*	*446.30*	*448.76*	*25.85*	*0.07*	*-25.78*	*0.498*	0.0	*1.598*
Dark Gray Shale	124	0.88	448.76	449.64	0.94	0.00	-0.94	0.03	0.0	0.050
Dark Gray Shale with Sandstone Streaks	323	4.21	449.64	453.85	1.88	11.50	9.62	--	6.1	0.060
Gray Sandstone with Shale Streaks	543	1.20	453.85	455.05	1.25	17.50	16.25	--	14.0	0.040
Dark Gray Shale	124	2.66	455.05	457.71	2.50	14.00	11.50	--	5.6	0.080
Dark Gray Shale	124	2.65	457.71	460.36	1.56	9.75	8.19	--	6.2	0.050
Black Shale with Coal Streaks	114	0.81	460.36	461.17	0.94	0.00	-0.94	0.030	0.0	0.050
Coal--HAZARD #4	*22**	*3.32*	*461.17*	*464.49*	*10.80*	*0.09*	*-10.71*	*0.346*	0.0	*0.964*
Gray Sandstone with Shale Streaks	543	0.71	464.49	465.20	0.16	0.00	-0.16	0.005	0.0	0.020
Dark Gray Shale	124	1.02	465.20	466.22	0.94	0.00	-0.94	0.030	0.0	0.060
Dark Gray Shale with Sandstone Streaks	323	3.71	466.22	469.93	0.31	0.75	0.44	0.010	2.4	0.030
Gray Sandstone with Shale Streaks	543	1.88	469.93	471.81	5.00	0.00	-5.00	0.160	0.0	0.190
Gray Crossbedded Sandstone	541	2.60	471.81	474.41	0.63	0.00	-0.63	0.020	0.0	0.050

Notes:
1. Data determined using weighted average of float and sink analyses.
2. Gray shading = Negative value for Net Neutralizing Potential

Table 3.2-3 Acid Base Accounting Data for Geologic Corehole LE-281-00

Unit	Rock Code	Unit Thickness (feet)	Top of Unit (feet)	Bottom of Unit (feet)	Maximum Potential Acidity tCaCO3/1000t	Neutralization Potential tCaCO3/1000t	Net Neutralizing Potential tCaCO3/1000t	Pyritic Sulfur Dry Basis %	Neutralization Potential Ratio (NPR)	Total Sulfur Dry Basis %
Gray Crossbedded Sandstone	541	5.00	254.50	259.5	0.06	20.75	20.69		334.7	0.002
Gray Crossbedded Sandstone	541	5.10	259.4	264.5	0.5	6.00	5.50		12.0	0.016
Gray Crossbedded Sandstone	541	5.00	264.5	269.5	0.562	18.00	17.44		32.0	0.018
Gray Crossbedded Sandstone	541	5.00	269.5	274.5	0.187	0.50	0.31		2.7	0.006
Gray Crossbedded Sandstone	541	5.00	274.5	279.5	0.25	2.00	1.75		8.0	0.008
Gray Crossbedded Sandstone	541	5.00	279.5	284.5	1.218	1.50	0.28		1.2	0.039
Gray Crossbedded Sandstone	541	4.00	284.5	288.5	0.375	2.25	1.88		6.0	0.012
Gray Crossbedded Sandstone	541	0.90	288.50	289.4	1.72	20.75	19.03		12.1	0.055
Dark Gray Shale with Sandstone Streaks	323	4.60	289.40	294	0.59	20.50	19.91		34.7	0.019
Dark Gray Shale with Sandstone Streaks	323	4.16	294.00	298.16	19.22	22.00	2.78		1.1	0.062
Dark Gray Sandy Fireclay	749	0.42	298.16	298.58	0.66	16.25	15.59		24.6	0.021
Coal--HAZARD #4	*22**	*5.92*	*298.58*	*304.5*	*11.50*	*2.96*	*-8.53*	*0.14*	*0.3*	*2.37*
Dark Gray Shale with Sandstone Streaks	323	2.13	304.05	306.18	0.22	4.75	4.53		21.6	0.007
Gray Sandstone with Shale Streaks	543	2.72	306.18	308.9	0.59	6.75	6.16		11.4	0.019

Notes:
1. Data determined using weighted average of float and sink analyses.
2. Gray shading = Negative value for Net Neutralizing Potential

Table 3.2-4 Acid Base Accounting Data for Geologic Corehole LE-197-92

Unit	Rock Code	Unit Thickness (feet)	Top of Unit (feet)	Bottom of Unit (feet)	Maximum Potential Acidity tCaCO3/1000t	Neutralization Potential tCaCO3/1000t	Net Neutralizing Potential tCaCO3/1000t	Pyritic Sulfur Dry Basis %	Neutralization Potential Ratio (NPR)	Total Sulfur Dry Basis %
Gray Sandstone with Shale Streaks	543	2.5	160.0	162.5	10.81	68.75	57.94		6.4	0.346
Dark Gray Shale	124	3.2	162.5	165.7	49.06	32.25	-16.81	1.38	0.7	1.57
Dark Gray Shale	127	4.2	166.0	170.2	15.41	13.75	-1.66		0.9	0.493
Dark Gray Shale with Sandstone Streaks	323	1.0	170.2	171.2	0.95	26.50	25.55		27.9	0.0303
Gray Sandstone with Shale Streaks	543	1.3	171.2	172.4	1.24	35.00	33.76		28.2	0.0397
Dark Gray Shale	124	2.3	172.4	174.7	2.05	61.75	59.7		30.1	0.0656
Dark Gray Shale with Sandstone Streaks	323	1.8	174.7	176.5	1.55	72.25	70.7		46.6	0.0495
Black Shale with Coal Streaks	114	2.0	176.5	178.5	14	15.75	1.75		1.1	0.448
Dark Gray Shale	127	0.9	179.3	180.3	0.36	10.75	10.39		29.9	0.0115
Dark Gray Shale	124	0.3	180.3	180.5	0.53	11.00	10.47		20.8	0.017
Gray Sandstone with Shale Streaks	543	3.5	181.5	185.0	0.67	27.50	26.83		41.0	0.0214
Dark Gray Shale with Sandstone Streaks	323	2.0	185.0	187.0	1.51	27.75	26.24		18.4	0.0482
Gray Crossbedded Sandstone	541	1.3	187.0	188.3	0.36	34.50	34.14		95.8	0.0116
Dark Gray Shale with Sandstone Streaks	323	1.7	188.3	190.0	0.77	26.75	25.98		34.7	0.0245
Dark Gray Shale with Sandstone Streaks	323	3.0	190.0	193.0	1.07	30.25	29.18		28.3	0.0343
Dark Gray Shale	124	2.7	193.0	195.7	1.06	26.50	25.44		25.0	0.0339
Coal--HAZARD #4 RIDER	*22**	*1.8*	*195.7*	*197.4*	--	--	--	*0.44*		--
Dark Gray Shale	127	2.6	197.4	200.0	0.54	12.00	11.46		22.2	0.0174
Dark Gray Shale with Sandstone Streaks	323	5.0	200.0	205.0	2.41	15.75	13.34		6.5	0.077
Dark Gray Shale with Sandstone Streaks	323	2.0	205.0	207.0	2.1	22.00	19.9		10.5	0.0672
Gray Crossbedded Sandstone	541	3.0	207.0	210.0	0.18	67.50	67.32		375.0	0.0056
Gray Crossbedded Sandstone	541	5.0	210.0	215.0	0.2	55.00	54.8		275.0	0.0064
Gray Crossbedded Sandstone	541	5.0	215.0	220.0	0.36	27.50	27.14		76.4	0.0116
Gray Crossbedded Sandstone	541	5.0	220.0	225.0	0.74	30.00	29.26		40.5	0.0238
Gray Crossbedded Sandstone	541	2.0	225.0	227.0	0.569	22.25	21.681		39.1	0.0189
Coal--HAZARD #4	*27**	*2.8*	*227.0*	*229.8*	--	--	--	*0.40*		--
Dark Gray Shale with Sandstone Streaks	323	2.3	229.8	232.0	0.21	12.25	12.04		58.3	0.0068
Dark Gray Shale	124	4.2	232.0	236.2	5.28	21.25	15.97		4.0	0.169
Gray Sandstone with Shale Streaks	543	3.8	236.2	240.0	5.94	21.25	15.31		3.6	0.19

Notes:
1. Data determined using weighted average of float and sink analyses.
2. Gray shading = Negative value for Net Neutralizing Potential

Table 3.2-5 Acid Base Accounting Data for Geologic Corehole LE-198-92

Unit	Rock Code	Unit Thickness (feet)	Top of Unit (feet)	Bottom of Unit (feet)	Maximum Potential Acidity tCaCO3/1000t	Neutralization Potential tCaCO3/1000t	Net Neutralizing Potential tCaCO3/1000t	Pyritic Sulfur Dry Basis %	Neutralization Potential Ratio (NPR)	Total Sulfur Dry Basis %
Dark Gray Shale with Sandstone Streaks	323	5.0	190.0	195.0	1.98	22.50	20.52		11.4	0.0633
Dark Gray Shale with Sandstone Streaks	323	5.0	195.0	200.0	3.34	54.00	50.66		16.2	0.107
Gray Sandstone with Shale Streaks	543	5.0	200.0	205.0	0.81	7.30	6.49		9.0	0.0258
Gray Crossbedded Sandstone	541	5.0	205.0	210.0	2.86	12.50	9.64		4.4	0.0916
Gray Crossbedded Sandstone	541	5.0	210.0	215.0	0.65	1.00	0.35		1.5	0.0209
Gray Crossbedded Sandstone	541	5.0	215.0	220.0	1.23	0.50	-0.73		0.4	0.0392
Gray Crossbedded Sandstone	541	5.0	220.0	225.0	2.23	7.00	4.77		3.1	0.0712
Gray Crossbedded Sandstone	541	5.0	225.0	230.0	0.51	0.00	-0.51		0.0	0.0163
Gray Crossbedded Sandstone	541	1.5	230.0	231.5	0.87	2.00	1.13		2.3	0.0278
Gray Crossbedded Sandstone	541	4.7	231.5	236.2	2.34	0.00	-2.34		0.0	0.075
Gray Crossbedded Sandstone	541	2.3	236.2	238.4	1.55	3.50	1.95		2.3	0.0496
Dark Gray Sandy Fireclay	748	5.0	238.4	243.4	4.13	3.75	-0.38		0.9	0.132
Gray Sandstone with Shale Streaks	543	2.4	243.4	245.8	1.13	14.75	13.62		13.1	0.0362
Gray Sandstone with Shale Streaks	543	2.7	245.8	248.5	1.57	50.75	49.18		32.3	0.0503
Gray Crossbedded Sandstone	541	2.8	248.5	251.3	2.67	3.75	1.08		1.4	0.0853
Coal--HAZARD #4 RIDER	*023**	*2.3*	*251.3*	*253.5*	--	--	--	*1.60*	--	--
00	127	0.9	253.5	254.4	2.07	12.50	10.43		6.0	0.0661
Dark Gray Shale	127	2.2	254.8	256.9	1.27	3.75	2.48		3.0	0.0407
Coal--HAZARD #4	*027**	*2.5*	*256.9*	*259.4*	--	--	--	*0.20*	--	--
Dark Gray Shale	127	3.3	259.4	262.7	0.03	0.00	-0.03		0.0	0.0095
Dark Gray Shale with Sandstone Streaks	323	5.0	262.7	267.7	6.53	2.50	-4.03		0.4	0.209
Gray Sandstone with Shale Streaks	543	2.3	267.7	270.0	5.69	2.50	-3.19		0.4	0.182

Notes:
1. Data determined using weighted average of float and sink analyses.
2. Gray shading = Negative value for Net Neutralizing Potential

Table 3.2-6 Acid Base Accounting Data for Geologic Corehole LE-207-93

Unit	Rock Code	Unit Thickness (feet)	Top of Unit (feet)	Bottom of Unit (feet)	Maximum Potential Acidity tCaCO3/1000t	Neutralization Potential tCaCO3/1000t	Net Neutralizing Potential tCaCO3/1000t	Pyritic Sulfur Dry Basis %	Neutralization Potential Ratio (NPR)	Total Sulfur Dry Basis %
Gray Sandstone with Shale Streaks	543	1.2	50.0	51.2	3.34	29.50	26.16		8.8	0.107
Dark Gray Shale with Sandstone Streaks	323	2.5	51.2	53.7	3.22	5.00	1.78		1.6	0.103
Gray Sandstone with Shale Streaks	543	2.8	53.7	56.4	3.34	8.75	5.41		2.6	0.107
Gray Crossbedded Sandstone	541	2.3	56.4	58.8	4.69	14.50	9.81		3.1	0.15
Dark Gray Shale with Sandstone Streaks	323	1.4	58.8	60.2	14.69	10.00	-4.69		0.7	0.47
Dark Gray Shale	127	1.3	60.2	61.4	14.69	8.50	-6.19	0.4	0.6	0.47
Dark Gray Shale with Sandstone Streaks	323	2.8	61.4	64.2	3.5	13.50	10		3.9	0.112
Dark Gray Shale	127	3.2	64.2	67.3	27.5	0.00	-27.5	0.63	0.0	0.88
Dark Gray Shale	127	1.7	68.7	70.3	0.43	30.00	29.57		69.8	0.0138
Dark Gray Shale	124	2.8	70.3	73.2	1.29	3.50	2.21		2.7	0.0414
Gray Sandstone with Shale Streaks	543	3.8	73.2	76.9	0.79	20.00	19.21		25.3	0.0254
Dark Gray Shale with Sandstone Streaks	323	3.1	76.9	80.0	0.85	57.50	56.65		67.6	0.0272
Dark Gray Shale with Sandstone Streaks	323	4.9	80.0	84.9	1.49	10.00	8.51		6.7	0.0478
Dark Gray Shale	124	1.7	84.9	86.6	1.33	20.00	18.67		15.0	0.0427
Dark Gray Shale with Sandstone Streaks	323	4.0	86.6	90.6	1.28	30.00	28.72		23.4	0.0411
Dark Gray Shale	124	1.5	90.6	92.1	1.37	18.50	17.13		14.5	0.0438
Dark Gray Shale with Sandstone Streaks	323	1.5	92.1	93.6	1.61	24.50	23.89		15.2	0.0514
Gray Sandstone with Shale Streaks	543	1.4	93.6	95.0	0.73	30.00	29.27		41.1	0.0233
Dark Gray Shale with Sandstone Streaks	323	2.1	95.0	97.1	1.28	20.00	18.72		15.6	0.0408
Coal--HAZARD #4 RIDER	*22*	*3.0*	*97.1*	*100.1*	--	--	--	--	--	--
Dark Gray Shale	127	3.0	100.1	103.1	1.08	0.00	-1.08		0.0	0.0347
Coal--HAZARD #4	*22*	*3.7*	*103.1*	*106.8*	--	--	--	--	--	--
Dark Gray Shale with Sandstone Streaks	323	0.9	106.8	107.7	1.72	2.50	0.78		1.5	0.055
Gray Crossbedded Sandstone	541	3.3	107.7	111.0	0.98	20.00	19.02		20.4	0.0315
Gray Crossbedded Sandstone	541	5.0	111.0	116.0	0.51	7.50	6.99		14.7	0.0162

Notes:
1. Data determined using weighted average of float and sink analyses.
2. Gray shading = Negative value for Net Neutralizing Potential

The majority of strata above the Hazard No. 4 coal seam have large NNP values (greater than 20 t $CaCO_3$/1000t) and NPR values greater than four and are not expected to generate AMD. One borehole, LE-281-00, has no strata with negative NNP values, other than the coal seams themselves; material from this location is not expected to generate AMD. Strata exhibiting AMD potential (negative NNP values and NPR values less than 1) are observed in four of the drill holes: LE-282-00, LE-197-92, LE-198-92, and LE-207-93. However, AMD potential is still considered to be low for these materials due to the following:

- The low total amounts of sulfur and pyritic sulfur available for acid generation. Most of the strata with negative NNP values have total sulfur values less than 0.3%, which indicates they are not likely to generate acid.
- The relatively small amount of material available for AMD due to thin geologic horizons of these materials
- Surrounding geologic horizons (those above and below the seam in the Corehole logs presented in Table 3.2-2 to Table 3.2-6) have large potential NNP

The PDS would involve room-and-pillar mining with a mine plan that would leave some pillars in-place following completion of mining. Water could naturally flow into this mined out void and contact potentially acid-generating coal pillars. In the absence of acid-neutralizing rock material AMD could develop. As described in Section 3.2.2.1, subsidence, in the form of rock collapse, is anticipated to occur in the 50-foot zone overlying the roof of the mined area. The material would collapse into the mined out void. To determine if the collapsed rock would contain sufficient neutralization potential to neutralize the acid generation potential and associated AMD from pillars left in place, calculations developed for the Gray Mountain Final Environmental Impact Statement (EIS) (USFS, 2004c) to compare the estimated NNP from remaining pillars to the estimated NNP of the material that may subside following mining, are applicable to this EA:

- The Proposed Action area is in close proximity to the Gray Mountain tracts
- The geology, including the mined coal seam(s), is the same as for the Gray Mountain tracks
- Both the Proposed Action area and Gray Mountain are underground mines and the mining methods are similar for both
- The occurrence and movement of groundwater is similar for both the Proposed Action area and Gray Mountain

The Gray Mountain AMD evaluation is presented Appendix D-2. Table 3.2-7 presents the results of the analyses.

The calculations were performed under two assumptions: (1) 85% of the coal would be removed and (2) 50% of the coal would be removed. The results indicate that the collapsed rock materials contain enough calcium carbonate to neutralize acid generation from the remaining pillars for either case. As shown in Table 3.2-7 for all scenarios, the neutralizing potential exceeds the potential acidity and is not

expected to generate acidity. In other words, any acid produced by the Hazard #4 seam would be neutralized by the surrounding rock, resulting in no AMD.

3.2.1.4.4 Historical AMD Generation

A coal mine AMD database maintained by KDMRE provides a listing of 241 inactive and 106 active coal mine sites in Kentucky that produce AMD (KDMRE 2012). Inactive sites are those sites where AMD has occurred in the past, but the site is no longer treating for AMD, and active sites are those where active permits are maintained and AMD is being generated. The database includes information on the location and the specific coal seam mined. From these data, no sites are currently actively treating for AMD and seven sites related to the Hazard No. 4 coal seam and Hazard No. 4 Rider have been treating for AMD, but are no longer treating, as shown on Table 3.2-8. One site (Shamrock Fuels) is known to be still producing AMD (Walker 2012).

According to KDMP records (KDMP 2012) there are 835 mines in their database that mine the Hazard No. 4 or Hazard No. 4 Rider. These data indicate that the Hazard No. 4 and Hazard No. 4 Rider coal seams rarely generate AMD (<1% of mines) in comparison with the number of mines advanced into these seams, and for most cases represent only short-term or minor impacts. Of the seven sites identified, treatment was not required or has been abated for all seven sites. For those sites with assessed off-site impacts, as noted on Table 3.2-8, all were considered minor based on the absence of reported water quality violations.

Table 3.2-7 Evaluation of Pillar Acidity versus Acid Neutralization Potential of Collapsed Materials

Borehole	Acidity Remaining in Pillars ($t\ CaCO_3$)*		Net Neutralization Potential of Cave in Material ($t\ CaCO_3$)*	Remaining Net Neutralization Potential ($t\ CaCO_3$)*		Remarks
	Assuming 85% Removal	Assuming 50% Removal		Assuming 85% Removal	Assuming 50% Removal	
LE-281-00	-0.307	-1.025	2.782	2.474	1.757	non-acid generating in both scenarios
LE-282-00	-0.216	-0.721	1.439	1.222	0.717	non-acid generating in both scenarios
LE-197-92	-0.160	-0.533	3.377	3.217	2.844	non-acid generating in both scenarios
LE-198-92	-0.245	-0.816	11.018	10.773	10.201	non-acid generating in both scenarios
LE-207-93	-0.657	-2.191	6.773	6.116	4.582	non-acid generating in both scenarios

Notes:
*Net Neutralization Potential is multiplied by mass of rock; therefore reported as t CaCO3. Assumes an area of 1000 square feet and heights reported on borehole logs (see Appendix D-2).
Densities used were: 2.6 g/cm^3 for sandstone, 2.7 g/cm^3 for shale, and 1.3 g/cm^3 for coal.

Table 3.2-8 State Acid Mine Drainage Sites Relating to the Hazard No. 4 Coal Seam

Company	County	Mine Type*	Lat	Long	Quad	Seam	Drainage	Treating**	AMD Source	Off-Site Impact
Historical Sites										
Big Elk Creek Coal Company	Perry	SC	37.17361	83.11417	Vicco	Hazard # 4, 7	North Fork Kentucky River	No/A	SPOIL	N/A
Consolidation	Knott	UG/SC	37.28333	82.78667	Kite	Hazard # 4 Elk 2 and 3	Cragers Fork	No/A	Underground	NA
Gabriel Energy	Owsley	CM	37.30389	83.58667	Mistletoe	Amburgey, Hazard # 4	Buffalo Creek	No/A	Hollowfill toe	Minor
Miller Brothers	Floyd	SC/SG	37.48778	82.86278	Wayland	Hazard #4 and rider	Saltlick Creek	No/A	Unknown	N/A
Shamrock Coal Company	Leslie	UG	36.945	83.45167	Helton	Hazard #4	Roark Branch	No/A	UG pump	Minor
Bledsoe Coal Corp.	Leslie	UG	36.97583	83.29861	Bledsoe	Hazard # 4	Greasy Cr-John Miniard Br	No/A	Unknown	Inactive since 1998
Shamrock Fuels	Leslie	UG, PP	37.00528	83.52583	Helton	Hazard #4 rider	Philips Fork	No/A	Unknown	Minor

Notes:
1. The 'historical' list includes all known sites that have had AMD-related water quality problems (iron and/or pH) in the past but which are no longer treating water discharges.
* CS = coal stockpile, RD = refuse disposal, PP = Preparation Plant, UG = underground mine, SC = Surface Contour, CM = Combination, SG = Surface Auger
** C = continual, I = intermittent, A = abated

The best indications of the potential long-term future environmental behavior for the coal related to proposed underground room-and-pillar mining of the Hazard No. 4 coal seam underlying the project area are the effects and impacts of the existing mines adjacent to the project area. Bledsoe Coal operates the Abner Branch, Oldhouse Branch or Beech Fork Mines near the USFS tract, and the Beech Fork room-and-pillar mine immediately north of the USFS tract. These mines have not generated AMD. No AMD has been identified in relation to historic long-wall mining activities at the nearby Middle Fork Mine.

3.2.1.4.5 Subsidence

Mining has occurred in the past and continues to occur near the Proposed Action as described in Section 2.6.

The KDMRE was contacted to identify if there were any open record violation reports regarding subsidence for the existing Beech Fork Mine permit 866-5130 (Fritz 2012).

Bledsoe received a Notice of Violation in August 2005 for failure to follow the subsidence plan. The violation was due to retreat mining (pulling pillars) under a protected structure. Bledsoe was not aware of the presence of the residence, because it had recently been constructed and was not shown on maps. Bledsoe paid a fine of $1,800. An investigation determined that there was no evidence of subsidence damage related to mining (Ayers 2012).

No other violations related to subsidence for permit 866-5130 were filed by KDMRE

3.2.2 Effects of Implementation

3.2.2.1 Proposed Action

3.2.2.1.1 Topography

Topographic impacts would be related to subsidence and are discussed in Subsidence (Page 38).

3.2.2.1.2 Geologic Resources and Acid Mine Drainage

Implementation of the PDS would involve retrieval of the federal coal, a geologic resource, for electricity production and other purposes. Any coal left in place in pillars, barriers, or left as a result of bypassing activities would be irreversibly lost, because the surrounding mined out areas will have collapsed and cannot be safely re-mined, or used for access. The federal coal beneath the project area consists of the Hazard No. 4. As described in Section 3.2.1.4 a portion of the coal pillars and overburden that would remain after mining is anticipated to be potentially acid-generating; however, as described below in (Subsidence over the Total Extraction Areas [pg. 43]) and Appendix D-2, rock from a 50-foot zone overlying the roof of the mined area is anticipated to collapse into the mined out void. The overwhelming amount of net neutralization potential (NNP) and relatively low sulfur content in this collapsed material is anticipated to minimize or eliminate any potential acid generation in the mined area.

Therefore, with regard to geologic resources, implementation of the PDS is anticipated to result in no Acid Mine Drainage (AMD). No related measureable indirect impacts, such as impacts to groundwater or surface water quality, are anticipated in relation to AMD.

3.2.2.1.3 Subsidence

3.2.2.1.3.1 General

Subsidence caused by underground mining can manifest at the surface in a number of ways. Topographical effects can result in changes to drainage and flooding in flat-lying areas. Changes in drainage patterns are typically rare and would occur in streams with shallow grades. In hilly areas, such as the region in which the USFS tract is located, flooding typically is not a problem because the existing slopes usually exceed any subsidence induced changes in slope that may occur.

Surface fracturing can occur in areas with shallow overburden, thick coal seam extraction or mining heights, or a combination of these. This can lead to diversion of stream and aquifer flows, or damage to surface structures including buildings, roads, and pipelines.

Vertical displacement and horizontal strains can occur from extraction of any material below the surface. Extraction of underground material causes closure of the opening (or mined out area) due to the redistribution of loads to the sides of the opening (the abutments) and to any material left as pillars. This closure can be transmitted to the surface as a subsidence bowl. The extent of the subsidence bowl is dependent on the nature of the material above the extracted area, the coal seam thickness or mining height, the depth of overburden, the areal extent of the extracted zone (panel width), and the size of remaining support from pillars or backfill. The surface expression is larger with weak rock, shallow overburden, thick coal seams, and large extraction zones.

The surface subsidence bowl extends over a larger area than the extracted zone; the edges of the bowl relative to the extracted area are defined by the angle of draw (Figure 3.2-5). Due to this lateral spreading of the subsidence effect, and the fact that the overburden can absorb some strain, the total vertical movement in the bowl would be less than the extracted thickness. When the extracted zone is relatively narrow, the vertical movement on the surface increases as the width of the extraction increases until the “critical width” is reached. At this point, the vertical movement is at a maximum and any further increase in extracted width does not lead to further lowering of the land surface at the center of the bowl. Surface expressions of subsidence before the critical width is reached are referred to as “subcritical.” When the critical width is exceeded, the subsidence is referred to as “supercritical.” The critical width depends on the nature of the materials in the overburden, but the main influence is from the thickness extracted relative to the depth.

Horizontal strains can develop from horizontal movement at the surface. These strains tend to stretch the surface (tensile) and are greatest near the edge of the bowl, and push inward (compressive) and are

greatest at the center of the bowl. Critical conditions occur when the horizontal strains reach a maximum level. If the surface subsidence is severe enough, the tensile strains can cause rupture and surface fractures may occur. Figure 3.2-5 shows the progression of displacement for subcritical, critical, and supercritical conditions. The progression moves from subcritical to supercritical as the mined area increases in width. For critical and supercritical widths, the tensile and compressive horizontal strains disappear in the center of the mined area. In terms of effects, vertical displacement alone (settlement, sinking, or lowering of surface) can cause disruption to drainage patterns or groundwater, flow through pipelines, and damage to roads and railways. Vertical movement by itself is not usually damaging to structures. The major potential for damage to surface structures comes from both tensile and compressive horizontal strains, and the relative vertical movement, or "slope." In the case of streams and near surface aquifers, the main potential for damage lies in the possibility of surface fracturing, which could divert stream and aquifer flows. On undeveloped forestland, the impacts are likely to be small. As a point of reference, the SME Mining Engineering Handbook (Hartman 1992, pg. 962) suggests the following as tolerable ranges in horizontal strain:

Table 3.2-9 Horizontal Strain Tolerance Levels

Surface Features	Tolerable Range	
	Horizontal Strain (inches/inch)	Slope (feet/foot)
Pasture, woodland, range, or wildlife food and cover	$5.0 – 10.0 \times 10^{-3}$	$250 – 660 \times 10^{-3}$
Wetland	5.0×10^{-3}	$30 – 80 \times 10^{-3}$
Lakes, ponds, marshes, rivers, streams	$5.0 – 10.0 \times 10^{-3}$	

There are also subsurface effects of the removal of material by mining. Over a mined out zone, frequently the rocks overlying the seam fail, or collapse, into the mined out void. The extent of this collapsed zone is a function of the area extracted, the thickness of extraction, and the nature of the overburden material. Over mined-out zones of large area, roof collapse is generally complete, and the vertical extent of the collapsed zone depends on the bulking of the collapsed material and its ability to prevent further collapse. In extreme cases, collapse can take place to the surface, but such collapse is usually associated with a much larger extracted height, or shallower depth, than that typical for coalmines. Over smaller areas, including room-and-pillar operations with low extraction rates and pillars that do not degrade over time, the vertical extent of any collapse zone would be limited. Other subsurface effects could include shear of wells passing through the subsidence zones, and possible disturbance of underground aquifers.

3.2.2.1.3.2 Specific to the Proposed Development Scenario

Subsidence Over No Mining and Partial Extraction Areas

The Proposed Action would involve mining the Hazard No. 4 and Hazard No. 4 Rider coal seams underneath the USFS tract. Standard room and pillar mining with second mining pillar recovery (retreat mining) is proposed to extract the maximum recoverable resources available. Room-and-pillar mining

would be performed, with rooms mined and pillars left for roof control on the advance, and pillars mined on retreat. Pillars would be mined in the panels, mains, and sub-mains. The average thickness of the Hazard No. 4 and Hazard No. 4 Rider coal seams is 3 ft. The estimated mining height is 5 ft. The coal seam dips to the northwest at about 1 degree and the overburden thickness is estimated to range between 140 to 1,290 ft (Figure 3.2-4). The Cawood Branch is approximately 8 to 12 ft wide.

As described in Section 2.2.1.3, a subsidence control plan would be implemented in accordance with 405 KAR 18:040 Section 26 as shown in Figure 2.2-1 to protect adjacent structures, US 421 and the stream flow and recharge area of the stress relief fracture system from potential subsidence effects. Areas to be protected are located along Cawood Branch and the boundary of the PDS area adjacent to Beech Fork. For Beech Fork, a “No Mining Zone” would be maintained using a 35-degree angle of draw from the coal seam to the surface adjacent to Beech Fork.

For Cawood Branch, no mining would occur in areas where the vertical distance from the coal bed to the stream channel is 100 ft or less: based on estimated overburden thickness (Figure 3.2-4), this is not anticipated to occur, thus a no mining zone is not shown on Figure 2.2-1. Extraction rates would be reduced to 58% where the vertical distance from the coal bed to the stream channel is between 100 ft and 300 ft. The same planned 58% recovery zone has been used and permitted under Amendment 3 of Permit 866-5130.

The width of the No Mining and 58% Recovery Zone is based on the angle of draw, which describes the angle required to reach the point where subsidence becomes negligible and identifies the width of the measurable subsidence. Typical practice for minimizing potential effects involves limiting the extraction ratio within this angle of draw (Peng 1992). The angle of draw calculation is shown in Figure 2.2-4. The 58% Recovery Zone would be designed to have a width equal to ½ the width of the stream (S) being protected, plus an offset of 15 feet, plus the additional width defined by a plane at 15 degrees to the vertical from the edge of this surface area to the coal seam (tan ø *H). The total width of the zone is presented in Table 3.2-10 and may be calculated from:

$$\text{Radius} = (\tan ø * H) + 15 + (.5)\, S$$
$$\text{Total Width} = 2R$$

where: ø = 15 degrees for 58% extraction and 35 degrees for no mining zone
15 = offset from stream bank on each side (ft)
H = depth of cover from the surface to the coal seam (ft)
*S = width of stream (ft) (Note: Width of stream is based on maximum estimate of 12 ft.)

Table 3.2-10 Subsidence Angle of Draw Calculation

Depth to Cover (H) ft	Maximum Stream Width (ft)	Maximum Width of No Mining Recovery Zone (ft) for Beech Fork -35-degree angle of draw	Maximum Width of 58% Recovery Zone (ft) along Cawood Branch -15-degree angle of draw
100	12	182	96
300	12	NA	203

No mining is planned in areas with less than 100 ft of cover. Based on estimated overburden depths shown on Figure 3.2-4, it is not anticipated that overburden less than 100 ft would be encountered under Cawood Branch, thus, a No Mining zone is not planned under this stream. However, if overburden less than 100 ft was encountered under Cawood Branch, then no mining would occur in these areas. The maximum calculated width of the “No Mining” recovery zone adjacent to Beech Fork is 182 ft. The width of the 58% Recovery Zone along Cawood Branch would range from 96 to 203 ft wide.

Areas within the 58% recovery zone would have 18.7 ft wide entries on 55 ft by 60 ft centers, leaving 48 ft by 29 ft pillars in place (Figure 2.2-3). Pillars left in-place after mining support the roofs in room-and-pillar mines with partial extraction. Provided the pillars left in place are sized appropriately, roof collapse and surface subsidence effects would be minimized or prevented. Based on the planned pillar dimensions and a coal strength of 468 psi; the safety factor for the pillars would be a minimum of 2.54 for a 5-foot seam height at a depth of 200 feet (Table 3.2-11). These safety factors are based on the Bieniawski pillar strength formula (Peng 1992, pp. 119-125). These safety factors indicate that the 58% extraction zone is acceptable with the specified pillar size and are sufficient for long-term stability of the pillars. In addition, the extraction rate of 58% has been used in previous mining activities under Permit 866-5130, Amendment #3. As discussed in Section 3.2-4, no evidence of subsidence has been reported for existing underground mining activities under Permit 866-5130, thus subsidence over this zone is expected to be negligible.

Table 3.2-11 Pillar Stress for 58% Extraction

Size		100 ft Overburden	150 ft Overburden	200 ft Overburden
Overburden unit weight[1]	pcf	134.25	134.25	134.25
Overburden	ft	100	150	200
Pillar width (Pw)	ft	29	29	29
Pillar length (Pl)	ft	48	48	48
Entry width (We)	ft	18.7	18.7	18.7
Original area	ft^2	3181.59	3181.59	3181.59
Pillar area	ft^2	1392	1392	1392
Area mined	ft^2	1789.59	1789.59	1789.59
R =	***%***	***0.562***	***0.562***	***0.562***
Virgin pillar stress (Sv)	psi	110.000	165.000	220.000
Pillar stress (Sp) =	***psi***	***251.42***	***377.13***	***502.84***
Compressive strength	psi	2745.00	2745.00	2745.00
Diameter of specimen	in	1.05	1.05	1.05
k =		2807.43	2807.43	2807.43
Pillar diameter	ft	42.10	42.10	42.10
Seam height (H)[2]	ft	5.00	5.00	5.00
S1		468	468	468
Pillar strength (S2)		***1276***	***1276***	***1276***
SF		**5.08**	**3.38**	**2.54**

$$\text{Extraction Ratio (R)} = \frac{\text{Area Mined}}{\text{Original Area}} = \frac{\text{Original Area - Pillar Area}}{\text{(Pw + We) (Pl + We)}} = \frac{\text{(Pw +We) (Pl +We) - (Pl x PW)}}{\text{(Pw + We) (Pl + We)}}$$

$$\text{Pillar Stress (Sp)} = \text{Sv} * \frac{\text{orig area}}{\text{pillar area}} = \text{Sv} * \frac{\text{(Pw +We) (Pl +We)}}{\text{(Pl x PW)}}$$

Sv = 1.1*Overburden depth

K constant = Compressive Strength*SQRT(diameter of specimen)

S1 = k/SQRT d limit size correction to dmax = 36 inches

$$\text{Safety of Factor (SF)} = \frac{\text{S2}}{\text{Sp}} = \text{S1}* \frac{\text{(0.64+(.36*(Pw/H))}}{\text{SP}}$$

Average density = Sum_i [Layer_Thickness_i * Layer_Density_i, {i,1,n}]/Sum_i [Layer_Thickness_i, {i,1,n}]

Material	Density	Units	Thickness
sandstone	145	lb/ft^3	430.05
Coal	85	lb/ft^3	23.5
Shale	125	lb/ft^3	365
Average density =	134.25		

Notes:
1. Bieniawski Pillar Strength Formula used to estimate pillar strength and safety factor (Peng 1992, pg. 119)
2. Seam height is assumed to be 60 inches
3. Overburden depth for areas with 58% extraction will be between 100 and 200 feet
4. In-situ coal strength (S_1) and compressive strength is based on test results for the Beech Fork Mine #30 reported in the Gray Mountain Coal EIS.
5. Density material from http://www.simetric.co.uk/si_materials.htm

The Hazard No. 4 and Hazard No. 4 Rider coal seam are located below drainage and are not expected to outcrop within the Proposed Action area. There are no dwellings, commercial or public buildings, nor other facilities such as pipelines, oil or gas wells, etc., located on the surface area overlying the proposed underground mining areas; however, a no mining zone is planned along the southern border of the PDS boundary as shown on Figure 2.2-1 to protect structures, groundwater users, Beech Fork, pipelines and US 421 which are outside, but adjacent to, the proposed mine. The mine plan projections shown on Figure 2.2.1 do not extend to the edge of the no mining zone under Beech Fork or US 421, so mine workings would be farther away than the maximum width of the protection zone.

Subsidence over Total Extraction Areas

Two situations can occur when pillars are removed during second mining. Firstly, the retreat mining could take all, or most, of the pillars, including the barrier pillars designed to protect the mains and submains. In this scenario it is unlikely that all of the pillars would be mined; however, the remaining pillar stubs would be too small to resist the added overburden load and may be assumed to collapse fairly soon after retreat mining. Secondly, sufficient material could be left in the barrier pillars to withstand crushing, in which case the individual panels would have overlapping subsidence bowls.

Possible surface subsidence expression can be estimated using one of the established predictive techniques that are presented in the SME Mining Engineering Handbook (Hartman 1992, pp. 940-971) and Surface Subsidence Engineering (Peng 1992, pp. 25-27, 48). The hyperbolic function was used to estimate possible subsidence effects in the Proposed Action area. This method has been demonstrated to fit well with the subsidence characteristics of the U.S. mines and has some application in the Appalachian coalfields (Hartman 1992 and Peng 1992). Other methods considered for predicting subsidence over total extraction areas include graphical empirical methods, such as that developed by the United Kingdom National Coal Board (Hartman 1992), and more analytical techniques based on curve fits to empirical data. The graphical methods developed by the NCB have been popular in the past, and work well in the geology of the European coalfields, but were not selected because they generally do not work as well in the U.S. due to the differences in the nature of the overburden materials.

The following assumptions in the calculation of subsidence over the total extraction areas are based on a conservative approach and were made to estimate total vertical subsidence, potential horizontal strains, and slopes for retreat or second mining:

- Overburden depths are 200 to 1,000 ft. Shallow overburden depths are most likely to occur under Cawood Branch and Beech Fork as shown in Figure 3.2-4. A minimum overburden depth of 200 ft was used since total extraction would not be planned under these streams in areas where the overburden is less than 300 ft. The maximum overburden depth is based on Figure 3.2-4.
- Panel widths range from 225 to 2,750 ft and represent cases where all barrier pillars remain and all barrier pillars are removed within a mining block. The 2.750 foot panel width was included during initial modeling, to represent a worst-case scenario; however, the barriers pillars will remain under the PDS.
- Mining height of 5 ft.
- Angle of draw of 25 degrees – based on typical value for Appalachia (Hartman 1992, Table 10.6.5). This angle of draw is used to calculate potential subsidence in the total extraction scenarios and is not related to the angle of draw used to determine protective barrier widths for the “No Mining Zone” and the 58% Extraction Zone for Cawood Branch and recharge areas.
- Critical length, L_c = 1.3*Overburden depth – a critical length factor of 1.3 is based on ranges from 0.9h to 1.7h for Appalachian coalfields, Peng 1992).
- Maximum subsidence (S_{max}) = 2.85 ft – based on mining height and “a” coefficient of 0.57. (Peng 1994, pg. 26) The “a” coefficient represents the strength of the overburden

strata. For weak and soft rock, the "a" coefficient is larger, and conversely is smaller for stronger rock. The strata in the lease area are expected to be strong, given the predominance of "strong rock" in the core hole logs, resulting in an "a" coefficient of 0.57 resulting in a S_{max} of 2.85 ft.

Based on these assumptions, the possible subsidence effects are presented in Table 3.2-12. In cases where the barrier pillars are removed and the width of the panel extracted is 2,750 ft, the maximum vertical subsidence is supercritical and estimated at 2.85 ft for a 5-ft mining height. The maximum horizontal strain is within the tolerable range and slope changes are well below the maximum slope as shown in Table 3.2-12. A vertical displacement of 2.85 ft, particularly in the absence of horizontal strain, is not expected to have significant impacts. For example, cases have been cited where the surface settled 20 ft or sunk 30 ft without significant damage (Hartman 1992, p. 941). The estimated value would fluctuate based on the assumptions used, but particularly for changes in overburden material and mining height. For example, the vertical subsidence would be as low as 1.7 ft at the same depth if a coefficient for hard rock was used and the mining height was 3 ft. The vertical subsidence is also proportional to the mining height, and could be smaller in areas with thinner coal seams or larger with thicker coal seams. Even at the greatest likely seam heights, the surface strains stay within the tolerable range for the local land use for woodlands, streams, and wetlands. In addition, there are no structures, pipelines or roadways above the planned mine working areas, extraction ratios are reduced under Cawood Branch and a "no mining zone" is planned along the southern border of the PDS area. Since the topography on the USFS tract is hilly, changes to the topography are not expected to be observable from natural conditions. Thus, effects due to surface subsidence from total extraction areas is anticipated to be negligible.

Table 3.2-12 Maximum Possible Subsidence Effects for Total Extraction Mining

Mining Height (ft)	Panel Width, L2 (ft)	Overburden Depth, D (ft)	Critical Width, Lc	S_0/Smax	Subsidence Case	Max. Vertical Subsidence S_0 (ft)	Max/Min Horizontal Strain (inches/inch)	Max. Slope (feet/foot)
5	225	200	260	93.03%	Subcritical	2.65	2.95E-03	2.14E-04
5	225	600	780	53.71%	Subcritical	1.53	1.76E-04	3.83E-05
5	225	1,000	1,300	41.60%	Subcritical	1.19	4.94E-05	1.78E-05
5	2,750	200	260	100.00%	Supercritical	2.85	4.79E-03	2.75E-04
5	2,750	600	780	100.00%	Supercritical	2.85	5.45E-04	9.17E-05
5	2,750	1,000	1,300	100.00%	Supercritical	2.85	1.96E-04	5.50E-05

Notes:
c coefficient = 1.4 for subcritical and 1.8 for critical, (Hartman 1992, pg. 946)
angle of draw = 25 degrees
b = 0.12; constant Hartman 1992
Lc = 1.3* Overburden Depth; critical length Lc ranges from 0.9h to 1.7h for Appalachian coalfields, Peng 1992, pg. 26)
Smax =2.85 = "a"* mining height where "a" = 0.57 (hard rock, Peng, 1992, pg. 26)

Subsurface Subsidence Effects over the Total Extraction Areas

Over the total extraction area, roof collapse may be expected to extend upwards as a caved zone, with a vertical extent on the order of 2 to 4 times the seam height. This extent is based on empirical data reported by Peng (1992), taking into consideration the fact that some coal would be left to reduce the effective height of extraction. Based on data reported by Peng (1992, p. 7) the height of the combined fracture and caved zone may be expected to extend a vertical distance on the order of 20 to 50 ft above the extracted seam. As presented in Section 3.4, the natural valley-floor stress-relief fracture zone (surface fracture system) associated with the narrow, V-shaped valleys near the USFS tract extends 30 to 50 feet below ground surface. In order for potential fractures associated with the proposed workings to impact the surface, and in particular, streams, the fractures would have to extend into the surface fracture system. Therefore, the depths of cover over the coal to be mined are considered sufficient to prevent disruption of stream flows.

If a perched aquifer were connected to a surface fracture system, impacts to the aquifer from mining could locally influence forest hydrologic conditions and forest vegetation. Based on the Minns 1993 study, perched aquifers are not anticipated to be prevalent under the USFS tract. However, if any perched aquifers do exist, only those situated within the 50-foot caved zone overlying the mined out area would likely be impacted. Figure 3.2-4 indicates that the coal seam is anticipated to have minimum cover of 140 feet; and in these areas, extraction ratios would be reduced to 58%. Therefore, under the minimum overburden cover case of 140 feet, there is minimum 40-foot separation between the surface fracture system and the caved zone associated with subsidence. Therefore, any perched aquifers situated at depths of more than 90 feet below ground surface and subsequently more than 40 feet below the lower extent of the surface fracture system, are not anticipated to be connected to the surface fracture system, and are not anticipated to influence forest hydrologic conditions and forest vegetation.

If the PDS is implemented, potential direct impacts such as subsidence are anticipated to have little observable impact and be negligible to non-existent. No associated measureable indirect impacts, such as impacts to groundwater or surface water quality, surface water flow, or impacts on forest hydrologic conditions or associated vegetation, are anticipated in relation to subsidence.

In summary, with regard to geologic resources, implementation of the PDS associated with the Proposed Action is anticipated to result in minimal to no direct impacts and no indirect impacts.

3.2.2.2 No Action Alternative

Under the NAS, the tract would not be mined at this time and there would be no effects to topography or geologic resources due to subsidence.

3.2.3 Cumulative Effects

A three-mile buffer area from the PDS boundary was defined as the cumulative effects area. This buffer was chosen to include projects within the Beech Fork drainage above the confluence with Middle Fork Kentucky River. The drainage area is representative of similar projects and within an area that can be reasonably analyzed. Extending the area to other watersheds would result in unwieldy analyses and effects too dispersed over a large area.

Leslie County has been an area of active underground and surface coal mining for more than a century, and mining of private coal resources will continue in the future. Past and present mining activities have taken place in the vicinity of the USFS tract. Historic mining activities are described in Section 2.4. In addition, the remainder of the tract located to the east is leased (BLM KYES 51005), and an application to mine the lease has been submitted to KDMP. If the application is approved the remainder of the tract would be mined using methods similar to those in the PDS.

Underground coal mining operations are required to follow strict regulations to prevent impacts related to subsidence in accordance with 405 KAR 18:040 Section 26. The subsidence control plan described in Section 2.2.6.1 for the PDS is similar to those implemented for past and present mining activities for permit 866-5130. The adjacent room and pillar mining operations have not resulted in impacts due to subsidence (Fritz 2012, Reed 2012). The long wall mining at the Middle Fork Mine, northwest of the PDS and west of US 421 resulted in minor subsidence, which was mitigated by the operator. No longwall mining has operated in the area for more than 10 years. If the subsidence control plan for the PDS is implemented, and similar protection measures are required for future projects, the PDS would add little to no cumulative effect over the existing and planned coal mining operations in the area.

Under the No Action Alternative, the lease area would not be mined, but the surrounding private land and, possibly the adjacent lease (BLM KYES 51005) may be mined. As described above, the operation would comply with 405 KAR 18:040 Section 26 regulations to prevent or mitigate subsidence. No cumulative topographical, geological or subsidence effects would occur.

If the No Action Alternative is selected, the NAS would be implemented and private coal reserves adjoining the tract would be mined. Subsidence protection zones under the NAS would be more extensive, and a more complicated mine plan would be required to gain access to the private coal. Retreat mining activities performed under these adjoining private lands would render the federal coal reserves difficult to access through the surrounding mined-out and collapsed areas, and prohibitively expensive and unsafe, due to unstable conditions, to mine. Future mining of the federal coal would be infeasible and the federal resource would be (sterilized).

3.3 Soil

3.3.1 Environmental Baseline

Soils on the USFS tract are typical of ridge tops and upper mountain slopes according to the *Soil Survey of Leslie and Perry Counties, Kentucky* (USSCS 1982). They are generally deep (ranging from 33 to 70 inches on average) and well- to moderately-drained. Textures, generally loamy, range from clay loam to channery loam. Slopes range from 15 to 70 percent, averaging about 50 percent.

Four soil series are present:

- Dekalb-rock outcrop—Latham
- Fairpoint
- Shelocta-Cutshin
- Shelocta-Gilpin

Dekalb-rock outcrop--Latham series soils are found on ridge tops and upper side slopes. Shelocta-Cutshin series soils are found on northeasterly aspect sideslopes. Shelocta-Gilpin series soils are found on southwestern aspect sideslopes. The Fairpoint soils are from loamy skeletal coal extraction mine spoil with a parent material of interbedded sedimentary rock. The soils are not suitable for cultivated crops, pasture, or urban uses due to steep slopes, erosion hazard, and stoniness. Figure 3.3-1 presents the distribution of soils types on the USFS tract.

3.3.2 Effects of Implementation

Changes to physiography and hydrology can impact forest resources, including soils and vegetation. Impacts to soil and vegetation in turn could result in indirect impacts to wildlife, including PETS species, through habitat alteration. In assessing potential impacts to soil, vegetation and wildlife, impacts may occur if there is:

- Impact to soils, such as losses of soil due to erosion
- Loss of productivity, that cause vegetation losses
- Increased erosion that results in a reduction in surface water quality

3.3.2.1 Proposed Action

If the proposed Action is selected and the PDS is implemented, no surface facilities or surface disturbances are proposed for the USFS tract. Therefore, there would be no direct impacts to soils under the Proposed Action. The subsidence analysis (Section 3.2.2) determined that predicted subsidence effects are not likely to affect surface vegetation or hydrology. Thus, no measureable direct or indirect impacts to surface vegetation that would result in reduced vegetation cover and increased soil loss due to erosion are predicted as a result of the PDS (Section 3.6).

3.3.2.2 No Action Alternative

If the No Action Alternative is selected and the NAS is implemented, the coal under the area of the USFS tract would not be mined and the soils that currently exist would remain unchanged. Therefore, no direct or indirect impacts to soils are anticipated if the NAS is implemented.

3.3.3 Cumulative Effects

The cumulative impacts area for soils was defined as the Beech Fork watershed above the confluence with Middle Fork Kentucky River. Direct effects to soil are not expected to combine with effects in adjacent drainages. However, the potential indirect effects to water quality from increased sediment may combine with surrounding drainages.

No measureable direct or indirect impacts to soils have been identified in association with nearby projects, including historical or current underground mining at the Abner Branch, Oldhouse Branch, and Beech Fork mines. No impacts are anticipated under the Proposed Action or the No Action Alternative. Consequently, no cumulative effects are expected.

3.4 Groundwater Quality and Quantity

3.4.1 Environmental Baseline

3.4.1.1 Groundwater Hydrology

A comprehensive groundwater study was completed at the Middle Fork longwall mine in Edd Fork (Minns 1993), located approximately 3 miles west of the project area. Due to the proximity of the Middle Fork Mine to the project area, the similar terrain, geology, and same-mined coal seam (Hazard No. 4), the conceptual model developed during that study is directly applicable to the groundwater system in the area of the Proposed Action. The model is typical of the Eastern Kentucky Coal Field.

Regionally, groundwater is typically recharged and flows along shallow bedrock fractures. Steep topography, fractures, and stratification alter flow paths; consequently, local and regional flow systems are not defined (Minns 1993). The regional stratigraphy consists of nearly flat-lying interbedded sandstones, shales, and coal seams of the Middle Pennsylvanian Breathitt Formation (Figure 3.2-3). The primary porosity of these strata is minimal due to poor sorting and cementation. Secondary porosity is created by shallow surface-fracture zones and weathering. These zones parallel the surface to a depth of 50 or 60 feet (Minns 1993). However, groundwater flow appears to be concentrated in the uppermost 30 feet where weathering has enhanced the fracture porosity (Shamrock 2011).

Groundwater flow is complicated by the presence of coal beds and large continuous fractures that are more transmissive than surrounding strata. Surface-fracture zones, located along hill slopes and in valley floors, provide direct conduits for groundwater flow from hillsides to adjacent streams and valley-floor

aquifers. Groundwater flow is fracture-controlled, and the strike and dip of the strata have little to no influence on groundwater flow in this type of setting.

The area in the vicinity of the Proposed Action consists of narrow steep-sided, V-shaped valleys containing small intermittent streams (Fern Branch and Cawood Branch drainages) which flow into the more maturely eroded, U-shaped valley containing the major perennial stream, Beech Fork.

The shallow-fracture aquifer is more extensive under the broad U-shaped valley (greater than 500 feet wide) of the Beech Fork drainage, where the fracturing likely extends to a depth of 100 feet. Under the narrow, V-shaped valleys of the project area, the fracturing does not extend below about 30 to 50 feet.

The primary source of groundwater in the vicinity of the project area is the shallow, valley-floor stress-relief fracture system associated with Beech Fork and its tributaries. It is likely that the groundwater and surface water systems are interconnected along the valley floors. Two groundwater user surveys have been conducted in the area: one for Permit 866-5130 and the other for Permit 866-5053, Amendment 4. The results of these user surveys are shown on Figure 2.2-1. One abandoned well (#64) was found within the project area, but is located in the “No Mining” zone along Beech Fork. All other groundwater users are located along Beech Fork or in a drainage nearby but outside the project area. The results of the groundwater user survey are presented in Appendix E. The total well depth, depth to water and surface elevation for drilled wells are presented below in Table 3.4-1.

Table 3.4-1 Groundwater Well Information

Well ID	Top of Well Elevation (feet-amsl)	Depth of Water (feet)	Total Well Depth (feet)	Well Diameter (inch)	Comments
11	1280	28	120	6	Non-drinking domestic. GW-311
Unknown	1280	40	80	6	Not in use
GW-1722	1280	90	150	6	Not in use
15	1350	Unknown	210	6	Wash clothes, odor, S, Fe
16	1340	Unknown	120	6	Domestic, good water
17	1350	Unknown	80	6	Domestic, good water
18	1520	Unknown	Unknown	6	Domestic, good water
19	1520	Unknown	Unknown	6	Well dry, 10-27-99
21	1280	Unknown	Unknown	6	Domestic, odor, Fe
22	1260	Unknown	Unknown	6	Not in use
48	1287	20	140	6	Fe, H_2S, GW-2073
unknown	1280	Unknown	Unknown	Unknown	Fe, H_2S
B1	1110	20	40	8	Domestic, non-drinking, Fe
B2	1054	Unknown	65	6	Domestic drinking
B3	1059	Unknown	Unknown	Unknown	Domestic drinking
B4	1065	Unknown	Unknown	Unknown	Domestic drinking

One groundwater user's well (GW1738) in the Simms Branch drainage a little to the north of the project area is used as a monitoring well to identify baseline/background conditions and would be used for monitoring purposes during mining operations under the PDS. Groundwater levels in the well fluctuate from 9 to 40 feet below top of well elevation. This correlates to a top of aquifer elevation between 1,391 and 1,360 feet amsl.

Local groundwater flow in the project area discharges to first order and second order streams (e.g. Cawood Branch and adjacent Fern Branch). Flow in the regional system is downward beneath the streams. In an undisturbed setting, groundwater flow is topographically controlled and would flow through the weathered surface fractures, nearly vertically along the valley walls, to the valley-floor aquifers and adjacent streams. Layers with different hydraulic conductivities tend to cause lateral flow along bedding planes that then create wet-weather springs, which divert some of the groundwater flow to surface flow. A spring/seep survey was conducted for Permit 866-5130. The only spring identified was along the Simms Branch drainage to the north of the project area. The seep occurred at an elevation of 1,700 feet amsl; however, the spring was dry at the time of the survey.

A conceptual model of groundwater flow in the vicinity of the project area is similar to the conceptual coalfield groundwater flow model of Harlow and LeCain (1991) and is presented on Figure 3.4-1. Local groundwater flow tends to mimic the surface water flow direction and drains into the Beech Fork drainage valley and the underlying regional flow regime.

Six groundwater monitoring wells (GW-14, 1724, 1737, 1738, 1739 and GW 2073) are being monitored in accordance with KDMP permitting requirements and for background data collection for the project area (Figure 3.2-2). These locations were chosen for background monitoring because:

1. The sites monitor the groundwater from the aquifers which have been identified in the area
2. Historical water quality and quantity data exists for these sites
3. The sites are located down dip of the project area

All of these monitoring wells are within the valley floor stress relief aquifer system of the surrounding Beech Fork, Fern Branch, Simms Branch, Elk Creek, Greasy Creek, and Laurel Fork drainages. The well and aquifer characteristics at these monitoring points are shown below in Table 3.4-2 and indicate that the aquifer system under the first and second order drainages, near the Forest Service tract, is approximately 50 feet thick, while it is 50 – 100 feet thick under Beech Fork, at an elevation between 1,000 feet to 1,320 feet. The ground surface elevation is between 1,080 feet and 1,400 feet amsl. Monitoring point GW 2073 is located nearest to the project area at the confluence of Beech Fork and Fern Branch as shown on Figure 3.2-2.

Table 3.4-2 Groundwater Monitoring Stations

Well ID	Top of Well Elevation (feet-amsl)	Depth of Well (feet)	Aquifer System	Local Stream	Top of Aquifer (feet-amsl)	Aquifer Thickness (feet)
GW-14	1120	20	Valley Floor Stress Relief Aquifer System	Beech Fork	1110	100
1724	1080	105	Valley Floor Stress Relief Aquifer System/Hance Formation	Greasy Creek	1070	95
1737	1040	120	Valley Floor Stress Relief Aquifer System	Beech Fork	1000	50
1738	1400	80	Valley Floor Stress Relief Aquifer System	Simms Branch	1320	60
1739	1050	80	Valley Floor Aquifer System	Elk Creek	1000	50
GW 2073	1300	140	Valley Floor Stress Relief Aquifer System	Fern Branch	Unknown	Unknown

Groundwater monitoring Well 1737 is a 6-inch diameter drilled well approximately 120 feet in depth and monitors the valley floor stress relief aquifer system. The well elevation is approximately 1,040 feet and is located more than three (3) miles northwest of the project area and 0.2 miles north of the town of Mozelle, Kentucky. The top of the aquifer measured in Well 1737 varies from 12 to 30 feet below ground surface (corresponding to 1,008 and 990 feet amsl). Water levels in well 1737 fluctuate and rapidly respond to precipitation and runoff events. This behavior is typical of small storage in colluvial/shallow bedrock groundwater systems.

Groundwater monitoring Well 1738 is a 6-inch diameter drilled well approximately 80 feet in depth and monitors the valley floor stress relief aquifer system. The well elevation is approximately 1,400 feet and is located more than ½ mile north-northwest of the project area in the Simms Branch drainage. The top of the aquifer measured at that well varies from 9 to 40 feet below ground surface (correlating to 1,391 and 1,360 feet amsl). Water levels in Well 1738 fluctuate and rapidly respond to precipitation and runoff events. This behavior is typical of small storage in colluvial/shallow bedrock groundwater systems. There is a subsidence protection zone at this location.

Groundwater monitoring Well 1739 is a 6-inch diameter drilled well approximately 80 feet in depth and monitors the valley floor stress relief aquifer system. The well elevation is approximately 1,050 feet and is located more than three miles north-northeast of the project area at the mouth of Elk Creek near the confluence with Greasy Creek. The top of the aquifer measured at that well varies from 15 to 29 feet below ground surface (correlating to 1,021 and 1,035 feet amsl). Water levels in Well 1739 fluctuate and rapidly respond to precipitation and runoff events. This behavior is typical of small storage in colluvial/shallow bedrock groundwater systems.

Groundwater monitoring Well GW 1724 is a 6-inch diameter drilled well approximately 105 feet in depth and monitors the valley floor stress relief aquifer system/Hance Formation. The well elevation is approximately 1,080 feet and is located in the Greasy Creek drainage downstream and 3,600 feet north of its confluence with Laurel Fork. The well is located between two and three miles northeast of the project area. The top of the aquifer measured at Well GW 1724 varies from 20 to 22 feet below ground surface (corresponding to 1,058 and 1,060 feet amsl). Water levels in Well GW 1724 fluctuate and rapidly respond to precipitation and runoff events. This behavior is typical of small storage in colluvial/shallow bedrock groundwater systems.

Groundwater monitoring Well GW-14 is a 6-inch diameter drilled well approximately 20 feet in depth and monitors the valley floor stress relief aquifer system. The well elevation is approximately 1,120 feet and is located in the Beech Fork drainage between two and three miles northwest of the project area. The top of the aquifer measured at Well GW 14 is reported at about 10 feet below ground surface (corresponding to 1,110 feet amsl).

Groundwater monitoring Well 2073 is a 6-inch diameter drilled well approximately 140 feet in depth and monitors the valley floor stress relief aquifer system. The well elevation is approximately 1,300 feet and is located near the confluence of the Fern Branch drainage with Beech Fork, immediately adjacent to the west side of the project area The top of the aquifer measured at Well 2073 is not reported.

The stratigraphy in the vicinity of the project area consists of the Breathitt Formation that exhibits significant lateral heterogeneity. The stratigraphic bedding of the rocks in the vicinity of the project area is nearly horizontal (less than 1 degree of dip). Bedded sedimentary rocks typically have two or more sets of near-vertical joints and some have horizontal bedding joints. The spacing of vertical joints in the bedded strata is largely controlled by differing lithology and competence. Fracture development in the Eastern Kentucky Coal Field probably resulted from a combination of regional tectonic joint sets that were enhanced very near the surface by weathering processes and overburden unloading (Minns 1993). Due to the differences in lithology and fracture-controlled nature of the rock, groundwater flow is likely complex. However, various models of the groundwater flow systems for the Eastern Kentucky Coal Field have been developed. Basically, laterally flowing groundwater will tend to follow the path of higher hydraulic conductivity and may change flow direction to follow a unit with higher hydraulic conductivity. The sedimentary layering of the rocks in the vicinity of the project area superimposes strata with different conductivities. Flow may be nearly vertical through low-conductivity layers (due to fractures) but horizontal in higher conductivity layers.

3.4.1.2 Groundwater Quality

A groundwater-monitoring program has been conducted in the vicinity of the project area in accordance with KDMP operating permit requirements for private lands that adjoin the project area. The program was designed to detect if adverse effects on the groundwater environment occur. Water quality data has been collected as part of the pre-mining ground water monitoring program from six monitoring wells (GW-14, 1724, 1737, 1738, 1739 and GW 2073). These six wells would also be monitored during mining. Groundwater quality over time with respect to monitoring parameters required by the KDMP is presented in tabular format in Appendix F-1 and graphically in Appendix F-2. Analytical results for samples collected from these wells are summarized in Table 3.4-3. Locations of the groundwater wells with respect to watercourses and proposed mining zones are shown on Figure 3.2-2. Water quality parameters for pre-mining and during mining are listed below in Table 3.4-4.

Table 3.4-3 Summary of Groundwater Monitoring Results

Parameter	EPA Secondary MCL Drinking Water Standards[1]	Groundwater Monitoring Points 2001/2002 through March 2003 Conditions																	
		Beech Fork, #1737			Simms Branch, #1738			Elk Creek, #1739			Greasy Creek & Laurel Fork, #1724			Beech Fork, GW-14			Fern Branch, GW-2073		
		Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
Total Iron (mg/L)		0.05	0.307	0.69	0.16	0.85	1.02	0.33	0.68	0.78	ns	ns	ns	ns	ns	ns	ns	ns	ns
Dissolved Iron (mg/L)	0.3	0.01	0.487	1.15	0.04	0.62	0.88	0.05	0.44	0.69	0.23	0.47	0.68	ns	ns	ns	ns	ns	ns
Total Manganese (mg/L)		0.01	0.119	0.24	0.12	0.45	0.74	0.01	0.02	0.08	ns	ns	ns	ns	ns	ns	ns	ns	ns
Dissolved Manganese (mg/L)	0.05	0	0.125	0.41	0.01	0.33	0.70	0.01	0.05	0.18	0.12	0.37	0.62	ns	ns	ns	ns	ns	ns
Sulfate (mg/L)	250	22	46.6	60	36	59	78	22	42	70	0.61	44	69	ns	ns	ns	ns	ns	ns
pH (standard units)	6.5 - 8.5	7.3	7.96	8.5	7.3	7.7	8.2	7.0	7.4	8.3	7.2	7.5	7.8	ns	ns	ns	ns	ns	ns
Alkalinity (mg/L $CaCO_3$)		101.5	116.61	122.57	100.4	106.7	115.1	81.5	102.2	120.6	110.0	113.9	120.1	ns	ns	ns	ns	ns	ns
Acidity (mg/L $CaCO_3$)		0	0	0	0	0	0	0	0	0	0	0	0	ns	ns	ns	ns	ns	ns
Specific Conductance (µmhos/cm)		237	498	827	372	565	779	337	500	677	488	558	620	ns	ns	ns	ns	ns	ns
Total Suspended Solids (mg/L)		3	8	11	2	9	15	2	8	19	4	8	12	ns	ns	ns	ns	ns	ns
Total Dissolved Solids (mg/L)		10	282	488	220	324	416	199	295	400	300	345	420	ns	ns	ns	ns	ns	ns
Depth to Water		12	20	30	9	25	31	15	22	29	20	21	22	ns	ns	ns	ns	ns	ns
Well Depth		120	120	120	80	80	80	80	80	80	105	105	105	ns	ns	ns	ns	ns	ns
Temperature		48.2	53.6	60.5	50	55	62	51	55	61	50	59	65	ns	ns	ns	ns	ns	ns

Parameter	EPA Secondary MCL Drinking Water Standards[1]	Groundwater Monitoring Points 2010 through July 2011 Conditions																	
		Beech Fork, #1737			Simms Branch, #1738			Elk Creek, #1739			Greasy Creek & Laurel Fork, #1724			Beech Fork, GW-14			Fern Branch, GW-2073		
		Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
Total Iron (mg/L)		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Dissolved Iron (mg/L)	0.3	0.2	0.65	1.4	0.19	0.79	1.40	0.15	0.55	1.40	0.51	0.67	0.97	0.51	0.69	0.91	0.51	0.69	0.80
Total Manganese (mg/L)		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Dissolved Manganese (mg/L)	0.05	0.19	0.37	0.86	0.09	0.28	0.48	0.06	0.20	0.40	0.05	0.27	0.40	0.32	0.47	0.63	0.33	0.53	0.77
Sulfate (mg/L)	250	34	55.83	83.2	9.60	61.30	83.20	58.00	71.25	83.20	14.80	42.78	72.30	32.60	55.13	88.90	38.90	56.78	70.00
pH (standard units)	6.5 - 8.5	7	7.71	8.4	7.20	7.96	8.70	7.40	7.76	8.00	7.00	7.43	7.80	7.00	7.68	8.20	7.70	7.85	8.00
Alkalinity (mg/L $CaCO_3$)		104.8	147.63	380.8	112.45	121.05	138.50	108.11	113.78	120.70	109.80	114.22	121.30	110.15	132.57	179.50	106.79	112.94	116.15
Acidity (mg/L $CaCO_3$)		<5	<5	<5	0	0	0	0	0	0	<5	<5	<5	<5	<5	<5	<5	<5	<5
Specific Conductance (µmhos/cm)		5.1	775.52	1750	221.00	523.00	820.00	151.00	343.07	615.00	410.00	710.00	987.00	633.00	995.50	1386.00	561.00	711.00	875.00
Total Suspended Solids (mg/L)		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Total Dissolved Solids (mg/L)		375	431	486	100.00	256.40	493.00	486.00	489.00	492.00	ns	ns	ns	ns	ns	ns	ns	ns	ns
Depth to Water		15	15	15	40.00	40.00	40.00	25.00	25.00	25.00	10.00	10.00	10.00	10.00	10.00	10.00	ns	ns	ns
Well Depth		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Temperature		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Notes:
[1] (EPA 2012a)
MCL – Maximum Contaminant Limit
For samples 1737, 1738, and 1739: Minimum, average and maximum concentrations calculated using results of January 2010 through July 2011 quarterly sampling.
For sample 1724, GW-14, and GW-2073: Minimum, average and maximum concentrations calculated using results of October 2010 through July 2011 quarterly sampling.
Min – minimum reported concentration
Max – maximum reported concentration
ns – not sampled

Table 3.4-4 Water Quality Parameters

Parameter	Method
Water level	Water level indicator
pH (standard units)	423*
Acidity (mg/l)	402*
Alkalinity (mg/l)	403*
Dissolved iron (mg/l)	303*
Dissolved manganese (mg/l)	303*
Sulfate (mg/l)	426c*
Specific conductance (micromhos/cm)	205*
Total dissolved solids (mg/l)	209B*
Temperature (°F)	

Notes:
* "Standard Methods for the Examination of Water and Wastewater." 16th Edition, 1985.

Water quality data from the groundwater wells (Table 3.4-3) indicate that iron and manganese in the wells have exceeded EPA secondary drinking water standards, but values for all the other analyzed parameters are within secondary drinking water standards (EPA 2012a). Manganese concentrations equaled or exceeded the EPA secondary drinking water standard of 0.05 mg/l in every well during the sampling program except in wells 1737 (August and December of 2002), 1738 (December 2001), and 1739 (April through September and December of 2002, March 2003). Well 1738 is located in a drainage that does not have known historical mining. Dissolved iron and manganese concentrations exceeded the secondary standard in 2001-2003, prior to active mining. Therefore, the exceedances may represent natural background concentrations. Historical and active mining has occurred in areas that could impact water quality at wells 1737 (Beech Fork), 1739 (Elk Creek), 1724 (near the Greasy Creek and Laurel Fork confluence), GW 2073 (Fern Branch), and GW-14 (Beech Fork). Water quality data collected from 2010 through July 2011 were compared to previous water quality data collected from 2001 or 2002 through 2003 at wells 1737, 1738, 1739, and 1724 to evaluate if groundwater conditions have changed. The results of these comparisons are as follows:

- The average dissolved iron concentration has increased slightly at all wells
- The average dissolved manganese has increased at 1737 and 1739, but decreased at 1738 and 1724
- The average sulfate has increased at 1737, 1738, and 1739, but decreased at 1724
- The average pH has increased slightly at 1738 and 1739, but decreased at 1737 and 1724
- The average alkalinity has increased at all wells
- The average specific conductance has increased at 1737 and 1724, but decreased at 1738 and 1739
- The average TDS has increase at 1737 and 1739, but decreased at 1738, while not monitored in 2010-2011 at 1724
- The average depth to water has increased at 1738 and 1739, but decreased at 1737 and 1724

In general, the average concentration changes from 2001/2002-2003 to 2010-2011 are relatively minor (many are within 10%). These data suggest that mining in the area has not had a significant impact on groundwater quality, particularly given that some parameter concentrations have actually decreased at some wells and that dissolved iron and dissolved manganese concentrations have decreased at well 1738 located in a drainage of no known historical mining.

3.4.1.2.1 Springs and Seeps

Springs and seeps may occur in areas where permeable rock outcrops to the surface. In the vicinity of the project area, the coal seams are permeable, and where the coal outcrops, it is likely that a spring or seep could be present during certain times of the year. Perched water tables may develop above layers of low hydraulic conductivity and unsaturated wedges develop beneath such layers. Multiple seepage faces may develop where several low-conductivity zones are present in a hillside. There are no areas where the Hazard No. 4 coal seam outcrop within the project area, thus, seeps and springs are not likely to occur.

In the vicinity of the Proposed Action, water quantity is inferred to be minimal based upon findings in the study completed in nearby Edd Fork to the west (Minns 1993). Two reconnaissance surveys were performed in support of an EIS conducted for the Grey Mountain Coal lease on two tracts located in the vicinity of the project area. The surveys were conducted in January 2003 and in March 2003 and three spring/seep areas were identified between the elevations of 1,400 feet and 1,600 feet. A search was also conducted on the Kentucky GIS website in 2012 to locate springs in the vicinity of the project area. These springs are shown on Figure 3.2-2 and are located outside the project area. There are no known seeps or springs within the project area.

3.4.2 Effects of Implementation

3.4.2.1 Proposed Action

3.4.2.1.1 Groundwater Hydrology

Based on results from Minns' study of the Edd Fork Mine, the most likely effect that could result from underground mining would be a local dewatering of the shallow, valley-floor stress-relief fracture system. This effect was noted in OSM studies of Greasy Creek, and the effects of nearby mining (USFS 2004c). However, mining under the PDS would never be within the 30 to 50 foot depth of the valley-floor stress-relief fracture system, and so this potential impact could not occur. Groundwater in the upper reaches of the mountains is minimal because the slopes are steep, runoff is rapid, and thus, low infiltration/recharge to the groundwater system is likely.

With regard to subsidence and related potential impacts to perched aquifers, a perched aquifer would be affected only if situated within the 50-foot zone above the mined coal seam that could be impacted by subsidence in the form of rock collapse (Section 3.2.2.1). With regard to indirect impacts caused by direct

impacts to perched aquifers, if a perched aquifer were connected to a surface fracture system, impacts to the aquifer could influence forest hydrologic conditions and forest vegetation. However, based on the Minns 1993 study, perched aquifers are not anticipated to be prevalent under the project area. In addition, due to the coal seam depth that has a minimum 140 feet of cover in mined areas, there is a minimum of 40 feet of separation between the natural valley-floor stress-relief fracture zone and the subsidence fracture zone (see Section 3.2.2.1). Therefore, any such perched aquifers, situated at depths of more than 90 feet below ground surface and subsequently more than 40 feet below the lower extent of the natural fracturing system, are not anticipated to be connected to the surface fracture systems, and are not anticipated to result in indirect impacts to forest hydrologic conditions or forest vegetation.

Therefore, potential subsidence related to mining under the PDS is anticipated to result in minimal to no adverse direct or indirect impacts to the groundwater regime in the vicinity of the project area.

Figure 3.2-4 shows the depth of the coal seam with respect to the surface water bodies in the project area. Results from the evaluation of potential subsidence (Section 3.2.2.1) indicate that under the PDS, fracturing would be limited because of the thickness of the coal seam and the depth of the coal seam below the surface of the project area.

Therefore, under the PDS, no potential long-term adverse direct or indirect impacts to surface water or near surface aquifers are anticipated to occur.

3.4.2.1.2 Groundwater Quality

As described in Section 3.2.1.4 (Acid Mine Drainage), analytical studies have been conducted on the rock types that would be mined under the PDS. The studies indicated that under the PDS, acid mine drainage (AMD) is unlikely due to the high net neutralization potential of the overlying rock that would cave into the mined areas. The PDS would involve underground mining that could result in a negligible increase in total dissolved solids to water resources. However, this increase is expected to be short-term and not represent a measureable long-term direct or indirect impact to local water resource quality.

Surface mining would not be conducted in the project area, and therefore would not have the potential for indirect impacts to groundwater through accidents, spills, or other mistakes. The PDS would involve underground mining, which could increase the potential for accidents, spills, or other mistakes that could lead to groundwater impacts. However, under the PDS, volumes or quantities of materials used within the mine would be small. Best management practices and permit requirements, including chemical handling requirements, would be followed during mining. During operations, a spill contingency plan would be maintained and followed. If a spill were to occur, it is anticipated that direct or indirect impacts to groundwater resources would be localized and minimal because the potential volume or quantity of material spilled would be small. Furthermore, it is assumed that in accordance with best management practices and permit requirements, the spill contingency plan would be implemented immediately and any potential impacts would be minimized. Implementation of these preventive measures would minimize the

potential for direct or indirect impacts to groundwater resources. In summary, under the PDS minimal short-term direct or indirect impacts to groundwater resources are anticipated to occur in response to the Proposed Action.

3.4.2.2 No Action Alternative

If this alternative is selected, the NAS would be implemented, and mining would not occur within the project area. No direct or indirect impacts to the groundwater regime within the project area are anticipated.

3.4.3 Cumulative Effects

A three-mile buffer area from the PDS boundary was defined as the cumulative effects area. This buffer was chosen to include projects within the Beech fork drainage above the confluence with Middle Fork Kentucky River. The drainage area is representative of similar projects and within an area that can be reasonably analyzed. Extending the area to other watershed s would result in unwieldy analyses and effects too dispersed over a large area.

Analytical results for iron and manganese concentrations in local groundwater exceeded EPA secondary drinking water standards. Such exceedance may represent natural background concentrations. In addition, historical and active mining has occurred in the vicinity of the project area. This mining activity could directly impact water quality at wells that would be used to monitor impacts from the PDS. However, few direct or indirect impacts to groundwater resources have been identified at nearby projects, including historical or current underground mining at the Abner Branch, Oldhouse Branch, and Beech Fork mines, and it is anticipated that any active or future mining in the area would be performed in accordance with state and federal regulations, thereby minimizing direct or indirect impacts to groundwater resources. Consequently, minimal short-term cumulative effects to groundwater resources are anticipated.

Under the PDS, short-term, minimal impacts to groundwater have been identified that could combine with impacts from other projects to cause cumulative effects. Consequently, short-term , minimal cumulative effects to groundwater resources are anticipated.

Based on the findings of the AMD analysis presented in Section 3.2.3, no AMD water quality impacts are expected to combine with existing or future impacts under the PDS. The majority of the strata above and below the Hazard No. 4 and the Hazard No. 4 Rider coal seams have large NNP values. Therefore, no cumulative effects to groundwater resources due to AMD are anticipated.

Under the NAS, no direct or indirect impacts to the groundwater regime or springs within the project area have been identified, and no cumulative effects are anticipated.

3.5 Surface Water

3.5.1 Environmental Baseline

3.5.1.1 Surface Water Hydrology

The project area is located within the watershed of the Middle Fork of the Kentucky River and in the Eastern Kentucky Coal Field physiographic region, which is characterized by mountainous terrain, rapid runoff, and moderate rates of groundwater drainage. The watershed is underlain by coals, sandstones, and shales.

Horton (1945) developed a hierarchical classification for surface water systems, subsequently modified by A. N. Strahler (1952) that remains in wide use. The smallest permanently flowing stream is termed "first order," and the union of two streams of order *n* creates a stream of order *n* + 1 (or "second order"). The area encompassing the project area is bounded by third-order streams – Beech Fork to the west, and Laurel Fork to the east. Laurel Fork joins up with Greasy Creek approximately 3.3 miles northeast of the project area and then Beech Fork and Greasy Creek join at the town of Hoskinston approximately 8.4 miles north of Helton. These two streams join the Middle Fork of the Kentucky River approximately 1 mile downstream at the town of Stinnett. Beech Fork and Laurel Fork do not flow through the project area; however, Beech Fork is immediately adjacent to the project area. These creeks, their main tributaries, and surface water monitoring points are shown on Figure 3.2-2.

Gray Mountain and Peters Gap form a topographical and watershed divide in the vicinity of the project area. Surface water bodies in the vicinity of the project area that flow west and north to Beech Fork include: Cawood Branch, Fern Branch, Mare Branch, Simms Branch, Apple Orchard Branch, Laurel Branch, Peters Branch (both Right and Left Forks), Dug Fork, and Marion Branch.

The project area has ephemeral or intermittent first order or second order streams that are headwaters to the Middle Fork of the Kentucky River watershed. The project area contains no lakes or other water bodies. Surface water monitoring has been conducted since 2002.

Only the first order Cawood Branch crosses through the project area. The next closest stream to the project area is Fern Branch to the northwest (Figure 3.2-2).

Under the PDS subsidence control plan described in Section 2.2.1.3, mining would occur under the Cawood Branch except where the distance from the coal bed to the stream channel is less than 100 feet. However, it is anticipated that this distance will always exceed 100 feet in the project area. Thirteen surface water points will be monitored under the PDS. This monitoring would continue to be performed during mining in accordance with KDMP operating permit requirements. Locations of the surface water monitoring points are shown on Figure 3.2-2, and the parameters being monitored are listed in Table 3.4-4. Stream flow is being monitored twice monthly during normal flow periods. Surface water

flow measurements, in cubic feet per second (cfs), from 2002 through April 2003 and from January 2010 through October 2011, are presented and summarized in Table 3.5-1 below:

Table 3.5-1 Surface Water Flow Measurement Summary

Monitoring Location	ID Number	Flows Measured In cfs
Fern Branch	1754	Dry – 15
Mare Branch	1753	Dry – 5
Simms Branch	1752	Dry – 10
Apple Orchard Branch	1751	Dry – 10
Laurel Branch	1750	Dry – 25
Marion Branch	1749	Dry – 30
Main Branch of Peters Branch	1748	Dry – 10
Dug Fork	1747	Dry – 5
Left Fork of Peters Branch	1746	0.49 – 5.5
Right Fork of Peters Branch	1766	Dry – 6.25
Right Fork of Cawood Branch	1767	1.04 – 6.55
Left Fork of Cawood Branch	1770	0.05 – 8.86
Blue Hollow	1765	Dry – 6.5

The 2002-2003 samples represent background conditions prior to the start of underground room and pillar mining in the Beech Fork Mine, located to the north of the proposed lease area. The 2010 – 2011 data represent current conditions. In general, the average high flows were measured starting in January and extending into the spring and early summer months. Periodically, high flows were observed in the late summer and fall, likely in response to precipitation events. Months when dry conditions were most frequently observed were in July, August, and September, with less frequent occurrences in February, March, April, May, June, October, November, and December. Based on the available stream flow data, these streams can be characterized as ephemeral or intermittent, with dry periods during the summer months.

Average surface water flows from January 2010 through September 2011 were compared to previous flows measured from 2002 through 2003 to evaluate if conditions have changed. At all stations the average flows have increased.

There are no surface water users in or adjacent to the project area. The nearest municipal surface water user in the area is the Hyden-Leslie County Water District, located approximately 20 miles downstream on the Middle Fork of the Kentucky River.

3.5.1.2 Regional Surface Water Quality

Water quality data for rivers and streams of the Kentucky River basin are reported to the EPA by the Kentucky Division of Water (KDOW). The *2000 Kentucky Report to Congress on Water Quality (305b)* (*2000 Report to Congress)* was prepared by the KDOW following submittal of electronic data to the EPA in March 2000 to fulfill requirements of Section 305(b) of the *Clean Water Act*, as amended. Section 305(b) of the *Clean Water Act* requires states to assess and report current water quality

conditions to EPA every two years. This report presents an assessment of water quality conditions in the Kentucky River basin for the period October 1997 to December 1999 (KDOW 2002). The 2010 report was reviewed and no new data or changes from the 2000 status have occurred (KDOW 2010).

State water quality reports [305(b)] are compiled according to the EPA guidelines that assess water quality based on potential uses or habitats that are supported by the stream or river. Potential use categories include: warm water aquatic habitat (WAH), primary and secondary commercial recreation (PCR and SCR), and fish consumption.

A segment is listed as: fully supporting, fully supporting all assessed uses but threatened for at least one use; impaired for one or more uses; or not attainable for any use. Streams are evaluated by segment, and only uses for which data exist are evaluated. A segment will be evaluated as “impaired” if it supports one use but does not support another (it is listed as not supporting). For instance, if a segment supports WAH, but not PCR, it is listed as “not supporting” (or threatened or impaired). A segment is listed as “partially supporting” if any assessed use fell into that category even if another use was fully supported. Many water bodies were assessed for only one use because data were not available to assess other uses.

For WAH, the following criteria were used:

- ***Fully supporting*** – Criteria for dissolved oxygen, un-ionized ammonia, temperature, and pH were met in 90 percent of the samples collected.
- ***Partially supporting*** – Any one criterion for dissolved oxygen, un-ionized ammonia, temperature or pH was exceeded in 11 to 25 percent of the samples.
- ***Not supporting*** – Any one of the criteria for dissolved oxygen, un-ionized ammonia, temperature or pH were exceeded more than 25 percent of the time.

For PCR, fecal coliform and pH data were used to indicate the degree of support for PCR (swimming) use:

- ***Fully supporting*** – The fecal coliform bacteria criterion of 400 colonies per milliliter or less was met in 80 percent of the samples.
- ***Partially supporting*** – The fecal coliform bacteria criterion was exceeded in 25 to 33 percent of the samples.
- ***Not supporting*** – The fecal coliform bacteria criterion was exceeded in 33 percent or more of the samples. Streams with pH less than 6.0 units in more than 10 percent of the samples were considered to not support swimming use.

For fish consumption, the following criteria were used to assess support for the fish consumption use:

- ***Fully supporting*** – No fish advisories or bans in effect.
- ***Partially supporting*** – "Restricted consumption" fish advisory or ban in effect for general population or a sub-population that potentially could be at a greater cancer risk (e.g.

pregnant women, children). Restricted consumption is defined as limits on the number of meals consumed per unit of time for one or more fish species.

- ***Not supporting*** – "No consumption" fish advisory or ban in effect for general population or a sub-population that potentially could be at greater risk, for one or more fish species, or a commercial fishing ban in effect.

The study period spanned from October 1997 through September 1999 and included three stream segments on Greasy Creek and Beech Fork, both situated within the Middle Fork of the Kentucky River watershed (USGS hydrologic unit code 05100202):

- ***Greasy Creek segment 0.0 to 10.0*** – From the mouth (confluence with the Middle Fork of the Kentucky River) upstream 10 miles to Bledsoe Coal discharge (presumably at confluence with Britton Branch, in the vicinity of the No. 61 Preparation Plant),
- ***Greasy Creek segment 11.8 to 22.0*** – From the confluence with Laurel Fork upstream 10.2 miles to the confluence with Big Laurel Creek, and
- ***Beech Fork segment 0.0 to 8.0*** – From the mouth (confluence with the Middle Fork of the Kentucky River) upstream 8 miles to the confluence with Big Branch.

Study conclusions for these locations are as follows:

Greasy Creek Segment 0.0 to 10.0		
Use Support Overall Use – Fully Support Aquatic Life – Fully Support	Causes of Impairment Priority organics	Sources of Impairment Municipal Point Sources Minor Municipal Point Source Urban Runoff/Storm Sewers Highway/Road/Bridge Runoff
Greasy Creek Segment 11.8 to 22.0		
Use Support Overall Use – Fully Support Aquatic Life – Fully Support	Causes of Impairment None listed	Sources Of Impairment None listed
Beech Fork Segment 0.0 to 8.0		
Use Support Overall Use – Fully Support Aquatic Life – Fully Support Fish Consumption – Fully Support	Causes of Impairment None listed	Sources Of Impairment None listed

The University of Kentucky Water Resources Research Institute prepared a data collection summary report in 2000 (Ormsbee and McAlister 2002). Data from this study pertinent to the project area included one sampling location on Beech Fork, at Stone Coal Branch. The fecal coliform count for this location was 103 fecal counts per 100 ml, indicating contamination by human sewage, probably due to a lack of properly functioning septic systems.

3.5.1.3 Local Surface Water Quality

The current surface water-monitoring program in the vicinity of the project area consists of 12 surface water monitoring points, which were selected to monitor stream flows and water quality that could be affected by mining. Analytical results of samples collected from these locations are presented in

Appendix G-1 and summarized in Table 3.5-2. Appendix G-2 presents graphical representations of surface water quality parameters during pre-mining (prior to Beech Fork Mine) baseline monitoring (2002-2003), and in 2010-2011, including a comparison to EPA national secondary drinking water standards for those parameters.

Table 3.5-2 Summary of Surface Water Monitoring Results

Water Quality Characteristic	Surface Water Monitoring Points 2002-2003																	
	Fern Branch, #1754			Mare Branch, #1753			Simms Branch, #1752			Apple Orchard Branch, #1751			Laurel Branch, #1750			Left Fork of Cawood Branch, #1770		
	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
Flow (Cfs)	Dry	1.09	3.55	Dry	0.16	2.18	Dry	1.18	5.37	Dry	0.76	2.29	Dry	1.23	2.97	0.39	1.73	2.42
Total Iron (mg/L)	0.13	0.27	0.46	0.14	0.30	0.44	0.07	0.26	0.48	0.05	0.22	0.57	0.10	0.33	0.60	0.15	0.39	0.73
Dissolved Iron (mg/L)	0.04	0.14	0.31	0.04	0.18	0.31	0.02	0.15	0.32	0.01	0.12	0.41	0.04	0.20	0.47	0.09	0.24	0.55
Total Manganese (mg/L)	0.07	0.24	0.69	0.01	0.13	0.56	0.05	0.23	0.63	0.03	0.19	0.54	0.02	0.20	0.47	0.09	0.20	0.56
Dissolved Manganese (mg/L)	0.01	0.14	0.56	0.01	0.08	0.42	0.01	0.14	0.50	0.01	0.09	0.26	0.01	0.12	0.28	0.01	0.10	0.31
Sulfates (mg/L)	29.00	57.21	81.00	10	30.10	75.00	2.00	48.17	80.00	12.00	49.19	81.00	5.00	56.13	81.00	22.00	42.92	65.00
pH (standard units)	7.40	8.03	8.40	7.5	8.28	8.50	7.90	8.24	8.50	7.70	8.09	8.40	7.80	8.23	8.60	7.20	8.00	8.20
Alkalinity (mg/L $CaCO_3$)	80.11	111.26	130.05	56.1	91.50	124.75	40.11	102.16	130.50	70.16	103.77	122.60	60.30	111.46	130.70	29.10	86.70	121.75
Acidity (mg/L $CaCO_3$)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Suspended Solids (mg/L)	6.00	14.25	31.00	5	12.20	35.00	6.00	17.48	39.00	3.00	12.81	28.00	4.00	16.38	29.00	5.00	12.33	18.00
Total Dissolved Solids (mg/L)	140.00	269.88	380.00	30	232.60	420.00	30.00	279.43	450.00	30.00	261.88	395.00	18.00	291.25	415.00	180.00	268.58	450.00
Specific Conductance (µmhos/cm)	200.00	442.21	644.00	40	351.90	712	50	469	762	40	426	661	20	469	703	200.00	442.08	762.00
Temperature	36.80	51.22	67.00	39	48.32	59	37	52	67	36	50	58	37	52	67	36.10	47.40	57.90

Water Quality Characteristic	Surface Water Monitoring Points 2010-2011																	
	Fern Branch, #1754			Mare Branch, #1753			Simms Branch, #1752			Apple Orchard Branch, #1751			Laurel Branch, #1750			Left Fork of Cawood Branch, #1770		
	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
Flow (Cfs)	0.10	3.20	15.00	Dry	1.65	5.00	0.05	2.11	10.00	Dry	2.25	10.00	0.25	3.44	25.00	0.05	3.34	8.86
Total Iron (mg/L)	0.05	0.50	2.68	0.05	0.53	1.91	0.21	0.47	1.88	0.03	0.42	0.80	0.05	0.42	2.22	0.15	0.45	0.72
Dissolved Iron (mg/L)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	0.27	0.27	0.27	ns	ns	ns
Total Manganese (mg/L)	0.02	0.24	0.69	0.01	0.26	0.65	0.02	0.24	0.63	0.01	0.25	0.64	0.02	0.23	0.65	0.02	0.25	0.55
Dissolved Manganese (mg/L)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Sulfates (mg/L)	40.00	63.17	104.80	33.00	68.57	124.30	26.30	61.18	101.20	33.60	67.90	167.40	15.20	56.32	108.90	36.00	68.22	101.50
pH (standard units)	6.90	7.67	8.60	7.10	7.83	9.60	7.10	7.72	8.50	7.10	7.74	8.60	7.00	7.66	8.40	7.10	7.85	8.80
Alkalinity (mg/L $CaCO_3$)	78.56	108.50	121.70	32.16	110.38	132.15	59.24	109.87	130.65	13.57	98.06	121.66	11.96	107.67	165.45	100.25	130.26	166.20
Acidity (mg/L $CaCO_3$)	0	<5	<5	0	<5	<5	0	<5	<5	0	<5	<5	0	<5	<5	0	3.18	7.05
Total Suspended Solids (mg/L)	4.00	11.67	21.00	1.00	12.03	16.00	1.00	11.27	23.00	1.00	11.58	16.00	2.00	11.56	18.00	7.00	11.68	19.00
Total Dissolved Solids (mg/L)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Specific Conductance (µmhos/cm)	101.00	364.50	852.00	156.00	465.00	974.00	166.00	415.07	987.00	136.00	399.21	920.00	154.00	331.54	985.00	110.00	280.29	284.80
Temperature	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Water Quality Characteristic	Surface Water Monitoring Points 2002-2003																				
	Right Fork of Peters Branch, #1766			Left Fork of Peters Branch, #1746			Dug Fork, #1747			Main Branch of Peters Branch, #1748			Marion Branch, #1749			Blue Hollow, #1765			Right Fork of Cawood Branch, #1767		
	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
Flow (Cfs)	Dry	0.73	3.47	0.49	2.28	4.79	Dry	1.04	4.32	Dry	2.84	6.93	Dry	2.45	5.97	Dry	0.67	1.79	1.04	1.37	1.72
Total Iron (mg/L)	0.07	0.19	0.33	0.05	0.27	0.67	0.05	0.29	0.56	0.10	0.43	0.80	0.10	0.46	0.77	0.04	0.23	0.39	0.16	0.41	0.59
Dissolved Iron (mg/L)	0.01	0.09	0.26	0.01	0.17	0.55	0.01	0.16	0.41	0.04	0.31	0.74	0.04	0.31	0.59	0.02	0.12	0.24	0.05	0.24	0.43
Total Manganese (mg/L)	0.02	0.21	0.47	0.07	0.20	0.32	0.01	0.13	0.36	0.05	0.23	0.68	0.05	0.22	0.50	0.05	0.11	0.32	0.02	0.26	0.69
Dissolved Manganese (mg/L)	0.01	0.11	0.31	0.01	0.11	0.21	0.01	0.06	0.22	0.01	0.14	0.55	0.01	0.13	0.39	0.01	0.05	0.15	0.01	0.16	0.57
Sulfates (mg/L)	11.00	45.06	80.00	15.00	43.17	88.00	9.00	37.05	84.00	12.00	43.67	78.00	12.00	46.13	90.00	20.00	49.81	90.00	10.00	37.08	69.00
pH (standard units)	7.60	8.09	8.60	7.10	7.90	8.40	7.50	7.82	8.50	7.00	7.58	8.00	7.60	8.05	8.40	7.50	8.03	8.20	7.20	7.97	8.60
Alkalinity (mg/L CaCO3)	40.12	97.90	124.99	70.24	107.35	122.10	52.18	102.85	121.75	80.22	103.02	122.03	30.11	103.76	125.10	26.05	91.56	120.14	26.31	72.19	122.10
Acidity (mg/L CaCO3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Suspended Solids (mg/L)	3.00	13.71	38.00	6.00	15.42	30.00	4.00	12.57	31.00	2.00	14.25	31.00	3.00	14.92	32.00	3.00	10.81	26.00	5.00	12.50	20.00
Total Dissolved Solids (mg/L)	50.00	196.76	477.00	30.00	218.83	394.00	30.00	180.76	315.00	70.00	239.25	363.00	30.00	247.63	407.00	60.00	204.69	422.00	30.00	236.83	450.00
Specific Conductance (µmhos/cm)	60	326	808	50	369	667	40	305	534	80	392	615	50	415	690	90.00	331.81	715.00	50.00	390.08	762.00
Temperature	36	48	58	37	51	68	36	51	59	37	52	65	38	51	65	36.10	48.86	58.20	35.10	47.42	58.20

Water Quality Characteristic	Surface Water Monitoring Points 2010-2011																				
	Right Fork of Peters Branch, #1766			Left Fork of Peters Branch, #1746			Dug Fork, #1747			Main Branch of Peters Branch, #1748			Marion Branch, #1749			Blue Hollow, #1765			Right Fork of Cawood Branch, #1767		
	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
Flow (Cfs)	Dry	2.10	6.25	0.95	2.99	5.50	Dry	2.13	5.00	1.10	3.27	10.00	0.29	4.77	30.00	0.25	2.76	6.50	1.05	3.94	6.55
Total Iron (mg/L)	0.05	0.42	0.90	0.08	0.47	2.10	0.07	0.43	0.96	0.10	0.50	2.98	0.11	0.48	1.25	0.09	0.45	0.86	0.08	0.46	0.72
Dissolved Iron (mg/L)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Total Manganese (mg/L)	0.03	0.26	0.70	0.02	0.27	1.25	0.04	0.26	0.58	0.03	0.27	0.90	0.02	0.26	0.70	0.02	0.27	0.77	0.01	0.25	0.66
Dissolved Manganese (mg/L)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Sulfates (mg/L)	29.40	65.58	164.50	25.00	57.46	80.00	25.00	74.77	146.50	20.10	64.03	113.00	35.30	66.23	101.00	23.60	66.26	101.00	45.00	71.07	101.90
pH (standard units)	7.00	7.72	8.40	7.10	7.88	8.40	7.10	7.70	8.40	7.00	7.73	8.20	7.20	7.89	8.90	7.20	7.84	8.30	7.50	8.07	8.60
Alkalinity (mg/L CaCO3)	12.14	110.13	123.51	11.10	112.36	123.62	54.68	117.61	201.38	11.30	110.15	163.25	20.79	115.23	165.35	20.04	112.20	134.56	105.60	130.77	151.20
Acidity (mg/L CaCO3)	0	<5	<5	0	<5	<5	0	<5	<5	0	<5	<5	0	<5	<5	0	<5	<5	0	3.65	7.07
Total Suspended Solids (mg/L)	1.00	12.46	26.00	5.00	14.83	121.00	7.00	12.29	26.00	1.00	12.07	22.00	1.00	12.02	26.00	2.00	12.27	18.00	8.00	11.64	18.00
Total Dissolved Solids (mg/L)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Specific Conductance (µmhos/cm)	132.00	396.07	894.00	205.00	426.62	987.00	103.00	307.68	898.00	152.00	446.36	984.00	217.00	478.88	548.48	200.00	450.73	945.00	190.00	312.48	461.00
Temperature	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Notes:
Min – minimum reported concentration, November 2001-April 2002
Ave – calculated average based on reported results November 2001-April 2002
Max – maximum reported concentration, November 2001-April 2002
ns – not sampled

Many of the drainages near the project area do not have historic mining activities that have been identified, but do have water quality parameters that exceed EPA secondary drinking water or mountain top mining benchmarks

Most of the analytical results for manganese and iron at all surface water stations exceeded the standards of the *National Secondary Drinking Water Regulations* (Regulations). However, only total manganese and iron concentrations have been measured in 2010 and 2011, and the standards are based on dissolved concentrations.

Surface water quality data collected from January 2010 through September 2011 were compared to previous water quality data collected from 2002 through 2003 at stations 1746, 1747, 1748, 1749, 1750, 1751, 1752, 1753, 1754, 1766, 1767, and 1770 to evaluate if surface water conditions have changed. The results of these comparisons are as follows:

- The average total iron concentration has increased at all stations
- The average total manganese has increased at all stations except 1754 where it remained the same and 1767 where it decreased slightly
- The average sulfate has increased at all stations except 1750 where it has decreased slightly
- The average pH has decreased at all stations except 1748 and 1767 where it has increased slightly
- The average alkalinity has increased at all stations except 1750, 1751, and 1754 where it has decreased
- The average total suspended solids (TSS) has decreased at all stations except 1765 where it has increased
- The average specific conductance has increased at 1746, 1747, 1748, 1749, 1753, and 1766, decreased at 1750, 1751, 1752, 1754, 1767, and 1770

In general, the average concentration from 2002-2003 to 2010-2011 for most parameters at most surface water stations has increased. The most noteworthy exceptions to this are pH (decreased at all stations but two), TSS (decreased at all stations but one), and specific conductance (decreased at six of twelve stations). All of the concentration changes are relatively minor (i.e., much less than an order of magnitude), suggesting that mining activities in the area have not had a significant impact on surface water quality, particularly given that some parameter concentrations have actually decreased from the 2002-2003 to 2010-2011 time periods. Many of the drainages in the vicinity of the USFS tract had no mining activities that have been identified but had water quality parameters that exceed EPA secondary drinking water standards, during the 2002-2003 sampling. For example, nearby surface water station 1765 (Blue Hollow) is located in a drainage that has had no historic or current mining (see Figure 2.4-1 and 2.4-2), yet iron, manganese and specific conductance were elevated in 2002 – 2003 and have shown slight increases in 2010-2011, despite the lack of activity. Also, the surface water station data presented

herein (Table 3.5-2 and Appendices G-1 and G-2) indicate that background levels of iron, manganese, and specific conductance may be naturally high, and not elevated as a result of mining.

On April 1, 2010, the EPA released an interim guidance to strengthen environmental permitting requirements for Appalachian mountaintop surface coal mining, which identified a benchmark concentration for conductivity (i.e., salinity) in surface waters of 300 microSiemens per centimeter (µS/cm). The final guidance was released on July 21, 2011. The EPA guidance was overturned in a Federal court ruling issued July 31, 2012. As such, the guideline is not a regulatory requirement. The benchmark value was developed following recommendations based on studies of surface mining, particularly mountaintop mining and valley fills (e.g., EPA 2011). The benchmark value is developed from studies in West Virginia, but the authors state that the criteria are applicable to Eastern Kentucky, based on similar salts and background. The value is designed to protect aquatic life, based on aquatic macroinvertebrate studies. EPA (2011) notes that the benchmark might not apply when the natural background exceeds the benchmark.

There are no surface mining operations in the immediate vicinity of the project area that could be impacting surface water conditions. Nonetheless, specific conductance concentrations were reviewed relative to the benchmark values. All surface water stations reported average specific conductance concentrations above 300 µS/cm for both 2002-2003 and 2010-2011. To evaluate this further, specific conductance was examined at the surface water station (1765) on the Blue Hollow drainage where no mining has occurred. Both the 2002-2003 and 2010-2011 average concentrations were above 300 µS/cm, implying that background specific conductivity levels are elevated above the EPA benchmark.

The elevation of the base of the Hazard No. 4 coal seam to be mined under the PDS is from 1,200 to 1,235 feet amsl. The elevation of the coal seam was compared to the elevation of the first-, second- and third-order streams on and near the project area and water levels in groundwater wells (Section 3.4.2). Although no third-order streams (e.g., Beech Fork) flow through the project area, the streambed elevations were compared to the mining elevations. The elevation of Beech Fork in the area of the project area ranges from 1,381 to 1,280 feet amsl in a northerly and downstream direction. The elevation of the Cawood Branch within the project area slopes from 1,390 to 1,310 feet amsl in a westerly direction. The lowest elevation on Cawood Branch above the proposed workings is 1,360 feet amsl.

According to 405 KAR 170, Section 3, no land within 100 feet of an intermittent or perennial stream shall be disturbed by surface mining and reclamation operations unless the Kentucky Natural Resources and Environmental Protection Cabinet specifically authorizes operations through such a stream. The project area would involve underground mining. No surface mining would occur under the PDS or NAS. Under the PDS, Cawood Branch, situated on the project area, would be protected under the subsidence control plan (Section 2.2.1.3). As mentioned above, the base of the coal seam underlying the project area is between 1,200 and 1,235 feet amsl dipping northeast. The PDS subsidence control plan would involve

subsidence protection and include a minimum 175-foot buffer zone between the workings and the stream banks of Beech Fork.

3.5.2 Effects of Implementation

3.5.2.1 Proposed Action

Potential impacts to surface water resources due to mining activities could include stream capture, local changes in flow, and water quality changes.

3.5.2.1.1 Surface Water Hydrology

Under the PDS subsidence control plan described in Sections 2.2.1.3, which would be implemented in accordance with KDMP regulations, limited mining would occur under ephemeral or intermittent streams.

The only stream on the project area is the Cawood Branch. The base of the proposed mine workings would be at elevations ranging from about 1,214 to about 1,218 feet amsl beneath this reach of the Cawood Branch. The ground surface elevation of the lowest point on Cawood Branch within the proposed workings is approximately 1,360 feet amsl. At this point, the Hazard No. 4 coal seam is approximately 140 feet below ground surface. Reaches of the Cawood Branch below this point are within the mining barrier of Beech Fork where no mining will occur (Figure 3.2-4).

The subsidence analysis presented in Section 3.2.2.1 indicates that because of the thickness of the coal seam and the rock types, fractures are anticipated to extend only 20 to 50 vertical feet above the roof of the proposed workings. The groundwater analysis presented in Section 3.4.2 indicates that on the surface, the natural valley-floor stress-relief fracture system, associated with the narrow V-shaped valleys in the vicinity of the project area, extends 30 to 50 feet below ground surface. In order for potential fractures associated with the proposed workings to impact the stream segments, the fractures would have to extend at least 90 feet above the proposed workings. The depths of cover beneath the stream segments are considered sufficient to prevent disruption of stream flows.

If a perched aquifer were connected to a surface fracture system and was within the rooting zone of the vegetation, the aquifer could influence forest hydrologic conditions and forest vegetation by removing moisture from the rooting zone. Hydrologic analysis performed for this environmental analysis, described in Section 3.4.2, concluded that under the PDS, any perched aquifers situated within a 50-foot vertical zone of rock overlying the roof of the mined area could potentially be impacted by subsidence in the form of rock collapse. However, based on site reconnaissance and the Minns 1993 study, perched aquifers are not anticipated to be prevalent under the project area. In addition, due to the coal seam depth that has a minimum 140 feet of cover in mined areas, there is a minimum of 40 vertical feet of separation between the natural valley-floor stress-relief fracture zone and the subsidence fracture zone (see Section 3.2.2.1). Therefore, any such perched aquifers, situated at depths of more than 90 feet below ground surface and subsequently more than 40 feet below the lower extent of the natural fracturing

system, are not anticipated to be connected to the surface fracture systems, and are not anticipated to result in indirect impacts to forest hydrologic conditions or forest vegetation.

Perennial stream flow in reaches below the project area could be reduced if subsidence-related tension fractures were to cause diversion of surface water into the underlying bedrock. However, this is unlikely based on the local geology of low-permeability bedrock formations underlying all of the perennial streams in the vicinity of the project area, and the low potential for subsidence as described in Section 3.2 and above.

Surface water quantities can be diminished or increased following underground mining. However, perceptible or quantifiable impacts to spring flow and creek discharge rates are not anticipated. No net water volume decrease is expected in the stream/alluvial groundwater system. This conclusion is supported by the historic flow data (Table 3.5-2), which demonstrates that there has been no decrease in flow rates when comparing 2002 – 2003 (prior to Beech Fork Mine) and 2010 -2011 (during active mining).

The same fracturing that might cause water loss can also cause an increase in surface water flow, but increased flow is not likely on the project area due to the steep terrain, rapid runoff, and the low potential for subsidence as described in Section 3.2 and above. In the absence of perched aquifers, many headwater streams in such areas are dependent upon naturally occurring stress and relief fractures as well as bedding plane separations as recharge sources. Rainfall that does not leave as runoff typically will infiltrate the forest floor and then flow along these fractures until it reaches an aquifer, or until enough of it accumulates to produce a surface flow.

Therefore, under the Proposed Action, no measureable direct or indirect impacts to surface water quantity are anticipated.

3.5.2.1.2 Surface Water Quality

Surface water quality can be impacted by increased sediment loads and/or chemical changes following mining. Under the PDS, sedimentation would not be a factor because no surface disturbances are planned on the project area. All mining activity would be in the form of underground operations. Access would be through existing underground workings from an existing mine portal west of the project area.

Under the PDS, there could be some minor changes in water chemistry as a result of mining. Increased rock fracturing following mining can result in increased rainwater infiltration, and thus increased exposure of the geologic strata to water. The increased water infiltration, coupled with increased surface area in new and enlarged fractures, can sometimes result in increases in dissolved solids, and thus in specific conductivity. However, rock fracturing to the surface is not anticipated under the PDS (see Section 3.4.2), and this potential impact is not anticipated to occur.

Since mining would be underground and there would be no surface disturbance, the natural vegetation cover would not be disturbed, and the runoff control and erosion protection provided by this material would not be altered. Due to the relatively small portion of the watershed that might be affected and the fact that the natural ground cover would not be disturbed, any increases or decreases in water quantity that might occur would be minor.

Based on the findings of the AMD study (Section 3.2.1.4), no AMD water quality impacts are expected to combine with existing or future impacts. The majority of the strata above and below the Hazard No. 4 and the Hazard No. 4 Rider coal seams have large net neutralization potential values.

If the PDS is implemented, the successful bidder would develop and implement a surface water-monitoring program that meets the requirements of the OSM and USFS. The program would be designed to quantify any measurable environmental impact accompanying operations, reclamation, and post-closure condition of the project area with reference to pre-operational data obtained during the baseline monitoring. No further mitigation beyond this is anticipated to be necessary.

In summary, under the PDS, no measureable direct or indirect impacts to surface water resources are anticipated. In addition, if the PDS is implemented, federal land and mineral administration and state permitting agency officials (KDMP, KDMRE, OSM, KDOW, EPA, USACE, and KDFWR) would inspect the mine, and observe monitoring results.

3.5.2.2 No Action Alternative

No direct or indirect impacts to the surface water regime would occur on the project area if the No Action Alternative is selected and the NAS is implemented.

3.5.3 Cumulative Effects

A three-mile buffer area from the PDS boundary was defined as the cumulative effects area. This buffer was chosen to include projects within the Beech fork drainage above the confluence with Middle Fork Kentucky River. The drainage area is representative of similar projects and within an area that can be reasonably analyzed. Extending the area to other watershed s would result in unwieldy analyses and effects too dispersed over a large area.

Available information on regional surface water indicates that existing conditions are degraded. Analytical results from sampling locations on Beech Fork indicate contamination by human sewage, probably due to a lack of properly functioning septic systems. Analytical results for surface water samples collected from several of the drainages in the vicinity of the project area indicate that background levels of iron, manganese, and specific conductance may be naturally high.

In addition, existing and historical mines are potential sources of stream impairment. Figure 2.4-1 shows historical and currently known mining activity in the vicinity of the project area.

From north to south (upgradient) on Figure 2.4-1, mining activities in the Beech Fork drainage in addition to the PDS include:

- Upgradient from the project area: Infinity Energy operates an auger mining operation and underground mine. These sites mined the Hazard No. 5A, 7, 8, 9, 10 and 11
- Downgradient from the project area: Bledsoe operates the Abner Branch, Beech Fork, and Oldhouse Branch Mines. These sites mined the Hazard No. 4

Water quality in rivers and streams of the Kentucky River basin is summarized in the *2000 Report to Congress* (KDOW 2000). In that report, Beech Fork segment 0.0 to 8.0 was designated as fully supporting overall use, aquatic life, and fish consumption.

The PDS mining activities would meet the requirements of the *Clean Water Act* and when considered in isolation would not contribute to surface water impairment or loss of existing uses. An evaluation of cumulative effects must consider other existing and foreseeable potential impacts. Other private and/or federal coal leases in the area can be expected.

In general, streams in the vicinity of the project area fully support the various uses. This project and on-going and future mining projects are expected to operate in accordance with all state and federal regulations. The DBNF HWA suppression will use the insecticide imidacloprid, which has a 3-hour half-life. Implementation Requirements and Design Criteria of sampling for highly permeable soils, and surveying for presence of water (described in the *Decision Notice and Finding of No Significant Impact for the Suppression of Hemlock Woolly Adelgid on the Daniel Boone National Forest* signed in March 2011) would greatly minimize or eliminate the potential for aquatic resources to be affected by imidacloprid. Mixing and transporting procedures for the chemical are designed to avoid any possibility of Imidacloprid accidentally entering a stream. By following these criteria and label restrictions, it is unlikely that there would be a negative effect to aquatic resources from the use of imidacloprid (USFS 2011). Therefore, no residual impacts over and above the existing impairment are anticipated. Because no residual impacts are anticipated to result from implementation of the PDS or NAS, no cumulative effects are expected.

3.6 Air

3.6.1 Criteria Pollutants

The Federal Clean Air Act (CAA), as amended in 1990, defines Environmental Protection Agency's (EPA's) responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer. The Federal CAA delegates the authority to states to regulate certain activities that may affect air quality. Kentucky implements its delegated authority under the Kentucky Administrative Regulations (KAR). These laws are administered at the State level by the Kentucky Department of Environmental Protection (KDEP). Air quality regulations and permitting are administered by the Kentucky Division of Air Quality (KDAQ).

National Ambient Air Quality Standards (NAAQS) have been established as the maximum allowable air quality thresholds. NAAQS have been established for CO, lead, nitrogen dioxide (NO_2), PM_{10}, $PM_{2.5}$, ozone, and sulfur dioxide (SO_2). There are primary and secondary NAAQS. Primary NAAQS have been established to protect human health while secondary standards have been established to protect the environment (crops, vegetation, visibility, etc.). A summary of the current NAAQS is shown in Table 3.6-1. KDEP has adopted the NAAQS and uses these standards as the basis for attainment area designations within the state.

Table 3.6-1 National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Time	Primary	Secondary	Form
Ozone	8-hour	0.075	0.075	Annual 4th-highest daily max 8-hr concentration, averaged over 3 years
PM_{10}	24-hour	150 µg/m^3	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
	Annual [1]	50 µg/m^3	50 µg/m^3	Not to be exceeded
$PM_{2.5}$	24-hour	35 µg/m^3	35 µg/m^3	98th percentile, averaged over 3 years
	Annual	15 µg/m^3	15 µg/m^3	Annual mean, averaged over 3 years
CO	8-hour	9 ppm	--	Not to be exceeded more than once per year
	1-hour	35 ppm	--	Not to be exceeded more than once per year
NO_2	Annual	0.053 ppm	0.053 ppm	Annual mean
	1-hour	0.100 ppm	--	98th percentile, averaged over 3 years
SO_2	Annual [1]	0.030 ppm	--	Not to be exceeded
	24-hour [1]	0.14 ppm	--	Not to be exceeded more than once per year
	3-hour	--	0.5 ppm	Not to be exceeded more than once per year
	1-hour	0.075 ppm	--	99th percentile of 1-hour daily max concentrations, averaged over 3 years
Lead	Rolling 3-mo. avg.	0.15 µg/m^3	0.15 µg/m^3	Not to be exceeded

Notes:
Source: EPA 2012b; Kentucky DEP 2012.
1. NAAQS has been revoked, but it remains in the Kentucky Administrative Regulations (401 KAR 53:010. Ambient Air Quality Standards).

3.6.2 Greenhouse Gases

On September 22, 2009, the U.S. EPA issued a final regulation (40 CFR 98) for the Mandatory Reporting of Greenhouse Gases, which became effective on October 30, 2009. The rule applies to direct greenhouse gas (GHG) emitters and suppliers. GHG emissions relevant to combustion sources include CO_2, methane (CH_4), and nitrous oxide (N_2O). Emissions of these gases are reported as CO_2 – equivalent (CO_{2e}) emissions. The CO_{2e} conversions are based on the global warming potential (greenhouse effect) of the GHG pollutant versus CO_2 and are as follows:

Table 3.6-2 GHG Pollutant vs. CO_2

Pollutant	CO_2 Equivalent Emissions
CO_2	1
CH_4	21
N_2O	310

CO_2, CH_4, and N_2O emissions were calculated for each emission source and were converted to CO_{2e} with the following equation:

$$CO_2e = (1 \times CO_2) + (21 \times CH_4) + (310 \times N_2O)$$

In the Final Rule, EPA promulgated 40 CFR 98 Subpart C: Stationary Fuel Combustion Sources and Subpart FF: Underground Coal Mines. Beginning January 1, 2010, Subpart C monitoring and reporting requirements apply to facilities with combined stationary combustion sources of 30 Million Metric British Thermal Units per hour (MMBtu/hr) or greater. Required GHG emissions reporting began in 2011 for calendar year 2010. Subpart FF requires monitoring and reporting of GHG parameters and emissions for active underground coal mines and underground coalmines under development that have operational pre-mining degasification systems. Required GHG emissions reporting for Subpart FF would begin in 2012 for calendar year 2011.

Currently, GHG regulations require estimation and reporting of GHG emissions. Subpart FF specifies emission calculation methodology that must be used to estimate annual GHG emissions.

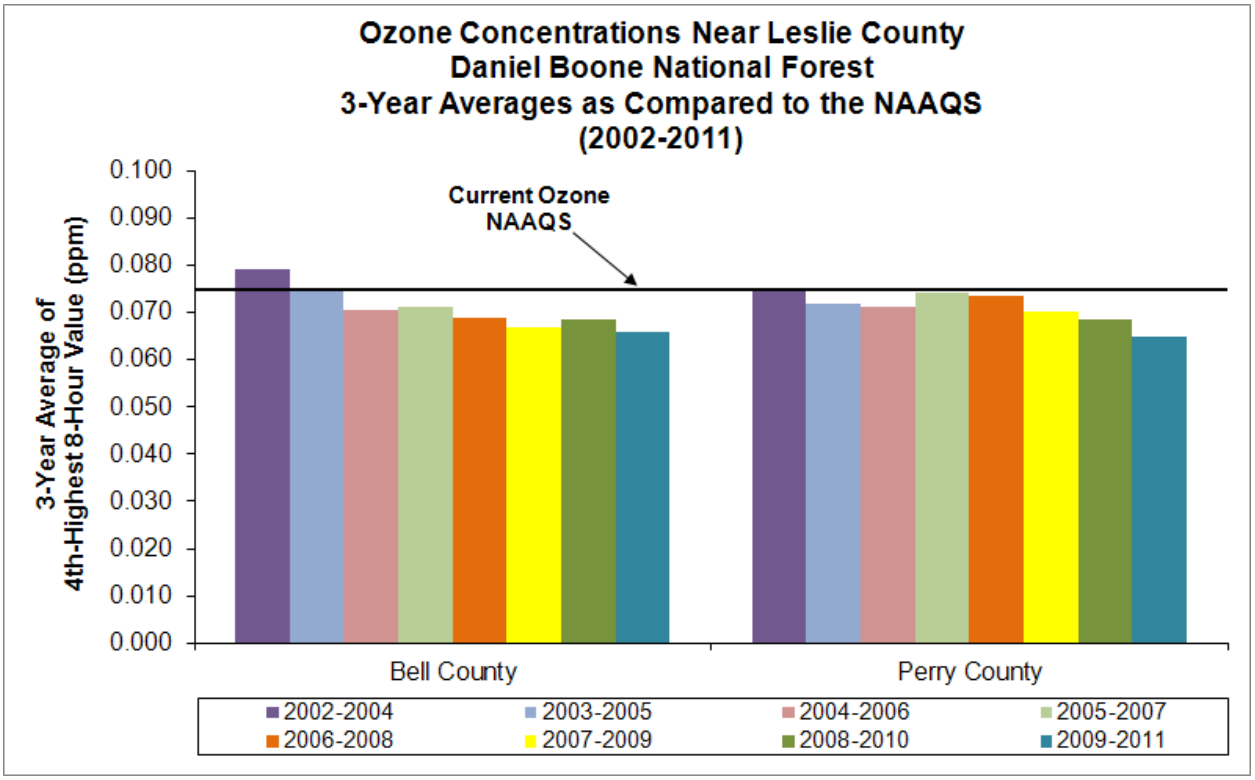
3.6.3 Environmental Baseline

Kentucky has operated an air quality-monitoring network since July 1987. The monitors are set up to measure the six criteria pollutants (ozone, SO_2, CO, NO_2, lead, particulate matter), acid rain, air toxics, or meteorology. The locations of the monitors are based on EPA regulatory requirements and are generally near populated areas or pollution sources. KDAQ reviews the station locations annually to ensure adequate coverage. The 2010 network consisted of 42 monitoring stations throughout 28 different counties. Data gathered from these monitors are used to determine compliance with the NAAQS as well as identify pollution trends. All of Kentucky's air monitors met the NAAQS for all six criteria pollutants for the first time in 2011.

There are currently no monitors in Leslie County and only two monitors in the counties surrounding Leslie County. Ozone is monitored in both Perry and Bell Counties. $PM_{2.5}$ is monitored in Bell County.

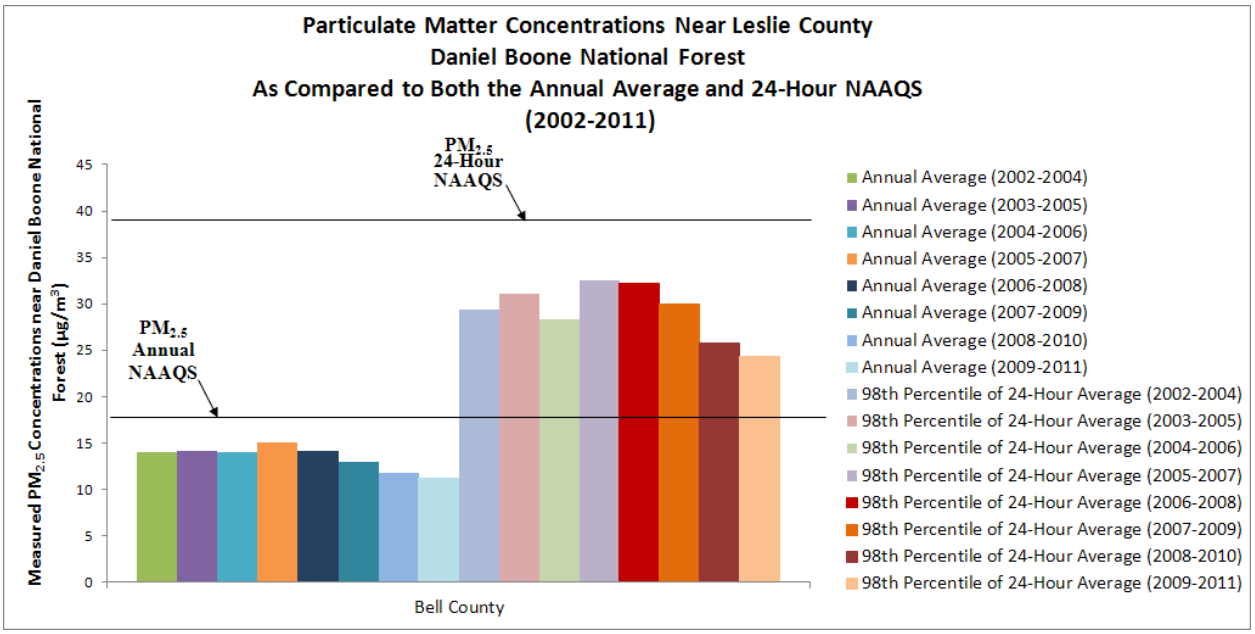
Ozone is a colorless gas that is not directly emitted from air pollution sources. Instead, ground-level ozone is formed as a result of photochemical reactions between VOC and NOx in the presence of sunlight. Therefore, certain months of the year is considered "ozone season." In Kentucky, ozone is monitored from March 1 through October 31 since meteorological conditions are most conducive to the formation of ozone.

The 8-hour ozone standard is attained when the average of the fourth-highest daily maximum 8-hour average for the three most recent years is 0.075 ppm or less. Both sites near the project area reported three-year averages below the standard (Bell county [0.066 ppm] and Perry County [0.068 ppm]). In general, ozone levels have declined in Kentucky over the past 25 years (based on 1-hour data) due to vehicle emission controls and a regional strategy for controlling NO_x emissions from large sources such as combustion engines, boilers, or turbines. The graphic below shows the measured ozone concentrations from 2002 through 2011 as compared to the current NAAQS of 0.075 ppm for the two monitors closest to the proposed project location (USFS 2012).



Particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$) is a mixture of solid particles and liquid droplets. $PM_{2.5}$ is directly emitted and is also formed in the atmosphere from chemical reactions. In 2010, there were 10 exceedances of the 24-hour standard and zero exceedances

of the annual $PM_{2.5}$ standard. No monitor exceeded the 3-year 24-hour or annual standards. In general, $PM_{2.5}$ levels have declined in Kentucky since 2000, with only a slight increase during 2005 and 2007. The graphic below shows the measured fine particulate matter concentrations from 2002 through 2011 as compared to the NAAQS at the monitor closest to the proposed project location (USFS 2012).



3.6.3.1 Greenhouse Gas Emissions

Under the PDS, the lease area would be mined using methods similar to those being used by Bledsoe on the adjacent Beech Fork Mine. Baseline emissions are approximated by emission records from Bledsoe, since the Beech Fork Mine is the main source of GHG in the project area.

The most recent full calendar year is 2011, which is established for this GHG inventory as the baseline year.

GHG emissions are commonly classified into three categories as defined by the Intergovernmental Panel on Climate Change (IPCC) *GHG Accounting Protocol)*: Direct (or Scope 1 emissions), Indirect Energy (Scope 2), and Other Indirect (Scope 3). Direct emissions occur on the premises of a facility, or are related to fleet vehicles associated with or based at the facility. They include on-site combustion emissions, vented and fugitive emissions, process-related emissions, and emissions from facility vehicles. Indirect energy emissions occur when a facility purchases or imports energy from sources located off-site (e.g., steam, heat, or electricity from the power grid). Other Indirect emissions include all other sources that an organization chooses to account for. These are sources of emissions that are not entirely within the control of the organization, such as employee commuting, air travel, subcontractor activity, and off-site treatment and disposal of process waste. Only direct and indirect sources of GHG emissions were considered for this inventory since these are the primary activities associated with Beech Fork Mine.

The potential direct GHG-emitting sources at the Beech Fork Mine consist of combustion sources (equipment) and coal mining (methane releases). Indirect GHG-emitting sources include the electricity usage to power equipment. Although coal mining is a potential GHG-emitting source, all tests conducted at the Beech Fork Mine indicate undetectable levels of methane from the seam. Therefore, methane emissions from coal mining activities have not been included in the GHG inventory. A summary of the GHG-emitting sources located at the Beech Fork Mine in 2011 is summarized in Table 3.6-3.

Table 3.6-3 GHG Emission Source Summary

Combustion Sources – Stationary/Portable		
Description	**Type**	**Capacity**
Brookville 20-ton	Diesel-Fired Equipment	143 Hp
Brookville 3-ton	Diesel-Fired Equipment	60 Hp
Low Track (2)	Diesel-Fired Equipment	60 Hp (each)
Volvo Loader	Diesel-Fired Equipment	200 Hp
Electricity Usage		
Description	**Year**	**Consumption**
Annual electricity consumption	CY 2011	12,750,000 KWh

Annual emissions of CO_2, CH_4, and N_2O were calculated for each of the applicable sources listed above. Emission calculations were performed using emission calculation methodologies presented in 40 CFR 98 Subpart C, actual electricity consumption for the highest consumption amount in the last three years, and estimated equipment usage rates. Annual CO_2e emissions were calculated for each source type and summed for the facility using the global warming potential of each GHG pollutant. Estimated GHG emissions by source and total for the facility are summarized in Table 3.6-4.

Table 3.6-4 GHG Emissions Summary

Source Description	**Estimated Emissions (metric tons/year)**			
	CO_2	**CH_4**	**N_2O**	**CO_2e**
Direct Emissions				
Combustion	271.24	0.011	0.0022	272.15
Indirect Emissions				
Electricity Usage	8,614.46	151.93	147.30	57,468.15
Direct and Indirect Total	**8,886**	**152**	**147**	**57,740**

The derivation of these emission rates including fuel consumption rates and emission factors is shown in detail in Appendix H. As shown above, the estimated direct CO_2e emissions are well below the current major source threshold of 25,000 metric tons/year.

3.6.4 Effects of Implementation

3.6.4.1 Proposed Action

The PDS is not expected to affect local or regional air quality because there would be no increase in combustion activities on an annual or short-term basis. Council on Environmental Quality Guidance

(CEQ 2010) recommends that projects with direct emissions of 25,000 metric tons or more of CO_2e emissions should be analyzed in NEPA documents. As shown above, the estimated direct CO_2e emissions are well below the current major source threshold of 25,000 metric tons/year.

Since the impact of the new lease area being mined would be offset by the completion of mining in other areas of the current mine area and methane (GHG) emissions are undetectable in the mine, overall annual emissions due to mining activities would not increase. The current emission rates would continue farther into the future. Based on this, it is not anticipated that current local and regional air quality would be impacted by the Project.

3.6.4.2 No Action Alternative

Under the No Action Alternative, the new lease area would not be mined and air quality would not change from the baseline. However, it is likely that the adjacent private land would be mined and emissions would be similar to baseline conditions. The estimated emissions are well below the below the current major source threshold of 25,000 metric tons/year. It is not anticipated that implementing the PDS would increase any indirect sources of air emissions including employee or construction vehicle traffic. Therefore, no direct or indirect air quality impacts are anticipated if the No Action Alternative is selected.

3.6.5 Cumulative Impacts

A three-mile buffer area from the PDS boundary was defined as the cumulative effects area. This buffer was chosen to include projects within the Beech Fork drainage above the confluence with Middle Fork Kentucky River. The drainage area is representative of similar projects and within an area that can be reasonably analyzed. Extending the area to other watersheds would result in unwieldy analyses and effects too dispersed over a large area.

The proposed project would extend the mine life. These emissions, when added to emissions from other existing and reasonably foreseeable activities in the area, would have a minimal cumulative impact. The proposed project would not result in cumulative impacts on an annual basis because an increase in emissions due to annual operations would not occur. However, a cumulative impact could occur due to the increase over the extended life of the mine. As stated above, the estimated direct annual emissions (272.15 metric tons/year) are well below the 25,000 metric tons/year threshold for major sources as suggested by CEQ for analysis in NEPA documents. Therefore, no measureable cumulative effects are expected.

3.7 Vegetation

3.7.1 Environmental Baseline

3.7.1.1 Local Vegetation

The forest associations on the USFS tract have been documented by the DBNF in the *Field Sampled Vegetation* (FSVeg) database (USFS 2011a). Figure 3.6-1 presents the forest associations on the USFS tract. As the figure demonstrates, vegetation consists of three mixed mesophytic forest types, one Conifer/Northern Hardwood type and one dry-mesic oak type. The mixed mesophytic forest types include yellow poplar-white oak-northern red oak, sugar maple-beech-yellow birch, and cove hardwoods-white pine-hemlock. The dry-mesic oak forest type is the white oak/northern red oak/hickory forest type. The Northern Hardwood type is the hemlock hardwood type. The distribution of each forest type on the RRD and on the USFS tract is presented below (Table 3.7-1):

Table 3.7-1 Distribution of Forest Types on the DBNF and USFS Tract

Forest Type	Area on RRD (acres) (% of RRD)	Area on USFS Tract (acres) (% of USFS Tract)
White oak-northern red oak-hickory	73,587 (51.5%)	103.4 (59.3%)
Hemlock-hardwood	329 (0.2%)	1.6 (0.9%)
Mixed Mesophytic Types		
Yellow poplar-white oak-northern red oak	49.996 (35.0%)	52.8 (30.3%)
Sugar maple-beech-yellow birch	6,536 (4.6%)	7.4 (4.2%)
Cove hardwoods-white pine-hemlock	432 (0.3%)	9.1 (5.2%)
Total Mixed Mesophytic	56,964 (39.9%)	69.3 (39.8%)
Totals	**130,880 (91.6%)**	**174.4 (100%)**

The mixed mesophytic habitat association is concentrated on colluvial slopes, with some concentration on north facing aspects. Water on these forest types is primarily from surface sources (rainfall). Occasionally, limited amounts of groundwater help maintain the forest types. On the USFS tract, the typical soil series is Shelocta, derived from sandstone, siltstone or shale. Beech, yellow-poplar, and a mixture of Eastern hemlock, sugar maple, and hardwood species can be observed. On both sandstone and limestone, American beech is particularly abundant on lower slopes and terraces near rivers and major creeks. Disturbance appears to have converted some beech forest to yellow-poplar or, especially on eroded soils, oak-hickory, and pine. Hemlocks are typically limited to riparian and shady areas (Martin 2003a).

Herbaceous cover is largely restricted to openings or on better soils with less undergrowth of ericaceous species and includes ground pine, spotted wintergreen, whorled loosestrife, butterfly pea, dwarf cinquefoil, dittany, foxglove, angelica, Maryland golden aster, sweet goldenrod, wavy leaf aster, pink lady's slipper and rattlesnake plantain (Martin 2003a).

Dry-mesic oak forests occur throughout the South in all ecological sections, most commonly in the mountains. They are usually found on dry, upland sites on southern and western aspects, and ridge tops. The species composition of this forest type varies greatly due to its wide distribution. Water on these forest types is primarily from surface sources (rainfall). On some sites, limited amounts of groundwater help maintain the forest types.

Dry-mesic oak habitat occurs from low to high elevations on dry-mesic sites, frequently on linear or convex landforms on north- and east-facing slopes or at high elevations, and sometimes on concave landforms on southerly and westerly aspects. This forest type is concentrated on slopes of moderate exposure, mostly on colluvial or Shelocta Latham soils, or on upper slopes or broader ridges with Whitley, Gilpin, or Berks soil series.

Northern hardwood forests occur exclusively in the northern tier of States in the East, except for a southern extension along the Appalachian Mountains. In the middle and southern Appalachians, this forest type is restricted to higher elevations that possess cool, mesic conditions. These conditions are most prevalent on northern- and eastern-facing slopes where direct radiation and evapotranspiration rates are reduced (USFS 1997a).

Forests of the hemlock-hardwood type are characterized by the dominance or co-dominance of eastern hemlock in nearly every vertical stratum. A number of tree associates, especially sweet and yellow birches and, northern red and chestnut oaks and eastern white pine, usually contribute to mixed overstories, but the total cover of overstory and understory hemlock in these forests usually exceeds that of any other species. In the Piedmont, where hemlock forests may intergrade with Mesic Mixed Hardwood forests, American beech and white oak are frequent associates. Understories vary from sparse to moderately dense; some stands have ericaceous shrub layers dominated by mountain-laurel or Catawba rhododendron. Herbs are typically very sparse, but rare stands on basic or calcareous substrates have more diverse lower strata. Eastern Hemlock – Hardwood Forests are closely related to Acidic Cove Forests but generally have a less diverse composition of woody species, a greater dominance of hemlock in all strata, and considerably lower species richness. Water on these sites is typically from surface water (rainfall) (Martin 2003b).

3.7.2 Effects of Implementation

Changes to physiography can impact forest resources, including vegetation. Impacts to vegetation may result in indirect impacts to wildlife, including PETS species, through habitat alteration. In assessing potential impacts to soil, vegetation and wildlife, impacts may occur if there are as follows:

- Impact to soils, such as losses of soil due to erosion or loss of soil productivity, that cause vegetation losses of the type described below
- Permanent loss of forest vegetation (terrestrial habitat) that would result in a deviation from Standards specified in the 2004 *Forest Plan*

- Permanent loss of forest vegetation (terrestrial habitat) that would result in inadequate habitat to support Management Indicator Species (MIS; See Section 3.9) as specified in Goal 1.7 of the 2004 *Forest Plan*
- Permanent loss of jurisdictional wetlands
- Permanent loss of aquatic habitat (due to reduction in flow or water quality) that would result in a reduction of aquatic macro invertebrate assemblages to a level that does not support MIS on the DBNF
- Taking of any T&E species without a permit, through habitat loss or otherwise

3.7.2.1 Proposed Action

Under the PDS, mining coal from beneath the USFS tract would not involve surface disturbance. Consequently, the PDS would not cause direct impacts to the vegetation present on the surface.

Soils on the USFS tract are upland soils described as well-drained to moderately well-drained and low- to medium-low soil water supply. Consequently, the upland mesophytic, mesic, and xeric forest vegetation on the USFS tract is adapted to obtain moisture from the vadose zone (the unsaturated zone above the water table).

With regard to potential indirect impacts to vegetation, the PDS would include a subsidence control plan**,** described in Section 2.2.1.3 that would protect the integrity of surface features and structures through subsidence protection zone identification, minimization of the occurrence of subsidence through mine panel design, and monitoring and control of the extent of planned subsidence. The subsidence control plan that would be implemented under the PDS would include a damage mitigation plan. If the Proposed Action is selected and the PDS is implemented, minimal subsidence is anticipated. The analysis of subsidence (Section 3.2.2.1) determined that subsidence strains would be below the threshold considered acceptable for pasture, woodland, range, or wildlife food and cover. It is possible that isolated, individual trees could be damaged due to shearing of roots in the subsidence troughs.

If a perched aquifer were connected to a surface fracture system, the aquifer could influence forest hydrologic conditions and forest vegetation, by reducing moisture available in the root zone. Hydrologic analysis performed for this environmental analysis, described in Section 3.4, concluded that under the PDS, any perched aquifers situated within a 50-foot vertical zone of rock overlying the roof of the mined area could potentially be impacted by subsidence in the form of rock collapse. Based on site reconnaissance and the Minns 1993 study, perched aquifers are not anticipated to be prevalent under the USFS tract. However, if any perched aquifers do exist, only those situated within the 50-foot zone overlying the mined out area would be impacted by rock collapse. Under the minimum overburden cover case of 140 feet in mined areas, any such perched aquifers, situated at depths of greater than 90 feet below the ground surface, and therefore more than 40 feet below the lower extent of the natural fracturing systems, are not anticipated to be connected to the surface fracture systems, and therefore are not anticipated to result in measureable indirect impacts to forest hydrologic conditions or forest vegetation.

No jurisdictional wetlands have been identified on the USFS tract, and none are expected, due to the steep slopes. Proposed underground mining of the USFS tract would not involve surface disturbance. Consequently, the PDS would not cause direct impacts to wetlands present on the surface. With regard to potential indirect impacts to wetlands, the PDS would include a subsidence control plan described in Section 2.2.1.3 that would protect the integrity of surface features and structures through subsidence protection zone identification, minimization of the occurrence of subsidence through mine panel design, and monitoring and control of the extent of planned subsidence. The subsidence control plan also would include a damage mitigation plan. If the Proposed Action is selected and the PDS is implemented, minimal subsidence is anticipated. As described in the subsidence evaluation (Section 3.2.2, Page 40), the predicted subsidence strains will be below the values that are considered protective of wetlands.

Therefore, no measureable direct or indirect impacts to wetlands are anticipated if the Proposed Action is selected and the PDS is implemented.

No measureable impacts to surface water quality are predicted (Section 3.4). Therefore, no indirect impacts are expected to vegetation resulting from changes in water quality.

If the Proposed Action is selected and the PDS is implemented, direct or indirect impacts to vegetation are expected to be negligible.

3.7.2.2 No Action Alternative

If the No Action Alternative is selected and the NAS is implemented, coal under the area of the USFS tract would not be mined and the vegetation that currently exists would continue in its current successional state. Therefore, no direct or indirect impacts to vegetation are anticipated if the No Action Alternative is selected.

3.7.3 Cumulative Effects

A three-mile buffer area from the PDS boundary was defined as the cumulative effects area. This buffer was chosen to include projects within the Beech Fork drainage above the confluence with Middle Fork Kentucky River. The drainage area is representative of similar projects and within an area that can be reasonably analyzed. Extending the area to other watersheds would result in unwieldy analyses and effects too dispersed over a large area.

No direct or indirect impacts to vegetation have been identified in association with nearby projects, including historical or current underground mining at the Abner Branch, Oldhouse Branch, and Beech Fork mines. There may be a short-term loss of vegetation related to the Infinity Mining auger operation, located on private lands upgradient of the project area. However, the operation is required to perform reclamation to reestablish vegetation in compliance with 405 KAR 16 (Performance Standards for Surface Mining Activities), so the impact would be temporary. The HWA treatment is expected to have a positive effect on vegetation by reducing the loss of hemlock on the stand.

Minor impacts are anticipated (potential mortality of individual trees) under the Proposed Action or the No Action Alternative. Consequently, minor cumulative effects are expected.

3.8 Wildlife

3.8.1 Environmental Baseline

The Daniel Boone National Forest is located along the Cumberland Plateau in the Appalachian foothills of eastern Kentucky. The forest encompasses over 708,000 acres of mostly rugged terrain. The land is characterized by steep forested ridges dissected by narrow ravines and over 3,400 miles of sandstone cliffs. The Redbird Ranger District comprises 145,840 acres in Clay, Leslie, Owsley, Perry, Harlan, and Bell counties. Within the Redbird Ranger District is the Redbird Wildlife Management Area. This area encompasses 25,529 acres on the Daniel Boone National Forest in Leslie and Clay Counties and is located 7 miles west of Hyden, Kentucky. The terrain is hilly too steep with gentle slopes in bottomlands and on ridge tops.

White-tailed deer, wild turkey, squirrel, raccoon, coyotes, ruffed grouse, black bear, and elk can be found in the area. The area is also home to several different bat species like the Indiana Bat, numerous small rodents, and various reptiles and amphibians like the black racer, copperhead, American toad, and green frog. Migrant and nesting warblers are abundant along with many other neotropical and resident songbirds. This area is also home to a rich diversity of aquatic life distributed throughout the various drainages in the area.

Management of terrestrial and aquatic species on the Daniel Boone National Forest is based on Management Indicator Species (MIS) as designated in the 2004 *Forest Plan*. The MIS are chosen to represent various forest communities and conditions and evaluate the effects of management activities relative to management goals stated in the 2004 *Forest Plan*. Forestwide Goal 1 states:

> *"Maintain a variety of life and recover native and desirable non-native populations that are rare and declining."*

Under Forestwide Goal 1, both Forestwide Goal 1.7 and Objective 1.7A have the goal of enhancing/ maintaining adequate habitat for MIS. Objective 1.7.A encourages that adequate habitat to support populations of the following MIS be provided:

Table 3.8-1 Daniel Boone National Forest Management Indicator Species

Species		Category	Target Habitat
Common Name	**Scientific Name**		
Acadian flycatcher	*Empidonax virescens*	Species of Special Interest; Ecological Indicator – Major Forest Community	Riparian corridor forest, >80 years old
Black-throated green warbler	*Setophaga virens*	Species of Special Interest; Ecological Indicator – Major Forest Community	Dense cove forest >80 years old
Cerulean warbler	*Setophaga cerulea*	Species of Special Interest; Representative of Habitat Association	Upland hardwood or mixed hardwood-yellow pine, >60 BA but 70-90 BA average, >41 years old
Summer tanager	*Piranga rubra*	Species of Special Interest; Ecological Indicator – Major Forest Community	Upland hardwood or mixed hardwood-yellow pine, 30-60 BA, >50 years old
Chipping sparrow	*Spizella passerine*	Species of Special Interest; Ecological Indicator – Major Forest Community	Upland hardwood or mixed hardwood-yellow pine, <30 BA with grassy layer, >50 years old
Northern cardinal	*Cardinalis cardinalis*	Species of Special Interest; Ecological Indicator— Major Forest Community	Upland hardwood or mixed hardwood-yellow pine, <30 BA with shrub layer, >50 years old
Field sparrow	*Spizella pusilla*	Species of Special Interest; Representative of Habitat Association	Grasslands, including old fields, prairie remnants, wooded grassland
Eastern towhee	*Pipilo erythrophthalmus*	Species of Special Interest; Representative of Habitat Association	Any forest type, recently cut over, 0-10 years old
Yellow-breasted chat	*Icteria virens*	Species of Special Interest; Representative of Habitat Association	Any forest type, recently cut over, 0-10 years old
Ovenbird	*Seiurus aurocapillus*	Species of Special Interest; Representative of Habitat Association	Older (not necessarily old-growth) forest, 70-90 BA average for southern yellow pine-oak communities, up to 130 BA for mesic communities
Pine warbler	*Setophaga pinus*	Species of Special Interest; Ecological Indicator -- Major Forest Community	Yellow pine communities, 70-90 BA, >41 years old
Prairie warbler	*Setophaga discolor*	Species of Special Interest; Representative of Habitat Association	Yellow pine communities, 0-10 years old, such as those recovering from southern pine beetle infestations through natural or artificial regeneration
Northern bobwhite	*Colinus virginianus*	Species of Special Interest; Ecological Indicator -- Major Forest Community; Demand Species	Woodland and wooded grassland, predominantly mature yellow pine or mixed yellow pine hardwood, 25-50 BA, with a predominantly warm season grasses and forbs herbaceous layer with scattered patches of rush. Also open grassland
White-tailed deer	*Odocoileus virginianus*	Demand Species	Various
Pitch pine	*Pinus rigida*	Species of Special Interest	Pitch pine regeneration, artificial or natural

The USFS tract contains areas designated in the 2004 *Forest Plan* under three prescription areas that pertain to wildlife habitat:

- Cliffline Community (2004 *Forest Plan* Prescription Area 1.C)
- Riparian Corridor (2004 *Forest Plan* Prescription Area 1.E)
- Habitat Diversity Emphasis (2004 *Forest Plan* Prescription Area 1.K)

The 2004 *Forest Plan* presents a series of goals and objectives designed to move each prescription area toward desired future conditions. Most of the goals and objectives relate to management/manipulation of surface vegetation in order to maintain current conditions or attain desired future conditions. No surface activities are included in the proposed action. Therefore, the majority of the aforementioned goals and objectives are not relevant to the proposed action. One exception, because it is specific to mineral production, is 1.K – Goal 3 for the Habitat Diversity Emphasis Prescription Area:

> *For projects that will increase the production, transmission, or conservation of energy, evaluate federal mineral project proposals in a timely manner while addressing safety, public health, and environmental protection considerations.*

The forest associations on the USFS tract have been documented by the DBNF in the *Field Sampled Vegetation* (FSVeg) database (USFS 2011a). The approximately 174 acres within the proposed action boundary is comprised of stands of white oak-northern red oak-hickory, yellow poplar-white oak-northern red oak, sugar maple-beech-yellow birch, and hemlock-hardwood and cove hardwood (See Table 3.7-1).

Cove hardwood forests' vegetative component is highly diverse in all vegetative strata. These forests are found on moist, fertile soils in concave landforms and ravines nestled well back into the sides of mountains and are dominated by such species as yellow-poplar (tulip tree), sugar maple, yellow birch, black cherry, American beech, and oaks (Franzreb 2005).

Mixed mesophytic forests are among the most biologically diverse ecosystems of the United States and occur on lower north- and east-facing slopes and mesic coves up to an elevation of around 5,000 feet amsl. When this forest type is located in less mountainous terrain, it may cover the entire landscape if suitable conditions exist (USFS 1997a).

There is no grassland, pine or pine-hardwood habitat, or immature (0 – 10 year age class) habitat on the USFS tract. Therefore, no habitat is anticipated for the MIS species associated with these habitats. The MIS species discussed below are associated with cove forest older than 80 years which are present on the mixed mesophytic forest associations within the tract.

The Acadian flycatcher breeds in mesic deciduous forests, frequently near streams, throughout Eastern North American (La Sorte et al. 2007). It is considered widespread and abundant on the DBNF. Its

population trend on the Northern Cumberland Plateau is stable to slightly increasing (La Sorte et al. 2007).

The black-throated green warbler occupies a variety of habitats over its range as a forest-interior species (La Sorte et al. 2007). Population trend data indicates a stable to slightly increasing population (La Sorte et al. 2007).

The Cerulean warbler breeds across a large portion of the southeastern U.S., from the mountains of Virginia, North Carolina, and Georgia to Central Arkansas, in mature and older deciduous forests with broken canopies (La Sorte et al. 2007). It is considered rare and uncommon on the DBNF. Its population trend data indicates large decreases across the region, including on the DBNF (La Sorte et al 2007).

The summer tanager represents dry, upland hardwood communities that tend to produce semi-open conditions. Eastern populations select habitat in open deciduous forest frequently near large gaps or along forest edge. In the southern U.S., these locations frequently occur in pine-oak forests (La Sorte et al. 2007). Population trend data indicates stable populations on national forests across the region, including the Daniel Boone National Forest where its population is increasing (La Sorte et al. 2007).

The ovenbird is associated with mature and secondary growth, dry to moderately moist sites with moderate understory. These mature mesic deciduous forests typically include oak-hickory and oak-pine forests (La Sorte et al. 2007). The ovenbird could be found on any of the hardwood associations on the tract.

The northern cardinal was chosen to represent woodland and wooded grassland/shrubland habitat. No such habitat is expected on the USFS tract. However, the northern cardinal is found in many different forest types and conditions on the DBNF (La Sorte et al. 2007).

White-tailed deer populations have increased in Kentucky from 81,910 (in 1980) to 900,000 (in 2011). Monitoring data for the DBNF indicates an increase from 9,629 (1997) to 13,117 (2003). This increase equates to about 50 deer per acre of forested land on the DBNF (USFS 2001). The white-tailed deer is common on all habitat types throughout the forest, and is likely present on the USFS tract.

Pitch pine is uncommon on the forest. Individual or small clumps may be found on dry, generally sandy textured, ridge tops throughout the forest. It is not found on the tract.

Several of the MIS species discussed are also listed on the DBNF Short List (Potential Species at Risk). Species listed on the Short List are species for which there is concern of extinction rangewide or those that are at risk of extirpation from the forest plan area.

Table 3.8-2 Daniel Boone National Forest Management Indicator Species Listed on the Short List (Potential Species at Risk) that are Associated with Habitat Present on the Tract

Common Name	Scientific Name
Acadian flycatcher	*Empidonax virescens*
Black-throated green warbler	*Setophaga virens*
Cerulean warbler	*Setophaga cerulea*
Summer tanager	*Piranga rubra*
Ovenbird	*Seiurus aurocapillus*

3.8.1.1 2004 Forest Plan Aquatic Macroinvertebrate Assemblages Indices

In regard to aquatic macroinvertebrate assemblages, the 2004 *Forest Plan* states:

> ***"Aquatic macroinvertebrate assemblage** – Indices based on aquatic macroinvertebrate assemblages fulfill all the criteria/definitions of MIS and are more effective than any individual or small group in reflecting the health of an aquatic system. Such indices reflect community structure and function as well as the physical and chemical parameters of an aquatic system. Because these indices are not individual or groups of species, they will not be referred to as management indicator species. However, they will be used in lieu of MIS."*

KDOW (2003) monitored aquatic macroinvertebrate assemblages on 1st and 2nd order streams throughout the state. Both wadeable and headwater reference sites were used to establish regional (e.g., ecoregions, bioregions or drainage basins) reference conditions for macroinvertebrates. A total of 106 wadeable and 92 headwater reference sites were sampled. These data were collected over a 5-year period between 1998 and 2003. A macroinvertebrate bioassessment index (MBI) was derived for each stream segment based on the total number of taxa and relative abundance of various orders. Narrative ratings were assigned using the median (Excellent), 10th percentile (Good), and trisection (Fair, Poor, and Very Poor) of the reference distribution below the 10th percentile.

One stream was sampled from within a one-mile radius of the USFS tract. This stream segment represents undisturbed conditions. Aquatic macroinvertebrate assemblages were sampled and identified to the lowest practicable taxon (usually genus/species.) MBIs for the undisturbed site was 69.2 (of a possible 100), which corresponds to a narrative rating of Fair.

3.8.1.2 Local Hydrology and Aquatic Biology

The USFS tract is located in the Middle Fork of the Kentucky River Headwaters Hydrologic Unit (hydrologic unit code 05100202010), in the Upper Kentucky River Management Area. The portion of the Middle Fork hydrologic unit located within the proclamation boundaries includes the headwaters and extends downstream, almost to the Breathitt-Leslie County line. This reach is in the Rugged Eastern Hills physiographic region subsection, which has a moderate number of small- to medium-sized intermittent and perennial streams. Typically, the relatively steep valleys of smaller streams are V-shaped, narrow, and boulder-dominated. Valleys of the larger streams also tend to be narrow but less steep, broader, and have more alluvial deposits. Drainage patterns are dendritic, and dissection is moderately high, with

about 11 km of perennial, intermittent, and ephemeral streams per square kilometer (18 miles per square mile). The Middle Fork of the Kentucky River is the largest stream traversing this subsection (CATT 2001). Several streams cross or are adjacent to the USFS tract: Beech Fork, Cawood Branch, and Fern Branch.

3.8.1.3 Fish Distribution and Abundance

There are 81 species of fish known from the Middle Fork of the Kentucky River, and an additional four species are considered probable based on occurrence near the forest boundaries (CATT 2001).

The Kentucky River has one endemic fish, the Kentucky arrow darter (*Etheostoma sagitta spilotum*). The Kentucky River also exclusively shares the frecklebelly darter (*Percina stictogaster*) with the Green River. About half the Kentucky arrow darter's entire range and one third of the frecklebelly darter's range lie within the proclamation boundaries of the DBNF. The Kentucky River also exclusively shares several fishes with the Cumberland River, and all of these have their primary ranges within the proclamation boundaries of the DBNF.

Due to the ephemeral or intermittent character and low flows of the streams associated with the location, only a few species of fish are expected in streams on the USFS tract. Species most likely present are the creek chub (*Semotilus atromaculatus*), which is common and widespread throughout eastern North America, fantail darter (*Etheostoma flabellare)*, rainbow darter (*Etheostoma caerelum)* and possibly the arrow darter (*Etheostoma sagitta spilotum*) (Tarter 2011).

3.8.1.4 Mussel Distribution and Abundance

At least 67 native mussel species are known presently or historically from rivers and streams in the DBNF (CATT 2001). The Middle Fork of the Kentucky River supports 19 species (Table 3.8-3).

Table 3.8-3 Distribution of Freshwater Mussel in Middle Fork Kentucky River within the Daniel Boone National Forest Proclamation Boundaries

Common Name	Scientific Name
Mucket	*Actinonaias ligamentina*
Threeridge	*Amblema plicata*
Spike	*Elliptio dilatata*
Snuffbox	*Epioblasma triquetra*
Wabash pigtoe	*Fusconaia flava*
Plain pocketbook	*Lampsilis cardium*
Wavy-rayed lampmussel	*Lampsilis fasciola*
Fatmucket	*Lampsilis siliquoidea*
Fluted-shell	*Lasmigona costata*
Fragile papershell	*Leptodea fragilis*
Washboard	*Megalonaias nervosa*
Round hickorynut	*Obovaria subrotunda*
Round pigtoe	*Pleurobema coccineum*
Pink heelsplitter	*Potamilus alatus*
Kidneyshell	*Ptychobranchus fasciolaris*
Pimpleback	*Quadrula pustulosa*
Salamander mussel	*Simpsonaias ambigua*
Pistolgrip	*Tritogonia verrucosa*
Little spectaclecase	*Villosa lienosa*

Freshwater mussels have not been identified in first order intermittent streams on the DBNF. Two of the streams on the USFS tract are first order streams. Species likely to be found in Beech Fork are *Corbicula sp*., fatmucket (*Lampsilis siliquoidea*), plain pocketbook (*Lampsilis cardium*), and wavy-rayed lampmussel (*Lampsilis fasciola*) (Tarter 2011).

3.8.2 Effects of Implementation

Changes to physiography and hydrology can impact biological resources, including wildlife and fisheries. Impacts to soil and vegetation may result in indirect impacts to wildlife and fisheries, including T&E species, through habitat alteration. In assessing potential impacts to wildlife and fisheries, significant impacts may occur if there are:

- Impacts to soils, such as losses of soil due to erosion or loss of soil productivity, that cause vegetation losses of the type described below
- Permanent loss of forest vegetation (terrestrial habitat) that would result in a deviation from Standards specified in the 2004 *Forest Plan*
- Permanent loss of forest vegetation (terrestrial habitat) that would result in inadequate habitat to support MIS as specified in Goal 1.7 of the *2004 Forest Plan*
- Permanent loss of aquatic habitat (due to reduction in flow or water quality) that would result in a reduction of aquatic macroinvertebrate assemblages indices to a level that results in a reduction in one class rating (as described in KDOW 2002)
- Taking of any threatened or endangered species without a permit, through habitat loss or otherwise
- Reduction in viability of any species listed on the Regional Forester's Sensitive Species list

3.8.2.1 Proposed Action

The PDS would not involve surface disturbance. Consequently, selection of the Proposed Action and implementation of the PDS would not cause direct impacts to the ecological function or habitat present on the surface. Accordingly, there would be no direct impacts to wildlife species in the form of mortality or displacement.

With regard to potential indirect impacts to habitat and related to changes to vegetation, the PDS would include a subsidence control plan, as described in Sections 2.2.1.3, that would protect the integrity of surface features and structures through subsidence protection zone identification; minimization of the occurrence of subsidence through mine panel design; and monitoring and control of the extent of planned subsidence. The subsidence control plan also would include a damage mitigation plan.

As a point of reference, the *SME Mining Engineering Handbook* (Hartman 1992) suggests the following as tolerable ranges in horizontal strain and slope:

Surface Features	Tolerable Range	
	Horizontal Strain (inches/inch)	Slope (feet/foot)
Pasture, woodland, range, or wildlife food and cover	$5.0 – 10.0 \times 10^{-3}$	$250 – 660 \times 10^{-3}$
Wetlands	5.0×10^{-3}	$30 – 80 \times 10^{-3}$
Lakes, ponds, marshes, rivers, streams	$5.0 – 10.0 \times 10^{-3}$	

The subsidence analysis (Section 3.2.1.1) determined that predicted strain and slope related to controlled subsidence would be below the values considered tolerable for land uses on the lease area. If the Proposed Action is selected and the PDS is implemented, and if subsidence effects were to damage streams and natural processes were not to restore the streams to their original condition, one of several actions identified in the subsidence mitigation plan (Section 2.2.1.3) would be implemented. Implementation of the PDS is anticipated to cause minimal subsidence, and impacts to access, ecological function, and habitat on the USFS tract are anticipated to be minor. Therefore, no measureable direct or indirect impacts to wildlife are anticipated if the Proposed Action is selected.

If a perched aquifer were connected to a surface fracture system, the aquifer could influence forest hydrologic conditions and forest vegetation by reducing the available moisture in the root zone. Hydrologic analysis performed for this environmental analysis, described in Section 3.4.2.1 concluded that under the PDS, any perched aquifers situated within a 50-foot vertical zone of rock overlying the roof of the mined area could potentially be drained by subsidence in the form of rock collapse. Based on site reconnaissance and the Minns 1993 study, perched aquifers are not anticipated to be prevalent under the USFS tract. However, if any perched aquifers do exist, only those situated within the 50-foot zone overlying the mined out area would be impacted by rock collapse. Under the minimum overburden cover case of 140 feet in mined areas, any such perched aquifers, situated at depths greater than 90 feet below ground surface and therefore more than 40 feet below the lower extent of the natural fracturing systems,

are not anticipated to be connected to the surface fracture systems, and therefore are not anticipated to result in measureable indirect impacts to forest hydrologic conditions, forest vegetation, terrestrial wildlife, or fisheries.

As discussed in Section 3.5.1.3, surface water quality in the project area is currently and historically degraded, with conductivity above the benchmark. If implementing the PDS were to increase conductivity in the streams, aquatic macroinvertebrate assemblages could be reduced. The surface water analysis (Section 3.5.2.1) determined that implementing the PDS is not expected to increase conductivity, because there would be no surface disturbance and there is little potential for a hydraulic connection between the workings and surface water. In addition, a review of the surface water quality monitoring data indicates that the existing underground mining in the lease area has not had a significant effect on conductivity. No change in conductivity that would reduce viability of Macroinvertebrate assemblages is expected.

No changes in flow (Section 3.5.2.1) are predicted for the larger drainage (Beech Fork) downgradient of the USFS tract. Potential indirect impacts, in the form of reduced productivity or loss of habitat, to riparian vegetation in Cawood Branch, or Fern Branch could result if increased sediment loads or AMD resulted from implementing the PDS. However, under the PDS no surface disturbance would occur, and AMD (Section 3.2.1.4) is not anticipated to occur; therefore, no measureable indirect impacts to water quality are predicted. Drying of intermittent streams early or altogether as a result of groundwater interception could potentially alter the life cycles of detritus feeders in these streams and therefore alter a fundamental part of the food web, which in turn could affect fish downstream in perennial streams. However, due to the fact that the natural ground cover would not be disturbed, and the fact that no increases or decreases in water quantity are anticipated to occur, no measureable indirect impacts are expected to wildlife or fisheries resulting from changes in water quality or changes in flow rates.

3.8.2.2 No Action Alternative

If the No Action Alternative is selected, the coal under the area of the USFS tract would not be mined and the conditions affecting wildlife and fisheries that currently exist would remain unchanged. Therefore, no direct or indirect impacts to wildlife and fisheries are anticipated if the No Action Alternative is selected and the NAS is implemented.

3.8.3 Cumulative Effects

A three-mile buffer area from the PDS boundary was defined as the cumulative effects area. This buffer was chosen to include projects within the Beech fork drainage above the confluence with Middle Fork Kentucky River. The drainage area is representative of similar projects and within an area that can be reasonably analyzed. Extending the area to other watershed s would result in unwieldy analyses and effects too dispersed over a large area.

No measureable direct or indirect impacts to wildlife or fisheries have been identified in association with nearby projects, including Hemlock Woolly Adelgid treatments and historical or current underground mining operations. The DBNF HWA suppression will use the insecticide, imidacloprid, which has a 3 hour half-life. Implementation Requirements and Design Criteria of sampling for highly permeable soils, and surveying for presence of water (described in the *Decision Notice and Finding of No Significant Impact for the Suppression of Hemlock Woolly Adelgid on the Daniel Boone National Forest* signed in March 2011) would greatly minimize or eliminate the potential for aquatic resources to be affected by imidacloprid. Mixing and transporting procedures for the chemical are designed to avoid any possibility of imidacloprid accidentally entering a stream. By following these criteria and label restrictions, it is unlikely that there would be a negative effect to aquatic resources from the use of Imidacloprid (USFS 2011b). No residual impacts are anticipated under the Proposed Action or the No Action Alternative. Consequently, no cumulative effects are expected.

3.9 Proposed, Endangered, Threatened and Sensitive Species (PETS)

3.9.1 Environmental Baseline

As part of this environmental analysis, potential impacts to Proposed, Endangered, Threatened, and Sensitive (PETS) species were evaluated. No flora or fauna species listed by the U.S. Department of the Interior Fish and Wildlife Service (USFWS) as Endangered, Threatened, or Candidate species have been identified near the project area.

Twenty-four (24) federally listed Endangered and Threatened species have been identified by the USFWS as potentially occurring on the DBNF. Seventy-one (71) USFS Sensitive species have been identified by the Regional Forester for monitoring on the DBNF. Four (4) designated critical habitats for federally endangered species have been identified on the DBNF by the USFWS and thirteen (13) proposed critical habitats.

Table 3.9-1 Proposed, Endangered or Threatened Species for the Daniel Boone National Forest

Group	Species	Common Name	Status
Mammal	*Myotis grisescens*	Gray Bat	E
	Myotis sodalis	Indiana Bat	E
	Plecotus townsendii virginianus	Virginia Big-eared Bat	E
Fish	*Etheostoma percnurum*	Duskytail Darter	E
	Notropis albizonatus	Palezone Shiner	E
	Phoxinus cumberlandensis	Blackside Dace	T
	Etheostoma susanae	Cumberland darter	E
Mussel	*Alasmidonta atropurpurea*	Cumberland Elktoe	E
	Cyprogenia stegaria	Fanshell	E
	Epioblasma brevidens	Cumberlandian Combshell	E
	Epioblasma capsaeformis	Oyster Mussel	E
	Epioblasma florentina walkeri	Tan Riffleshell	E
	Epioblasma torulosa rangiana	Northern Riffleshell	E
	Epioblasma triquetra	Snuffbox	E
	Lampsilis abrupta	Pink Mucket	E
	Pegias fibula	Little-wing Pearlymussel	E
	Villosa trablis	Cumberland Bean Pearlymussel	E
Plant	*Arenaria cumberlandensis*	Cumberland Sandwort	E
	Conradina verticillata	Cumberland Rosemary	T
	Schwalbea americana	American Chaffseed	E
	Solidago albopilosa	White-haired Goldenrod	T
	Spiraea virginiana	Virginia Spiraea	T
	Trifolium stoloniferum	Running Buffalo Clover	E

Status “E” means the species is listed as ‘Endangered’ by USFWS.
Status “T” means the species is listed as ‘Threatened’ by USFWS.

Table 3.9-2 Regional Forester's Sensitive List for the Daniel Boone National Forest (Amended 7/9/2007)

Group	Species	Common Name
Mammal	*Corynorhinus rafinesquii*	Rafinesque's big-eared bat
	Myotis austroriparius	Southeastern myotis
	Myotis leibii	Eastern small-footed bat
	Sorex dispar blitchi	Long-tailed shrew
Bird	*Aimophila aestivalis*	Bachman's sparrow
	Falco peregrinus	Peregrine Falcon
	Thryomanes bewickii altus	Appalachian Bewick's wren
	Haliaeetus leucocephalus	Bald eagle
Fish	*Ammocrypta clara*	Western sand darter
	Ammocrypta pellucida	Eastern sand darter
	Etheostoma cinereum	Ashy darter
	Etheostoma maculatum	Spotted darter
	Etheostoma tippecanoe	Tippecanoe darter
	Ichthyomyzon greeleyi	Mountain brook lamprey
	Noturus stigmosus	Northern madtom
	Percina burtoni	Blotchside logperch
	Percina macrocephala	Longhead darter
	Percina squamata	Olive darter
	Typhlichthys subterraneus	Southern cavefish
Mussel	*Anodontoides denigratus*	Cumberland papershell
	Cumberlandia monodonta	Spectaclecase
	Fusconaia subrotunda subrotunda	Long-solid
	Pleurobema oviforme	Tennessee clubshell
	Pleurobema rubrum	Pyramid pigtoe
	Ptychobranchus subtentum	Fluted Kidneyshell
	Quadrula cylindrica cylindrica	Rabbitsfoot
	Simpsonaias ambigua	Salamander mussel
	Toxolasma lividus	Purple lilliput
	Plethobasus cyphyus	Sheepnose
Gastropod	*Paravitrea placentula*	Glossy supercoil
	Pleurocera curta	Shortspire hornsnail
	Rhodacme elatior	Domed ancylid
	Vertigo bollesiana	Delicate vertigo
	Vertigo clappi	Cupped vertigo
Crustacean	*Cambarus bouchardi*	Big South Fork crayfish
Insect	*Cheumatopsyche helma*	Helma's net-spinning caddisfly
	Manophylax butleri	Cliffline caddisfly
	Ophiogomphus howei	Pygmy snaketail
	Pyrgus wyandot	Appalachian grizzled skipper
	Speyeria diana	Diana fritillary
	Speyeria idalia	Regal fritillary

Group	Species	Common Name
Vascular Plant	*Aster saxicastellii*	Rockcastle aster
	Aureolaria patula	Spreading yellow false foxglove
	Berberis canadensis	American barberry
	Carex juniperorum	Juniper sedge
	Cleistes bifaria	Small spreading pogonia
	Collinsonia verticillata	Stoneroot
	Cypripedium kentuckiense	Kentucky Lady's slipper
	Dodecatheon frenchii	French's shooting star
	Helianthus eggertii	Eggert's sunflower
	Hexastylis contracta	Mountain heartleaf
	Juglans cinerea	Butternut
	Lesquerella globosa	Short's (Globe) bladderpod
	Marshallia grandiflora	Large-flowered Barbara's buttons
	Monotropsis odorata	Sweet pinesap
	Paxistima canbyi	Canby's mountain-lover
	Platanthera integrilabia	White fringeless orchid
	Schisandra glabra	Bay starvine
	Scutellaria saxatilis	Rock skullcap
	Shortia galacifolia var. galacifolia	Southern Oconee bells
	Silene ovata	Blue Ridge catchfly
	Silene regia	Royal catchfly
	Thalictrum mirabile	Little Mountain meadowrue
	Thaspium pinnatifidum	Cutleaved meadow parsnip
	Vitis rupestris	Sand grape
Nonvascular Plant	*Hygrohypnum closteri*	Closter's brook-hypnum
	Plagiochila austinii	A liverwort
	Plagiochila sullivantii var sullivantii	Sullivant's leafy liverwort
	Radula sullivantii	A liverwort

The above-mentioned PETS species come from two official lists:

- The United States Fish and Wildlife Service officially approved PET species list letter for the Daniel Boone National Forest, dated January 17, 2012
- Those species listed for the Daniel Boone National Forest as Sensitive, on the Regional Forester (R8) approved list, dated August 21, 2001, and revised July 9, 2007

The snuffbox (*Epioblasma triquetra*) was listed as Endangered by USFWS on March 15, 2012. It was previously listed as Proposed on the DBNF January 17, 2012, list and on the Regional Forester's list as sensitive. The Cumberland darter (*Etheostoma susanae)* is now listed as endangered, but is still on the Regional Forester's list.

Twenty-two (22) federally listed Endangered and Threatened species, sixty-four (64) USFS Sensitive species, four critical habitats, and thirteen proposed critical habitats for federally endangered species have been eliminated from further consideration based on current known distribution and habitat preference. These eighty-six (86) species either have ranges that are well outside the proposed project's action area or do not have suitable habitat within the project footprint and analysis area.

The proposed project is located outside the four (4) stream segments USFWS has designated as critical habitat for Cumberland elktoe, Cumberlandian combshell, and oyster mussel. Consequently, the proposed action would have “no effect” on the critical habitats listed above. These critical habitats will not be considered further in this EA. Should new information arise concerning these critical habitats they will again receive further evaluation.

On October 12, 2011, the U.S. Fish and Wildlife Service published a proposed rule for critical habitat for the Cumberland darter. The Cumberland darter is endemic to the Cumberland River. The proposed project is located outside the thirteen (13) stream segments proposed as critical habitat for the Cumberland darter.

A *Biological Assessment and Evaluation* (BAE) has been prepared by Golder Associates (Golder 2012), and approved by the Redbird Ranger District of the DBNF, for evaluation of potential impacts to Proposed, Endangered, Threatened and Sensitive (PETS) species as a result of selecting the Proposed Action and implementing the PDS, and for compliance with the requirements of Section 7 of the Endangered Species Act (ESA and submitted to the USFWS Frankfort office. The USFWS evaluates Proposed, Endangered and Threatened species. The evaluation of Forest sensitive species was provided to USFWS as a courtesy. Concurrence on the BAE was received from the USFWS in a letter dated August 16, 2012. The BAE includes a description of the habitat for each PETS species, as summarized below.

The federally listed PETS species that have been selected for detailed analysis include the following:

Table 3.9-3 Species Analyzed

Status	Taxa	Common Name
Sensitive	Vascular Plant	Butternut
Sensitive	Insect	Diana fritillary
Sensitive	Fish	Eastern sand darter
Sensitive	Mammal	Eastern small-footed bat
Endangered	Mammal	Indiana bat
Sensitive	Mammal	Rafinesque's big-eared bat
Endangered	Mussel	Snuffbox

3.9.2 Effects of Implementation

Changes to physiography and hydrology can impact other resources, including PETS species. Impacts to soils and vegetation could result in indirect impacts to wildlife, including PETS species, through habitat alteration. In assessing potential impacts to soil, vegetation, wildlife, and PETS species, significant impacts may occur if there are as follows:

- Impacts to soils, such as losses of soil due to erosion or loss of soil productivity, that cause vegetation losses of the type described below
- Permanent loss of vegetation designated as "critical habitat" under the ESA
- Permanent loss of forest vegetation (terrestrial habitat) that would result in a determination of "likely to adversely affect" for a Threatened, Endangered or Proposed Species under the ESA or a determination of "likely to result in a trend to federal listing or a loss of viability" for any species listed on the Regional Forester's Sensitive Species list
- Permanent loss of aquatic habitat (due to reduction in flow or water quality) that would result in a determination of "likely to adversely affect" for a Threatened, Endangered or Proposed Species under the ESA or a determination of "likely to result in a trend to federal listing or a loss of viability" for any species listed on the Regional Forester's Sensitive Species list
- Taking of any PETS species without a permit, through habitat loss or otherwise
- Reduction in viability of any species listed on the Regional Forester's Sensitive Species list

3.9.2.1 Proposed Action

Two federally Threatened, Endangered or Candidate species have suitable habitat in the project area: the Indiana bat and the snuffbox. Although there are no documented occurrences of either species on the project area, there is potential habitat for the Indiana bat on the project area. There is potential habitat for the snuffbox downgradient of the project in Beech Fork.

3.9.2.1.1 Indiana bat

The entire project area is potential summer habitat for the Indiana bat. It is well established that two main threats to the continued existence of the Indiana bat are from disturbance of caves that provide hibernacula for winter habitat (e.g., Tuttle and Kennedy 2002; USFWS 1983) and white-nose syndrome. The PDS would involve underground mining and would not involve surface disturbance. Consequently, selection of the Proposed Action and implementation of the PDS would not cause direct impacts to the ecological function or habitat present on the surface.

With regard to potential indirect impacts to habitat, specifically loss of roosting habitat, if subsidence were to cause the loss of vegetation used for roosting habitat, the PDS would include a subsidence control plan, described in Section 2.2.1.3, which would protect the integrity of surface features and structures through subsidence protection zone identification, minimization of the occurrence of subsidence through mine panel design, and monitoring and control of the extent of planned subsidence. The subsidence control plan also includes a damage mitigation plan.

The PDS would involve minimal subsidence, and negligible impacts to ecological function and habitat are anticipated. There is a small possibility that individual trees could be lost due to shearing of roots in subsidence troughs. The analysis of subsidence in Section 3.2.2.1 determined that subsidence strains would be below the threshold considered acceptable for pasture, woodland, range, or wildlife food and

cover. Therefore, although there is a small possibility of loss of individual roost trees, no loss of roosting habitat is expected.

If a perched aquifer were connected to a surface fracture system, the aquifer could influence forest hydrologic conditions and forest vegetation, potentially causing the loss of summer habitat or roost trees. Hydrologic analysis performed for this environmental analysis, described in Section 3.7, concluded that under the PDS, any perched aquifers situated within a 50-foot vertical zone of rock overlying the roof of the mined area could potentially be impacted by subsidence in the form of rock collapse. Based on site reconnaissance and the Minns 1993 study, perched aquifers are not anticipated to be prevalent under the project area. However, if any perched aquifers do exist, only those situated within the 50-foot zone overlying the mined out area would be impacted by rock collapse. Under the minimum overburden cover case of 140 feet in mined areas, any such perched aquifers, situated at depths of greater than 90 feet below ground surface and therefore more than 40 feet below the lower extent of the natural fracturing systems, are not anticipated to be connected to the surface fracture systems, and therefore are not anticipated to result in measureable indirect impacts to forest hydrologic conditions or forest vegetation. The BAE (Golder 2012) determined that implementing the PDS is “not likely to adversely affect” the Indiana bat. The USFWS concurred with this conclusion.

3.9.2.1.2 Snuffbox

There will be no surface disturbance associated with the proposed project, and there is no habitat for or records of occurrence of the snuffbox on the project area. The analysis of subsidence (Appendix A) determined that subsidence strains would be below the threshold considered acceptable for pasture, woodland, range, or wildlife food and cover. Therefore, no direct effects are expected from implementing the PDS.

If there are changes in stream flow or groundwater regimes, indirect impacts could result, due to loss of habitat or mortality of individuals located downstream of the project in Beech Fork. The room-and-pillar extraction method with retreat mining that would be implemented under the proposed leasing development scenario would result in predictable and controlled subsidence. A Subsidence Control Plan meeting the requirements of Kentucky Regulation 405 KAR 8:040E, Section 26 would be implemented to minimize the potential for loss of forest habitat due to localized slumping or changes in hydrology In addition, the proposed development scenario includes Protection Zones and No Mining Zones designed to protect streams and groundwater resources. Although habitat exists downgradient, there are no documented records in Beech Fork. The hydrologic analysis (Section 3.7) determined that there is no potential for the PDS to effect surface water. The BAE (Golder 2012) determined that implementing the PDS “not likely to adversely affect” the snuffbox. The USFWS concurred with this conclusion. Therefore, no impacts are expected under the proposed development scenario.

3.9.2.1.3 USFS Sensitive Species

Although there are no documented occurrences of USFS Sensitive Species in the project area, many of the species recorded on the Redbird Ranger District inhabit upland forest habitat. Therefore, effects to upland species are being evaluated. For the reasons stated above in the description of federal species, there would be no direct loss of habitat. If the Proposed Action is selected and the PDS is implemented, and if subsidence effects were to damage terrestrial habitat or streams and natural processes were not to restore terrestrial habitat or the streams to their original condition, one of several actions identified in the subsidence mitigation plan (Section 2.2.1.3) would be implemented. The PDS would involve minimal subsidence, and negligible impacts (a small possibility of the loss of individual trees) to ecological function and habitat are anticipated. The analysis of subsidence in Section 3.2.2.1 determined that subsidence strains would be below the threshold considered acceptable for pasture, woodland, range, or wildlife food and cover. Therefore, no direct impacts are expected, and indirect impacts, if any, will be negligible.

No USFS Sensitive Species have been identified in Cawood Branch that bisects the aboveground area. For the species associated with streams, riparian corridors, or lower mesic slopes and could occur in the project area, there would be no direct impact, because there would be no surface disturbance, associated with the PDS. If there were changes in stream flow or groundwater regimes, indirect impacts, in the form of loss of habitat, or mortality of trees, to these species could result. The water resource analysis (Section 3.7) indicates that under the PDS, no increases or decreases in water quantity or quality are anticipated to occur. In addition, as described in Sections 2.4, 3.2, and 3.7, the PDS would include subsidence protection zones and no mining zones designed to protect streams and groundwater resources. Therefore, under the PDS associated with the Proposed Action, no measureable indirect impacts are predicted.

3.9.2.2 No Action Alternative

If the No Action Alternative is selected and the NAS is implemented, the coal under the USFS surface would not be mined and the status of PETS Species that currently exist would remain unchanged. Therefore, no direct or indirect impacts to PETS species are anticipated if the No Action Alternative is selected.

3.9.3 Cumulative Effects

A three-mile buffer area from the PDS boundary was defined as the cumulative effects area. This buffer was chosen to include projects within the Beech Fork drainage above the confluence with Middle Fork Kentucky River. The drainage area is representative of similar projects and within an area that can be reasonably analyzed. Extending the area to other watersheds would result in unwieldy analyses and effects too dispersed over a large area.

No direct or indirect impacts have been identified in association with nearby projects, including historical or current underground mining at the Abner Branch, Oldhouse Branch, and Beech Fork mines. There

may be a short-term loss of vegetation related to the Infinity Mining auger operation, located upgradient of the project area. However, the operation is required to perform reclamation to reestablish vegetation in compliance with 405 KAR 16 (Performance Standards for Surface Mining Activities), so the impact would be temporary

The DBNF HWA suppression uses the insecticide imidacloprid, which has a 3 hour half-life. Implementation Requirements and Design Criteria of sampling for highly permeable soils, and surveying for presence of water (described in the *Decision Notice and Finding of No Significant Impact for the Suppression of Hemlock Woolly Adelgid on the Daniel Boone National Forest* signed in March 2011) would greatly minimize or eliminate the potential for aquatic resources to be affected by imidacloprid. Mixing and transporting procedures for the chemical are designed to avoid any possibility of imidacloprid accidentally entering a stream. By following these criteria and label restrictions, it is unlikely that there would be a negative effect to aquatic resources from the use of Imidacloprid (USFS 2011b)

As there are only negligible impacts to PETS species associated with the proposed action, negligible cumulative effects are expected.

3.10 Wetlands and Riparian Areas

3.10.1 Environmental Baseline

Wetlands are defined by the U.S. Department of the Army Corps of Engineers (USACE) in 33 CFR 328.3 as:

> *"…areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions…"*

Wetlands can provide essential habitats for wildlife, provide flood protection through absorption of storm water, improve water quality by retention of sediments and/or pollutants, and add scenic diversity and aesthetic value to the landscape. Federal and state legislation exist to preserve wetland values and functions. The USACE has jurisdiction over the filling of wetlands through the Federal Water Pollution Control Act of 1972 (P.L. 92-500) (*Clean Water Act)*, while the EPA is responsible for reviewing all USACE fill permit decisions.

No wetlands are known to exist on the USFS tract. National Wetland Inventory maps, topographic maps, and aerial photographs were reviewed to identify potential wetland sites. No potential wetlands were identified. Wetlands are not expected due to the steep slopes.

3.10.2 Effects of Implementation

3.10.2.1 Proposed Action

According to National Wetland Inventory information, no jurisdictional wetlands have been identified on the USFS tract, and none are expected, due to the steep slopes. Within the USFS tract, there are contiguous riparian vegetation communities or phreatophytic vegetation along Cawood Branch (Figure 3.10-1). Proposed underground mining of the USFS tract would not involve surface disturbance. Consequently, the PDS would not cause direct impacts to wetlands present on the surface.

With regard to potential indirect impacts to wetlands, the PDS would include a subsidence control plan described in Section 2.2.1.3 that would protect the integrity of surface features and structures through subsidence protection zone identification, minimization of the occurrence of subsidence through mine panel design, and monitoring and control of the extent of planned subsidence. The subsidence control plan also would include a damage mitigation plan. If the Proposed Action is selected and the PDS is implemented, minimal subsidence is anticipated. However, if subsidence effects were to damage terrestrial habitat or streams, and natural processes were not to restore the streams to their original condition, one of several actions identified in the subsidence mitigation plan (Section 2.2.1.3) would be implemented. No measureable impacts to ecological function and habitat are anticipated. Therefore, no measureable direct or indirect impacts to wetlands are anticipated if the Proposed Action is selected and the PDS is implemented.

If subsidence were to occur, the most likely causes of water quality impacts would be, reduced productivity or loss of habitat, from increased sediment loads. However, no measureable impacts to surface water quality are predicted (Section 3.4). The subsidence analysis in Section 3.2.2, determined that predicted subsidence will be less than the values that may affect wetlands. In addition, the hydrologic analysis (Section 3.4.2) determined that there is little potential for fracturing above the workings to impact the surface stress relief aquifer. Therefore, no measureable indirect impacts are expected to wetlands or riparian areas resulting from changes in water quality.

If the Proposed Action is selected and the PDS is implemented, direct or indirect impacts to wetlands or riparian corridors are expected to be negligible.

3.10.2.2 No Action Alternative

If the No Action Alternative is selected and the NAS is implemented, coal under the area of the USFS tract would not be mined and the riparian corridors that currently exist would remain unchanged. Therefore, no direct or indirect impacts to wetlands or riparian areas are anticipated if the No Action Alternative is selected.

3.10.3 Cumulative Effects

A three-mile buffer area from the PDS boundary was defined as the cumulative effects area. This buffer was chosen to include projects within the Beech Fork drainage above the confluence with the Middle Fork Kentucky River. The drainage area is representative of similar projects and within an area that can be reasonably analyzed. Extending the area to other watersheds would result in unwieldy analyses and effects too dispersed over a large area.

No direct or indirect impacts to wetlands or riparian areas have been identified in association with nearby projects, including historical or current underground mining at the Abner Branch, Oldhouse Branch, and Beech Fork mines. No residual measureable impacts are anticipated under the Proposed Action or the No Action Alternative. Consequently, no cumulative effects are expected.

3.11 Socio-economics

3.11.1 Environmental Baseline

Socio-economic resources are resources that provide social or economic value and are currently available to the local and regional community. Examples of socio-economic resources include local jobs, county tax revenue, and community services. The USFS tract associated with the Proposed Action is located in southern Leslie County and lie within the DBNF Redbird Ranger District. Socio-economic centers in the vicinity of the USFS tract include the small communities of Bledsoe and Helton, and the larger county seat of Hyden.

Existing socio-economic resources in the vicinity of the USFS tract historically have been based mainly on the coal mining industry, which has been in a steady decline due to recent industry trends. Oil and gas field development has played a minor role in Leslie County's economy as a whole. With one major sawmill in the county and new markets opening in the area, the timber industry made a major impact on the local economy. Agriculture was not a primary source of income, and involved primarily subsistence farming of vegetable gardens. Tourism has had a limited impact on the economy, with several festivals in the central and northern parts of the county attracting visitors throughout the year (Leslie County Extension Office 2002).

According to the 2010 Census, which presented estimated data on 12 different sectors of industry, two sectors dominated in Leslie County: education, health, and social services (29.9%); and agriculture, forestry, fishing, hunting, and mining (26.7%). Retail trade was the next largest sector, making up 7.0% of industry in Leslie County. Each of the other sectors made up between 0.9 and 6.1% of industry in Leslie County. On a state-wide level, the education, health, and social services sector comprises 23.2% of industry and represents the largest industrial sector in Kentucky overall, as it did in Leslie County. However, manufacturing (14.1%) and retail trade (11.8%) comprised relatively large portions of industry state-wide, and each of 10 other sectors made up between 1.9% and 8.0% of industry in Kentucky. The agriculture, forestry, fishing, hunting, and mining sector comprises only 3.0% of industry in Kentucky (U.S.

Census Bureau 2010). An economy based on several larger industrial sectors tends to be a more stable economy in the short-term and the long-term, as diversity in economic cycles leads to growth, maturation, and protection during down turns for different sectors at different times. In Leslie County, where mining is one of two dominant sectors with few other significant sectors, sustaining the sector is critical to the local economy.

Consequently, coal is one of the most significant socio-economic resources in the area. Coal mining provides local jobs; private landowner royalty income; county, state, and federal tax, fee, and royalty revenue; and business revenue. In addition, coal mined in Kentucky has several valuable end uses: electricity generation, heat, and coking coal for iron and steel production. In evaluating the value of coal in an area, two terms are commonly used: coal resource and coal reserve.

Coal resource estimates refer to geologic or regional occurrence of coal. The primary factors for these determinations are correlation (accurate identification of coal beds), coal bed extent, and thickness. Coal seams less than 14 inches thick are excluded from the resource estimation (USFS 2004a).

Coal reserve estimates refer only to the portion of the coal that is technically and economically recoverable under prevailing market conditions. Technical considerations include character of the roof rock, mining methods, seam thickness, and variation in that thickness, coal inclination, interruption of the coal seam by channels or cut-offs, and coal quality (USFS 2004a). Often, detailed information needed to compile reserve estimates is not available, particularly on National Forest land.

Numerous coal mines operating in Leslie County provide jobs, tax revenue to the county, and royalties to property owners. Operations at the existing Shamrock Beech Fork underground complex include; the Beech Fork, Abner Branch and Oldhouse Branch room-and-pillar mines; and processing at the Beech Fork preparation plant west of US 421.

Additional socio-economic resources present in the vicinity of the USFS tract include the goods and services such as gasoline and food sold by several small businesses in the nearby communities of Helton and Mozelle. Employees at the existing mines in the area purchase materials from these businesses, thereby supporting the economic viability of the communities.

Population statistics are commonly used to describe the socio-economic conditions of a geographic region. About 11,233 people live in Leslie County (U.S. Census Bureau 2012). Environmental justice communities such as minority populations comprised 1.2% of the total population in Leslie County in 2011. American Indian and Native Alaskans comprised 0.2% of the population in Leslie County in 2010, compared to 0.3% in Kentucky. No Bureau of Indian Affairs land is located in the vicinity of the USFS tract, based on available mapping from the *National Atlas of the United States* (USGS 2003). No federally recognized tribes or tribal lands are located within the DBNF or in Kentucky, though historical tribal lands of the Cherokee, Shawnee, and Chickasaw tribes are located in Kentucky (USFS 2004a).

Asian or Pacific Islanders comprised 0.1% of the population in Leslie County compared to 1.2% in Kentucky in 2011. Black or African Americans, not of Hispanic origin, comprised 0.2% of the population in Leslie County in 2011, compared to 8% in Kentucky. People of Hispanic or Latino origin comprised 0.4% of the population in Leslie County in 2011, compared to 3.2% in Kentucky (U.S. Census Bureau 2012).

Median household income was $26,857 for Leslie County in 2010, compared to $40,576 for Kentucky. Per capita income was $14,753 for Leslie County in 2010, compared to $22,515 for Kentucky (Kentucky Cabinet for Workforce Development 2012 and US Census Bureau 2012). For consideration of environmental justice issues, such as communities with low-income populations, the percentage of persons living below poverty level was 24.6% in Leslie County in 2010, compared to 17.7% in Kentucky. On a broad regional scale, Leslie County is one of 21 counties in Kentucky that, in part or whole, comprise the USFS DBNF. To facilitate continual evaluation of programs in the DBNF zone of influence, the USFS has divided the 21 counties into four units of analysis, based on population. Leslie County is included in a 14-county unit of analysis known as the General Forest area, which is described as being isolated by rugged terrain and a poor transportation system (USFS 1997b). USFS economists have determined that the regional transportation system is a major influence on the social and economic characteristics of the 21 counties within the DBNF, including Leslie County. Unemployment in the 21 counties has been above national and state levels since 1970. Several interrelated characteristics contribute to regional unemployment:

- Limited job opportunities exist in the area
- Most consumable items are imported to the area
- Products created in the area and exported are sensitive to economic cycles
- People who commute to jobs outside the area typically enter labor markets where employment variability is greatest, and therefore sensitive to economic cycles

These characteristics result in exceptional cycle-sensitivity in employment and incomes for residents of eastern Kentucky (USFS 1997b).

On a smaller regional scale, Leslie County is part of an eight-county region, including Wolfe, Lee, Owsley, Breathitt, Perry, Leslie, Knott, and Letcher Counties known as the Kentucky River Area Development District (KRADD). The KRADD was formed in 1968 by the union of the Upper Kentucky River Development Council and the Middle Kentucky River Development Area Council. These two councils were developed in response to the *Appalachian Regional Development Act of 1965*, which provided financial incentives for states to form local development districts. The councils were developed to provide planning and technical assistance to counties, municipalities, and community citizens' groups in formulating and implementing comprehensive development programs, and to facilitate access to federal financial resources for proposed projects of government and community organizations. Socio-economic

conditions in these eight (8) counties, situated in Kentucky's eastern coal field, are more similar to one another than to the rest of Kentucky (Collins et al. 2003).

Of all the eight (8) KRADD counties, Leslie County is perhaps the most reliant on mining as a significant economic resource. Services, government, wholesale and retail trades also are significant. Transportation is of lesser importance, and few workers are employed in finance and contract construction (Collins et al. 2003). In order to better illustrate a wide range of economic differences among communities within the KRADD, selected data were combined to calculate a score that would rank KRADD census tracts into five groups to estimate their condition relative to each other (Collins et al. 2003). Average weekly wages in industries covered by unemployment insurance in Leslie County in 2010 were $715 for all industries, compared to $1,336 for mining (Kentucky Cabinet for Workforce Development 2012). Estimates based on the one-in-six sample of housing units that received the Census 2010 long form indicate that unemployed persons 16 years and older in Leslie County in 2010 composed about 4.5% of the population, compared to about 4.9% in Kentucky (U.S. Census Bureau 2010). The unemployment rate in Leslie County in 2011 was 12.5% (Kentucky Cabinet for Workforce Development 2012).

The location of the USFS tract, and of the coal underlying those properties, is fixed. Therefore, the Proposed Action and PDS cannot be relocated. The USFS tract associated with the Proposed Action is undeveloped, and provides incidental dispersed recreation opportunities, picnicking grounds (Section 3.12) and associated minor, indirect beneficial economic impacts to the local, regional, and national community

It is likely that the tract is used for recreational hunting and fishing. As described in Section 3.11.1, tourism is not a significant industrial sector in Leslie County. As described further in Section 3.12, recreational use of the USFS tract associated with the Proposed Action is incidental only and recreational picnics, and provides minimal contribution to the local, regional, or national economy.

3.11.2 Effects of Implementation

3.11.2.1 Proposed Action

Exploratory drilling has been performed on private lands adjacent to the USFS tract, and the amount of recoverable coal underlying the tract has been calculated based on proposed panel layouts. Based on these calculations, a projection of recoverable coal reserves underlying the USFS tract has been developed. In 2005, Bledsoe Coal Leasing Company submitted a *Kentucky State Mining Permit Application* (Shamrock 2011), in which Bledsoe presented an estimate of 910,159 tons of recoverable coal reserves underlying the USFS tract.

The actual mining rate would be determined by the size and geometry of the resource as determined during mining activities. Resource recovery rates would be as high as 85% locally, achieved in the

second (retreat) mined rooms. Adverse ground conditions, support left for bleeder entries, barrier pillars for main protection, and areas of reserve where seam or middleman thickness would prohibit the economical mining of the coal bed are normal conditions that typically require some of the reserve to be left unmined. Based on the history of mining in the immediate vicinity of the USFS tract, it is forecast that the overall recovery rate would be 50% of the total 910,159 tons of coal present to equal approximately 455,080 tons of recoverable coal. The mining rate could be as much as 25,000 clean tons per month when one continuous mining machine and associated equipment, known collectively as a "section," is mining exclusively on the USFS tract, with a projected average annual production rate of 150,000 tons per year. Production rates are difficult to predict due to the irregular shape of the boundaries of the USFS tract. Also, mining rates may be impacted by factors such as coal price and alternate coal sources.

If an existing permitted coal preparation facility is used to process the federal coal, this processing would not result in an increase in the facility's production rate. The regional coal processing facilities can obtain coal from a radius of approximately 40 miles, and depending upon the coal market, could be in operation for many years beyond the life of the coal on the USFS tract, with or without the federal coal. Consequently, the present level of associated coal truck traffic, processing, and life of the existing regional coal processing plant and facilities would not be changed.

Coal mining in Leslie County and the surrounding region will continue through the foreseeable future, as long as mining in the area is economically feasible. Implementation of the PDS associated with the Proposed Action would result in approximately 3 years of mining. Operation of the existing mines will provide continued employment in the mines and in related businesses, coal severance tax revenue, and other county, state, and federal tax revenue. Implementation of the PDS would contribute beneficial socio-economic impacts to the local, regional, and national community by providing:

- Local employment
- Indirect economic benefits to local and regional businesses
- Federal and private royalty income on the coal reserves that underlie the USFS tract
- State coal severance tax revenue
- Business revenue

Implementation of the PDS would support about 180 existing regionally high-paying jobs for members of the local community (Bledsoe Coal 2011). In the year 2010, the average weekly wage for all employees in Kentucky was $745 per week, and $715 per week in Leslie County (Kentucky Cabinet for Workforce Development 2012). Implementation of the PDS would maintain high-paying jobs in Leslie County, creating a moderate direct beneficial impact.

If the Proposed Action is selected and the PDS is implemented, other positive indirect impacts are anticipated. Typically, local mining companies purchase supplies and materials locally, and employ local

trucking companies to transport coal. Implementation of the PDS would provide revenue and jobs for these local suppliers and other businesses, thereby creating a moderate indirect beneficial impact.

Another direct economic impact that is anticipated if the Proposed Action is selected is the use of the federal coal resource, which in essence would be foregone, or sterilized, if the No Action Alternative is selected.

Under the PDS, private reserves on adjoining properties would be more fully accessible and therefore salable. Landowners that have leased the private mineral rights adjoining the USFS tract would receive royalty income on those portions of private reserves, creating a moderate indirect impact.

Implementation of the PDS would provide a source of state coal severance tax revenue, a portion of which would be refunded to Leslie County for investment in community services. The severance tax rate on coal mined in Kentucky is 4.5% of the gross value of the coal, which is the amount received or receivable for the coal (Kentucky Office of the State Budget Director 2012). Based on the estimated recoverable 455,080 tons underlying the USFS tract and on the October 2012 market rate of $66 per ton (U.S. EIA 2012), the state coal severance tax revenue would be about $1,351,588. Creation of this returned revenue source would be a major direct impact. Implementation of the PDS also would provide federal revenue in the form of royalties on the federal coal reserves. Creation of this federal royalty source would be a moderate direct impact.

If the Proposed Action is selected and the PDS is implemented, other potential economic impacts at a local and state level include continued local and regional government revenue in the form of payroll taxes, sales taxes, workers' compensation funds, property taxes, state income taxes, and other taxes and fees. At the federal level, government revenue would include Black Lung Excise taxes and Abandoned Mine Land fees. Creation of these revenue sources would be moderate indirect impacts.

Approximately $30 million could be earned from the sale of approximately 455,080 tons of coal, based on a March 2012 market price of $66 per ton, if the Proposed Action is selected and the PDS is implemented.

The area in the vicinity of the USFS tract is sparsely populated, and no residences are present on the USFS tract. Consequently, no environmental justice communities such as minority populations or low income communities would be directly affected by the Proposed Action or No Action Alternative. Because no Indian reservations are situated on or near the USFS tract, no impacts to lands owned or managed by Native Americans are anticipated. Under the PDS associated with the Proposed Action, environmental justice communities could experience indirect socio-economic impacts such as employment opportunities, and community benefits provided by various revenues associated with the proposed mining.

3.11.2.2 No Action Alternative

If the No Action Alternative is selected and the NAS is implemented, all existing and future access to the federal reserves underlying the USFS tract would be foregone as adjoining reserves are mined. Consequently, the socio-economic impacts associated with the Proposed Action and PDS would not occur. Instead, implementation of the NAS would result in several socioeconomic impacts:

- Loss of access to an energy resource
- Loss of federal royalty revenue
- Loss of private royalties
- Loss of state coal severance tax and other tax revenue

Future mining of the federal coal would involve substantial capital expenditure in road construction, portal or shaft installation, conveyance equipment, and hauling mechanisms. Under current economic conditions, such a capital expenditure would not be feasible and mining of the isolated federal coal would become impractical. Approximately 455,080 recoverable tons of federal coal reserves would be sterilized if the No Action Alternative is selected. The loss of the potential benefits of those reserves, including use as an energy resource, would be a moderate direct impact. Also, federal royalty from those reserves would be permanently lost. In accordance with 43 CFR 3473.3-2, the federal royalty is 8% of the value of the coal. Based on the March 2012 market rate of $66 per ton, the lost federal royalties would be about $2,402,820, which would be a moderate direct impact.

Implementation of the NAS would reduce the potential amount of state coal severance tax revenue. Based on the estimated recoverable 455,080 tons underlying the USFS tract and on the March 2012 market rate of $66 per ton, the lost state coal severance tax revenue would be about $1,351,586. This loss in tax revenue would impact Leslie County as a whole, because a portion of the state coal severance tax revenues are returned to the counties. The lost coal severance tax source would be a major, direct impact.

If the No Action Alternative is selected and the NAS is implemented, other indirect economic impacts at a local and state level include losses in payroll taxes, sales taxes, workers' compensation funds, property taxes, state income taxes, and other taxes and fees. At the federal level, government revenue losses would include Black Lung Excise taxes and Abandoned Mine Land fees if the No Action Alternative is selected. Loss of these tax, fee, and fund revenue sources would be a minor direct impact.

3.11.3 Cumulative Effects

A three-mile buffer area from the PDS boundary was defined as the cumulative effects area. This buffer was chosen to include projects within the Beech fork drainage above the confluence with Middle Fork Kentucky River. The drainage area is representative of similar projects and within an area that can be

reasonably analyzed. Extending the area to other watersheds would result in unwieldy analyses and effects too dispersed over a large area.

The Abner Branch, Oldhouse Branch, and Beech Fork Mine are active and provide numerous moderate and major direct and indirect socioeconomic benefits to the local, regional, and national community in the form of increased revenue. These impacts combine in a positive way with the PDS associated with the Proposed Action.

In summary, no other projects in the vicinity of the USFS tract have been identified that have socio-economic impacts with which impacts from the PDS or NAS could combine to contribute to cumulative effects on environmental justice. In contrast, residual impacts that would result under the PDS would combine with impacts of existing nearby operations to bring about socio-economic cumulative effects. Under the NAS, beneficial impacts of existing nearby operations may counteract residual impacts that would occur if the No Action Alternative is selected, but those existing impacts do not outweigh the residual impacts resulting under the NAS to result in cumulative effects.

3.12 Recreation and Visual Resources

The USFS categorizes recreational opportunities into two broad categories:

- ***Developed recreation opportunities*** – offer areas with constructed facilities providing public amenities and conveniences
- ***Dispersed recreation opportunities*** – feature primitive settings, isolation, challenge, and risk

The USFS categorizes the USFS tract into both of these categories as an area providing developed and dispersed recreation opportunities. The USFS also analyzes the recreation program on the National Forests by identifying the types of available recreation experiences. The Recreation Opportunity Spectrum (ROS) model, as described in the FEIS for the DBNF's *Land and Resource Management Plan* (USFS 2004b), is a tool used by the USFS to develop an inventory of existing recreation settings by physical, biological, managerial characteristics, access, and types of facilities available in a particular area. The ROS (USFS 1990) provides a framework for stratifying and defining classes of outdoor recreation environments, activities, and experience opportunities in the National Forests. Six levels of recreation experience have been defined:

- ***Primitive*** (Largely unmodified tracts of land 5000 acres of land or larger; evidence of human activity is not noticeable to the casual observer; at least three miles from roads or motorized trails)
- ***Semi-primitive non-motorized*** (Predominantly natural environment with minimum evidence of human activity. High probability of isolation from sights and sounds of humans. Motorized use is prohibited)
- ***Semi-primitive motorized*** (Predominantly natural environment with some evidence of human activity. Concentration of users is low. Motorized use is allowed)

- ***Roaded Natural*** (Predominantly natural appearing environment with moderate evidence of human activity; moderate probability of experiencing affiliation with others, motorized use is allowed)
- ***Rural*** (Substantially modified natural environment. Probability of experiencing affiliation with others is prevalent, as is the convenience of sites and opportunities. Motorized use is allowed)
- ***Urban*** (Substantially developed environment dominated by man-made structures. Sights and sounds of humans are predominant. Probability of experiencing others is prevalent, as is a higher level of convenience of sites and opportunities than in Rural ROS experiences. Motorized use is provided for)

3.12.1 Environmental Baseline

The USFS tract associated with the Proposed Action is classified as "Roaded Natural" and has the Cawood Recreation Area located on it. The Roaded Natural classification is characterized by a broad range of uses, depending on the terrain, like off road vehicle driving, horseback riding, nature viewing, and hunting. On the USFS tract, these uses probably only occur incidentally if at all. There are no developed trails in the area but other incidental uses on the USFS tract may include hiking, mountain biking and dispersed camping. The Cawood Recreation Area has a picnic area located along Cawood Creek at the site of an old Civilian Conservation Corps camp. The picnic area is open seasonally from early April through the end of October.

3.12.2 Effects of Implementation

3.12.2.1 Proposed Action

The PDS would not involve surface disturbance. Consequently, the PDS would not cause direct impacts to the current quality of access, ecological function, habitat, or safety of visitors presently existing on the surface. With regard to potential indirect impacts to habitat, and specifically vegetation (Section 3.6), the PDS would include a subsidence control plan, as outlined in Section 2.2.1.3 which describes how mining activities would be performed in a way that protects the integrity of surface features and structures through protection zone identification; minimization of the occurrence of subsidence through mine panel design; and monitoring and control of the extent of planned subsidence. As described in Section 2.2.1.3, the subsidence control plan also would include a damage mitigation plan The PDS would involve minimal subsidence, and no measureable impacts to access, ecological function, habitat, and safety of visitors to the USFS tract are anticipated. Therefore, no measurable impacts to recreation resources are anticipated if the Proposed Action is selected.

3.12.2.2 No Action Alternative

If the No Action Alternative is selected and the NAS is implemented, the coal under the area of the USFS tract would not be mined and the recreation opportunities that currently exist would remain unchanged. Therefore, no impacts to recreation resources are anticipated if the No Action Alternative is selected.

3.12.3 Cumulative Effects

A three-mile buffer area from the PDS boundary was defined as the cumulative effects area. This buffer was chosen to include projects within the Beech fork drainage above the confluence with Middle Fork Kentucky River. The drainage area is representative of similar projects and within an area that can be reasonably analyzed. Extending the area to other watershed s would result in unwieldy analyses and effects too dispersed over a large area.

No direct or indirect impacts to recreation resources have been identified in association with nearby projects, including historical or current underground mining at the Abner Branch, Oldhouse Branch, and Beech Fork mines. No measureable impacts are anticipated under the Proposed Action or the No Action Alternative. Consequently, no cumulative effects to recreation resources are expected.

3.13 Cultural Resources

3.13.1 Environmental Baseline

Because the PDS associated with the Proposed Action involves underground mining, which would include controlled subsidence, KDMRE regulations 405 KAR Sections 8:010, 8:020, 8:030, 8:040, and 24:040 (revised June 28, 1989) require that an archaeological survey of the USFS tract be performed. Cultural Resource Analysts, Inc. (CRA) conducted an archaeological survey of the 174 acres contained within the USFS tract from May 21-22, 2012, under Special Use Permit Number 5591 issued by the United States Department of Agriculture, Forest Service. Results of the survey are described in a Cultural Resource Survey of a Coal Lease Parcel within the Daniel Boone National Forest, Redbird Ranger District, Leslie County Kentucky (the Archeological Survey Report; CRA 2012). The purpose of the assessment was to locate, describe, evaluate, and make appropriate recommendations for the future treatment of archaeological sites and historic properties (structures) that would be threatened by the PDS. The investigation conformed with the Specifications for Conducting Fieldwork and Preparing Cultural Resource Assessment Reports (Sander 2006). Field methods used were commensurate with conditions observed and consisted of an intensive pedestrian survey, supplemented with the use of shovel testing.

As described in the Archaeological Survey Report, (CRA 2012), the USFS tract associated with the Proposed Action is located in southern Leslie County, and the topography consists of ridge tops, steeply sloped mountainsides, and valleys in heavily dissected mountainous terrain. Elevations within the area range from 1,320 to 2,280 feet amsl. The USFS tract is drained by Cawood Branch and Fern Branch, which drain to Beech Fork on the west, which flows into the Middle Fork of the Kentucky River. Given that the majority of land in the area consists of steep hillsides, archaeologists expected the primary site types to be historic residences, prehistoric open habitations, and prehistoric rockshelter sites were the primary site types expected, but cemeteries were also considered a possibility (CRA 2012).

Concurrent with the fieldwork, a records review was conducted at the Office of State Archaeology. Prior to the fieldwork, a records review was provided by the Daniel Boone National Forest Supervisor's Office.

The reviews indicated that a portion of the project area had been previously surveyed during a 1996 investigation, and no previously recorded archaeological or cultural historic sites were located within the project area. The project area measures 70.56 ha (174.36 acres), however, due to previous archaeological survey coverage, the current investigation surveyed an area measuring 51.82 ha (128.04 acres).

Three previously unrecorded archaeological sites (15Ls209–15Ls211) were documented within the project boundaries during the survey. Site 15Ls209 is a prehistoric open habitation of indeterminate temporal affiliation and a historic farm/residence dating to the late nineteenth through the twentieth centuries. Site 15Ls209 includes a standing coal storage structure (LS-93) that was assessed as cultural historic resource. Site 15Ls210 is a historic farm/residence dating to the mid-nineteenth through the mid-twentieth centuries. Site 15Ls211 is a historic farm/residence dating to the early- through the late twentieth centuries. All three sites have limited research potential and are recommended as not eligible for the National Register of Historic Places under Criterion D. The coal storage structure (LS-93) is also recommended as not eligible for the National Register of Historic Places under Criterion A, B, or C. No cultural resources listed in, or eligible for, the National Register of Historic Places have been identified on the tract.

No paleontological resources, such as significant fossils have been identified on the Redbird Ranger District, or elsewhere on the DBNF (Ison 2003).

3.13.2 Effects of Implementation

3.13.2.1 Proposed Action

The CRA (2012) report determined that no archeological sites eligible for or listed in the National Register of Historic Places would be affected by the PDS associated with the Proposed Action. The report was submitted to the Kentucky State Historical Preservation Office (SHPO) for concurrence. A concurrence letter was received from SHPO, dated August 10, 2012. No known paleontological resources would be affected by the PDS. Therefore, no measureable impacts to cultural, historical, and paleontological resources are anticipated if the Proposed Action is selected.

3.13.2.2 No Action Alternative

No impacts to cultural, historical, and paleontological resources are anticipated if the No Action Alternative is selected.

3.13.3 Cumulative Effects

A three-mile buffer area from the PDS boundary was defined as the cumulative effects area. This buffer was chosen to include projects within the Beech fork drainage above the confluence with Middle Fork Kentucky River. The drainage area is representative of similar projects and within an area that can be

reasonably analyzed. Extending the area to other watersheds would result in unwieldy analyses and effects too dispersed over a large area.

No direct or indirect impacts to cultural, historical, or paleontological resources have been identified in association with nearby projects, including historical or current underground mining at the Shell Branch, Straight Creek, Middle Fork, and Beech Fork mines. No measureable impacts are anticipated under the Proposed Action or the No Action Alternative. Consequently, no cumulative effects are expected.

3.14 Noise

3.14.1 Environmental Baseline

The USFS tract supports recreation and wildlife habitat. The primary noise sources are off-road vehicles and hunting firearms, which are used occasionally for recreation on the tract. Noise from existing traffic on nearby US 421, which is dominated by coal truck traffic, may contribute to background noise levels in the vicinity of the USFS tract. For comparison, examples of common sounds measured in decibels are shown on Figure 3.14-1 (HUD 1985). At the existing, permitted facilities associated with the Beech Fork Mine, noise is generated by operation of existing conveyor belt systems that deliver coal from the mine face to the surface at portal openings; by haul trucks and other off-highway vehicles; and by equipment at the existing, permitted preparation plant located on private lands.

3.14.2 Effects of Implementation

3.14.2.1 Proposed Action

The PDS would involve underground coal mining, and no construction, mining activities, or other operational activities would occur on the surface. If an existing permitted coal preparation facility is used to process the federal coal, processing the federal coal would not result in an increase in the facility's production rate or an increase in the frequency of associated coal truck trips on local roads. The nearby regional coal processing facilities can obtain coal from a radius of approximately 40 miles, and depending upon the coal market, could be in operation for many years beyond the life of the coal on the USFS tract. Therefore, under the PDS, no measureable noise impacts are anticipated.

EPA and other publicly and privately funded researchers have conducted extensive noise measurements of active surface mining areas. The EPA and the Federal Highway Administration have identified 55 decibels as the outdoors sound level adequate to protect public health and welfare in residential areas, and it is generally accepted that underground mining activities are not audible at the surface. Consequently, because the PDS would not involve surface activities, no additional noise impacts to on-site or off-site receptors are anticipated.

Furthermore, according to federal surface mining law, the use of explosives with respect to blasting and resultant ground vibration is regulated (30 CFR 817.67). The PDS would involve the use of continuous

mining equipment only, and no blasting would be performed. Therefore, no noise or ground vibration impacts are anticipated.

3.14.2.2 No Action Alternative

If the No Action Alternative is selected, the coal under the area of the USFS tract would not be mined and the noise levels that currently exist would remain unchanged. Therefore, no impacts to noise are anticipated if the No Action Alternative is selected.

3.14.3 Cumulative Effects

No direct or indirect noise impacts have been identified in association with nearby projects, including historical or current underground mining at the Abner Branch, Oldhouse Branch, and Beech Fork mines. No measureable impacts are anticipated under the PDS or NAS. Consequently, no cumulative effects are anticipated.

3.15 Transportation

Among the eight KRADD counties, Leslie County has been comparatively more isolated. As late as 1922, there were no major highways or railroads in the county. Until the 1940s, the highway network in the KRADD counties consisted of horse and footpaths, stream beds, and unimproved roads. With the proliferation of truck-mines during World War II, there was a flurry of construction of two-lane gravel and paved roads. In the 1950s, no part of eastern Kentucky had a major east-west highway. The Mountain Parkway was completed in 1963, and federal funds were acquired to construct KY 15 from Jackson to Hazard as part of the Appalachian Development Highway System (Collins et al. 2003). The proposed construction of I-66 along KY 80 to I-75 would greatly improve access to the region. If completed, this section of road would connect the Hal Rogers Parkway to the Cumberland Parkway and create a much needed roadway across Kentucky (DOT 2011).

3.15.1 Environmental Baseline

Currently, Leslie County's transportation system is a road system. Major roads include US 421, Kentucky Highway 80, and the east-west corridor consisting of the Hal Rogers Parkway. Numerous county roads traverse the county. Although county roads have been improved in the last several years, many gravel and dirt roads are still used on a regular basis by county residents (Leslie County Extension Office 2002). Roads typically wind through the mountainous terrain, following streambeds. Because Leslie County is sparsely populated, and because coal mining has been the dominant industry in the vicinity of the USFS tract for over 50 years (Section 3.11), coal trucks have been the dominant vehicle class using the roads for at least the past 30 years. Impacts result from the use of coal trucks in the area, such as emissions from fuel use, impacts from the weight of the coal trucks and the frequency of use by the trucks to the road surfaces, requiring county and federal funds to pay for materials and labor to maintain the roads on a regular basis. However, coal transport by truck also results in indirect impacts including continued

employment for federal and county maintenance crews, continued employment for coal truck drivers, and state revenue from truck licensing fees.

3.15.2 Effects of Implementation

3.15.2.1 Proposed Action

Under the PDS, coal would be extracted, or severed, and transported via existing underground conveyor systems from the active mine face underlying the USFS tract to existing surface portals. The coal would then be hauled by truck, on existing haul roads, to an existing coal preparation plant. The processing of the coal would not result in an increase in the facility's production rate. Clean coal from the preparation plant would be hauled by truck via existing U.S. and county roads to an existing, permitted railcar loadout facility in Harlan County, Kentucky. This hauling of the processed federal coal would not result in an increase in frequency of truck trips associated with the existing regional coal processing plant on local roads. The regional coal processing facilities can obtain coal from a radius of approximately 40 miles, and continually process a consistent amount of coal. This coal is subsequently hauled by truck, at a fairly consistent rate, to the local railcar loadout facility. Depending upon the coal market, these facilities could be in operation for many years beyond the life of the coal on the USFS tract. If the closest permitted coal preparation facility is used to process the federal coal, waste materials from the preparation plant would be transported via existing conveyance systems to existing, permitted storage facilities situated on private land. Mine personnel, supplies, and waste materials would be transported from the mine portal to and from the active face on personnel carriers that travel on the coal railcar lines.

The PDS would use existing coal transportation facilities. The surface portals, and subsequent transportation facilities would be located outside of the USFS tract boundaries and are not a part of this analysis. No changes to the existing transportation system would occur under the Proposed Action. Therefore, no impacts to transportation are anticipated as a result of the Proposed Action.

3.15.2.2 No Action Alternative

The present level of traffic would be the same under the No Action Alternative. No changes to the existing transportation system would occur whether the Proposed Action or the No Action Alternative is selected. Therefore, no impacts to transportation are anticipated as a result of the Proposed Action or No Action Alternative.

3.15.3 Cumulative Effects

A three-mile buffer area from the PDS boundary was defined as the cumulative effects area. This buffer was chosen to include projects within the Beech fork drainage above the confluence with Greasy Creek. The drainage area is representative of similar projects and within an area that can be reasonably analyzed. Extending the area to other watershed s would result in unwieldy analyses and effects too dispersed over a large area.

Historical and current transport of local coal mined in Leslie County and the region via coal trucks has resulted in direct and indirect impacts to transportation resources. However, because no impacts are anticipated under the Proposed Action or the No Action Alternative, no cumulative effects are anticipated.

4.0 PREPARERS AND CONTRIBUTORS TO ANALYSIS

- Golder Associates Inc. (Third Party Contractor)
  - Dr. William Thomas (Bill) Thompson, Ph.D., Rock Mechanics. Project Director, Senior Reviewer Geology and Subsidence
  - Mr. Michael Bellitto, MS Timber Harvesting Restoration Ecologist, Project Manager, Primary Author, Introduction and Issue and Alternatives, and Cultural Resources. Senior Reviewer,
  - Mr. Jeffrey Trlica, Project Coordinator, Primary Author, Soils, Vegetation, Wetlands and Riparian, Socioeconomics
  - Mr. Travis Trant, Wildlife Biologist. Primary Author, Wildlife, Recreation and Visual Resources, Transportation and Noise
  - Mr. Cameron Young, Wildlife Biologist. Primary Author, Proposed, Endangered, Threatened and Sensitive species.
  - Ms. Annette Moltzan, Geological Engineer. Primary Author, Topography and Geological Resources, Subsidence Analysis.
  - Ms. Fawn Bergen. Air Quality Engineer. Primary Author, Air Quality and Greenhouse Gas Inventory.
  - Mr. Ed Pottorff. Hydrologist. Primary Author Groundwater Quality and Quantity and Surface Water
  - Mr. Trent Miller. Wildlife Biologist. Senior Peer Reviewer.
- U.S.D.A. Forest Service
  - Wayna Adams, DBNF Forest Archaeologist
  - Elizabeth Botner, Redbird Ranger District Silviculturist/Planner
  - Claudia Cotton, PhD, DBNF Forest Soil Scientist
  - Patti Davis, DBNF Geologist
  - Melanie Pitrolo, USFS Air Quality Specialist
  - Kim Tarter, Redbird Ranger District Biologist
  - Jon Walker, DBNF Forest Hydrologist
- U.S.D.I. Bureau of Land Management,
  - Randall Mills,, Mining Engineer/Geologist, SSFO
  - Gary Taylor, Planner & Environmental Coordinator, SSFO
  - Fay Winters, Wildlife Management Biologist, SSFO
  - Allison McCartney, Wildlife Biologist, SSFO
  - John Sullivan, Archeologist, SSFO
- Kentucky Division of Mine Permits
  - Mr. Jim Adamson
- Kentucky Division of Mine Reclamation and Enforcement
  - Mr. Shawn Fritz
- Kentucky Division of Water
  - Mr. Mike Reed

5.0 CONSULTATION

5.1 Endangered Species Act

Section 7 of the Endangered Species Act (ESA) requires a federal agency to evaluate a proposed action for compliance with the ESA. Section 7(a)(2) states that each federal agency shall, in consultation with the Secretary, insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat.

By regulation, a biological assessment is prepared for "major construction activities" considered to be federal actions significantly affecting the quality of the human environment as referred to in the *National Environmental Policy Act* of 1969 (NEPA) (42 U.S.C. 4321 et seq.). A major construction activity is a construction project or other undertaking having similar physical impacts, which qualify under NEPA as a major federal action. Major construction activities include dams, buildings, pipelines, roads, water resource developments, channel improvements, and other such projects that modify the physical environment and that constitute major federal actions. A biological assessment is required if listed species or critical habitat may be present in the action area.

The DBNF has seventy–one (71) Regional Forester approved Sensitive species. The species include birds, mammals, aquatic species, plants and insects. It is required that Sensitive species be evaluated apart from NEPA. It is not necessary to evaluate them in the same document as federal listed species. Two documents are required to be written: a biological assessment, which addresses federal species; and a biological evaluation, which addresses USFS Sensitive species. Typically, as was done for this Proposed Action, for convenience the species were evaluated in the same document, which is called a *Biological Assessment and Evaluation* (BAE).

In this case, the USFS is the federal action agency. The federal action agency may designate the applicant or a non-federal representative (often a consultant) to prepare the biological assessment, although the federal action agency takes responsibility for the content of the assessment and for the findings of effect. The BAE was prepared jointly by Golder Associates and the DBNF Redbird Ranger District Biologist (District Biologist). Through informal agreement between the DBNF and the USFWS, the USFWS agreed to accept determinations made by the District Biologist. Because determinations of “no effect” or “not likely to adversely affect” were made by the District Biologist for all federally listed species; and “no effect” for critical habitat, formal consultation was not required. The District Biologist forwarded a copy of the BAE to the USFWS Field Office in Frankfort, Kentucky with a request for concurrence. Concurrence on the BAE was received from the USFWS on August 16, 2012.

5.2 National Historic Preservation Act

Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires Federal agencies to take into account the effects of their undertakings on historic properties, and afford the Advisory Council on

Historic Preservation a reasonable opportunity to comment. The historic preservation review process mandated by Section 106 is outlined in regulations issued by ACHP. The responsible Federal Agency, in this case the USFS, determined that, because the proposed action requires a federal permit, Section 106 consultation is required. The USFS consulted with the State Historic Preservation Office (SHPO). If the agency finds that no historic properties are present or affected, it provides documentation to the SHPO and, barring any objection in 30 days, proceeds with its undertaking.

The USFS submitted the Cultural Resource Survey (CRA 2012) to the Kentucky Historic Preservation Office (SHPO), requesting concurrence that the project would have no effect on Historic Properties under 36 CFR 800. The USFS received a written response (dated August 10, 2012) from the Kentucky Acting Director, Kentucky Heritage Council and State Historic Preservation Officer, concurring with the opinion of no effect on historic properties. The SHPO considered the undertaking's potential to affect archaeological as well as architectural resources that may be eligible for listing on the National Register.

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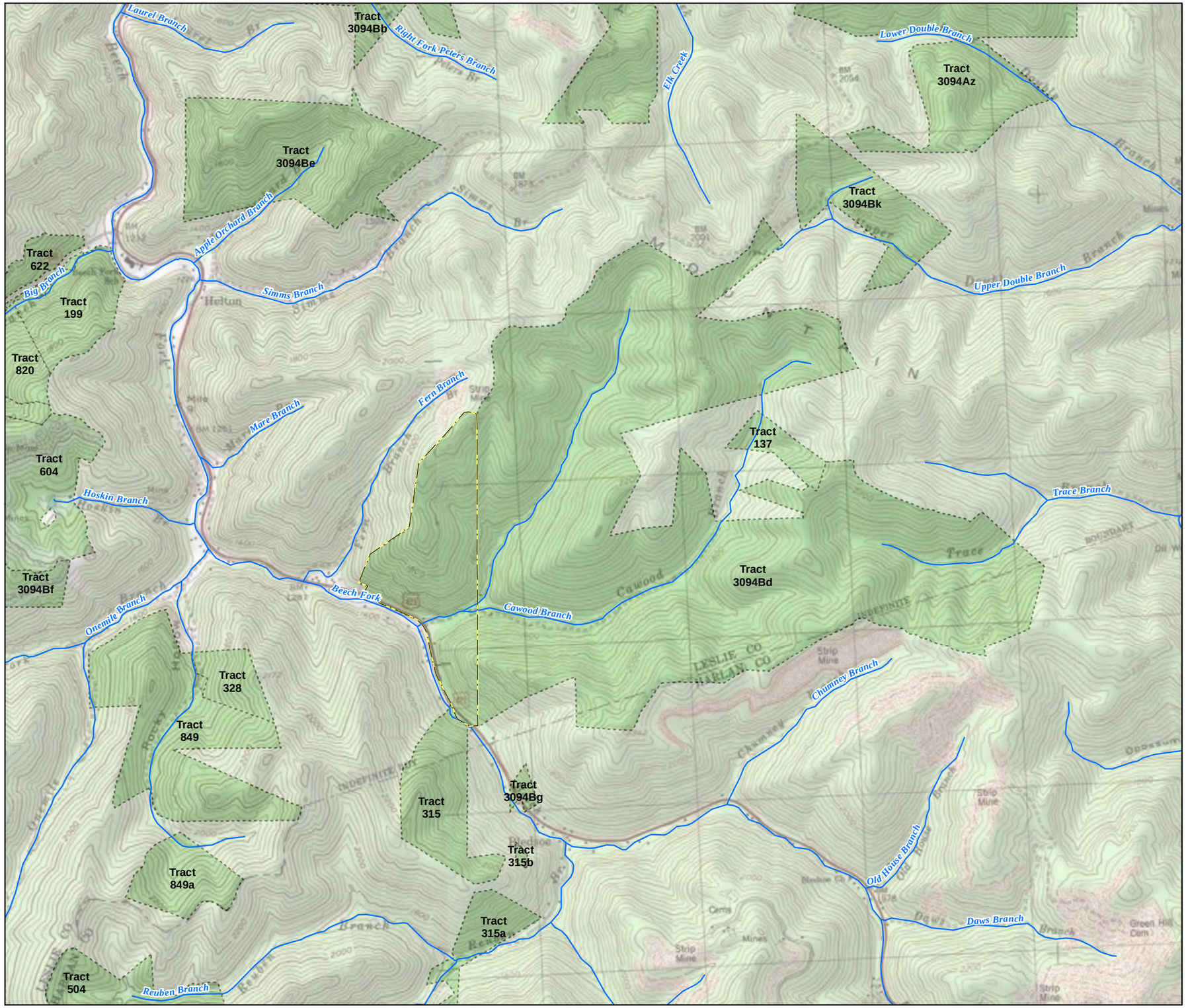
FIGURES



LEGEND

- Lease Boundary (KYES-53865)
- Stream
- USFS Tracts

REFERENCES

COORDINATE SYSTEM: NAD 1927 STATEPLANE KENTUCKY SOUTH FIPS 1602.
PROPOSED LEASE BOUNDARY FOLLOWS DANIEL BOONE NATIONAL FOREST (DBNF) OWNERSHIP BOUNDARIES, FROM GIS DATA PROVIDED BY DBNF, AND IS NOT FROM A FIELD SURVEY. ROADS PROVIDED BY THE DANIEL BOONE NATIONAL FOREST. US TOPO MAPS PROVIDED BY ESRI ARCGIS ONLINE AND DATA PARTNERS INCLUDING USGS AND © 2007 NATIONAL GEOGRAPHIC SOCIETY.

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1 INCH = 2,000 FEET
IF PRINTED AT 11 X 17 IN

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TITLE

VICINITY MAP

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No. 103-81786			FILE No.	VicinityMap.mxd
DESIGN	JMH	6/29/2012	SCALE AS SHOWN	REV 0
GIS	JMH	6/29/2012		
CHECK	ADM	6/29/2012	FIGURE 1.1-1	
REVIEW	TWT	6/29/2012		

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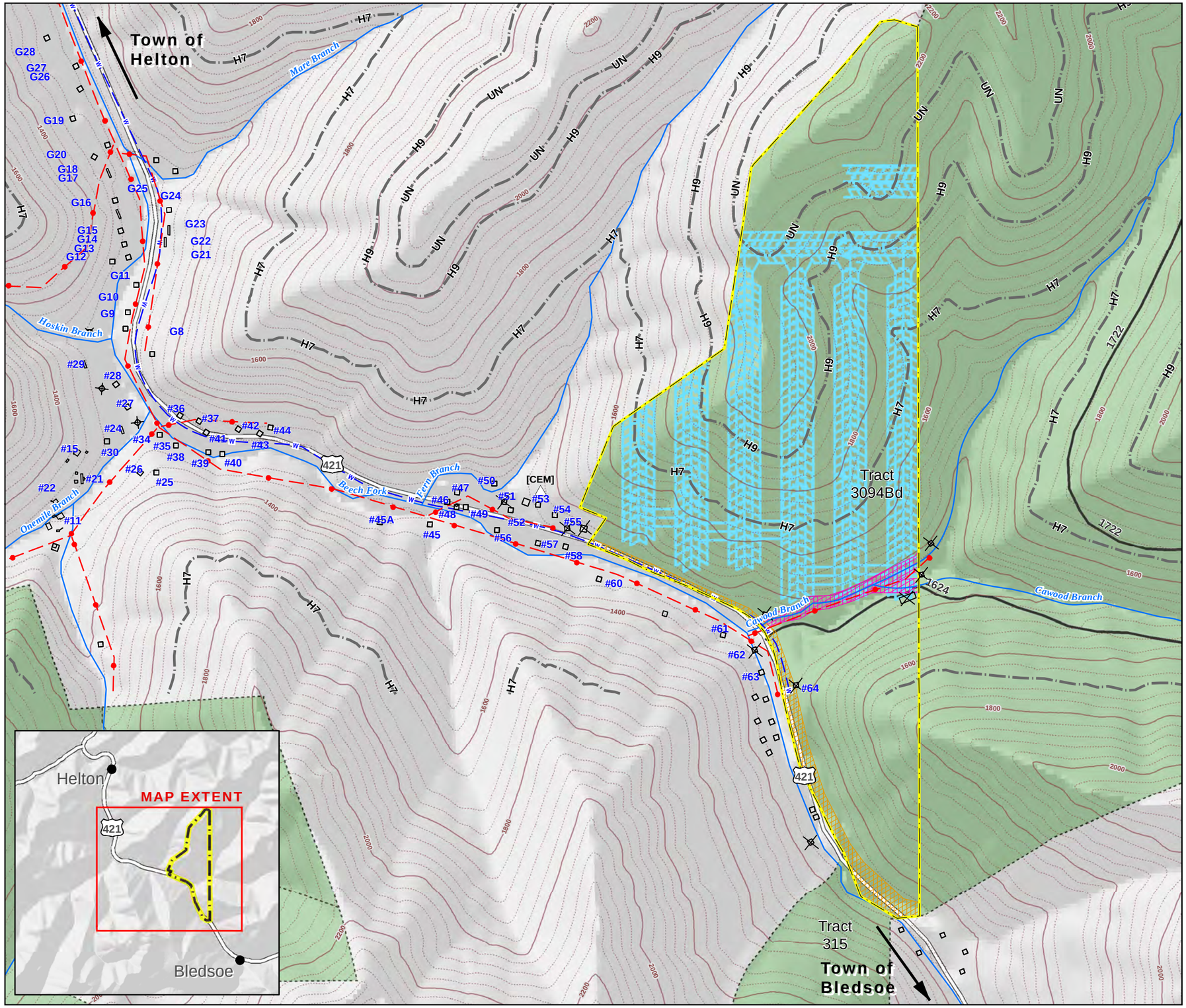

LEGEND

- Lease Boundary (KYES-53865)
- Mine Projections
- Cemetery [CEM]
- Dwelling/Business, Barn or Storage Building
- Structure Gone
- Utility Line
- Water Line
- #39 Groundwater Users for Survey for 866-5053 (G prefix denotes amended survey for 866-5053, and # prefix denotes survey for 866-5053 Amendment 4)
- Stream
- Approximate Recovery 58% No Total Retreat Mining
- No Mining
- Coal Seam Outcrop (H7 - Hazard #7, H9 - Hazard #9, UN - Unknown Coal Seam)
- USFS Tract

Surface Elevation (40-foot contour interval)

- Major Contour
- Minor Contour

NFS Road

- US Highway
- Unimproved

NOTES

NO KNOWN CEMETERIES WITHIN LEASE BOUNDARY.

REFERENCES

COORDINATE SYSTEM: NAD 1927 STATEPLANE KENTUCKY SOUTH FIPS 1602. PROPOSED LEASE BOUNDARY FOLLOWS DANIEL BOONE NATIONAL FOREST (DBNF) OWNERSHIP BOUNDARIES, FROM GIS DATA PROVIDED BY DBNF, AND IS NOT FROM A FIELD SURVEY. ROADS AND STREAMS PROVIDED BY THE DBNF. SURFACE ELEVATION CONTOURS DERIVED FROM DIGITAL ELEVATION MODEL PROVIDED BY USGS. OIL AND GAS WELLS PROVIDED BY KENTUCKY GEOLOGICAL SURVEY. UTILITIES, BUILDINGS, COAL OUTCROPS, AND MINING BARRIERS PROVIDED BY SHAMROCK COAL CO., INC. GROUNDWATER USER SURVEYS WERE PROVIDED BY THREE CONSULTANTS AND FROM TWO DIFFERENT SHAMROCK COAL CO., INC. PERMITS. THE GWUS FOR MINOR REVISION #1 WILL ONLY CONTAIN THE SURVEY INFORMATION FOR G64-G104.

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1 INCH = 700 FEET
IF PRINTED AT 11 X 17 IN

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TITLE

PROPOSED DEVELOPMENT SCENARIO

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No. 103-81786			FILE No. ProposedDevelopment.mxd	
DESIGN	JMH	6/29/2012	SCALE AS SHOWN	REV 0
GIS	JMH	6/29/2012		
CHECK	ADM	6/29/2012	**FIGURE 2.2-1**	
REVIEW	TWT	6/29/2012		

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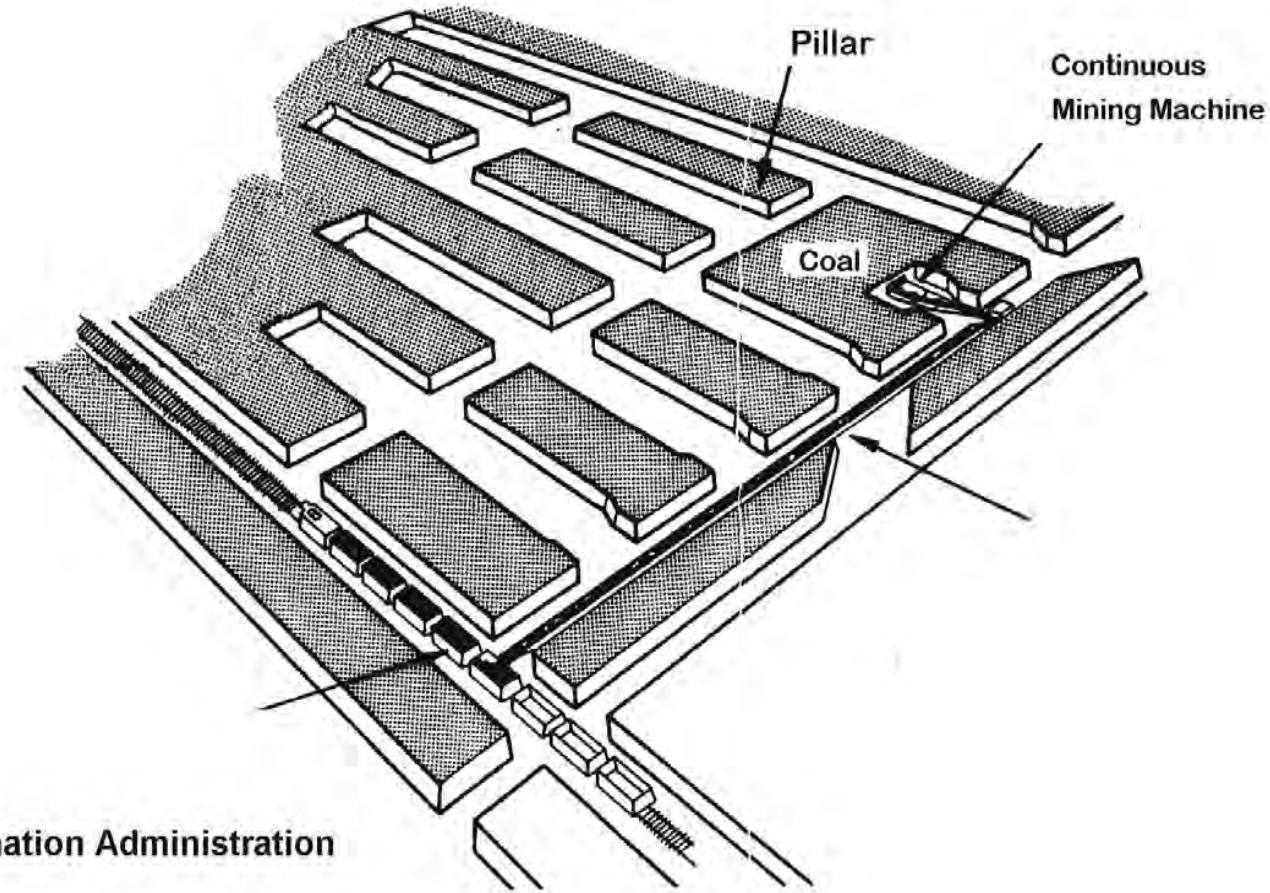
Room-and-pillar



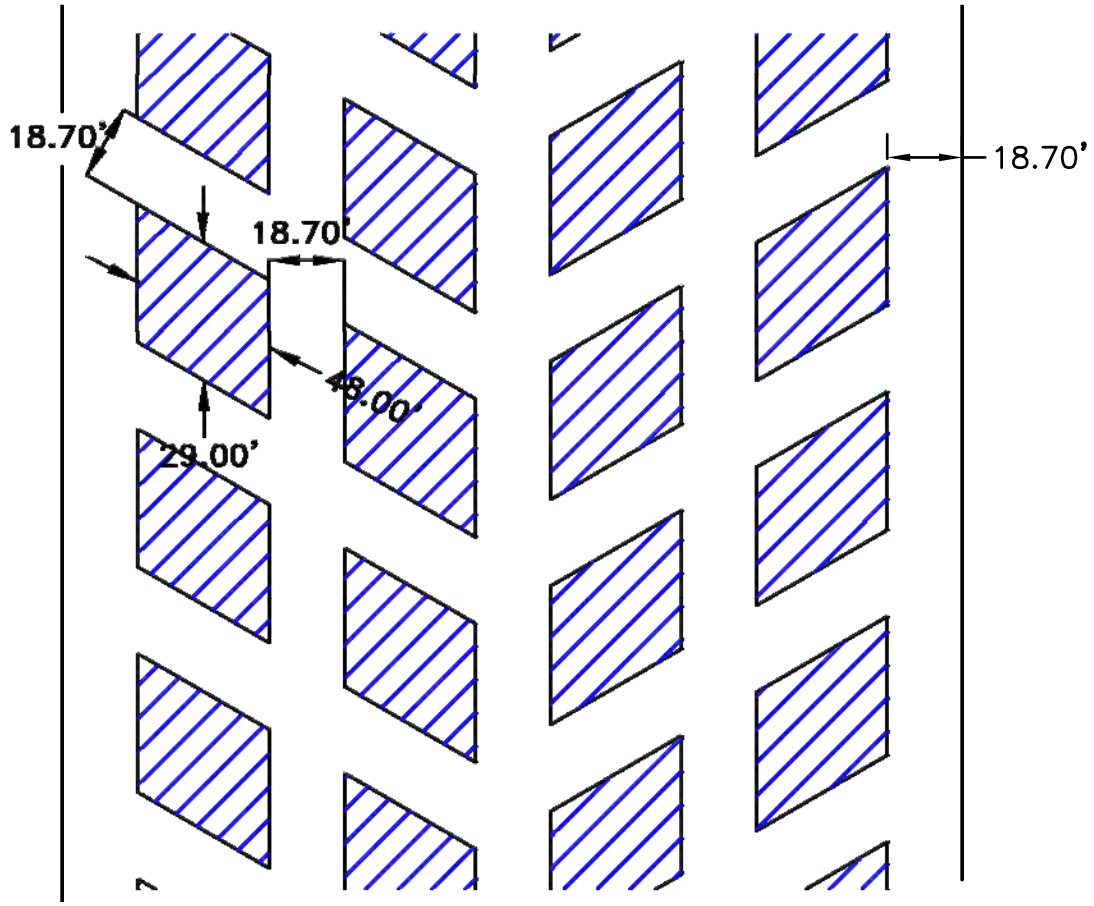
Source:
Energy Information Administration

ROOM-AND-PILLAR MINE SCHEMATIC

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT NO.		103-81786	FILE	Blesoe.xls
DESIGN	JMH	04/10/2012	SCALE AS SHOWN	REV. 0
GIS		04/10/2012		
CHECK	ADM	04/10/2012		
REVIEW	TWT	04/10/2012		

FIGURE 2.2-2



Note:
Pillar sizes, entry widths, etc. may vary from those depicted due to mining conditions or other unforeseen circumstances, but will be configured to remain within the 58% extraction limitations.

LEGEND:

COAL LEFT IN PLACE

AREAS COAL REMOVED

TYPICAL 55' X 60' BLOCK OF COAL 3,300 sq. ft.

COAL LEFT IN PLACE 1,400 sq. ft (29' X 48' BLOCK OF COAL)

AREA MINED 1,908 sq. ft.

TOTAL AREA MINED 58% OF BLOCK

TOTAL COAL LEFT IN PLACE 42% OF BLOCK

SOURCE: SHAMROCK 2011

TITLE

TYPICAL ENTRY PANELS SHOWING 58% EXTRACTION RATE

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No.	103-81786		FILE No.	10381786A005	
DESIGN	TWM	04/05/12	SCALE	N\A	REV. A
CADD	TWM	04/05/12			
CHECK	ASM	04/05/12			
REVIEW	MWB	04/05/12			

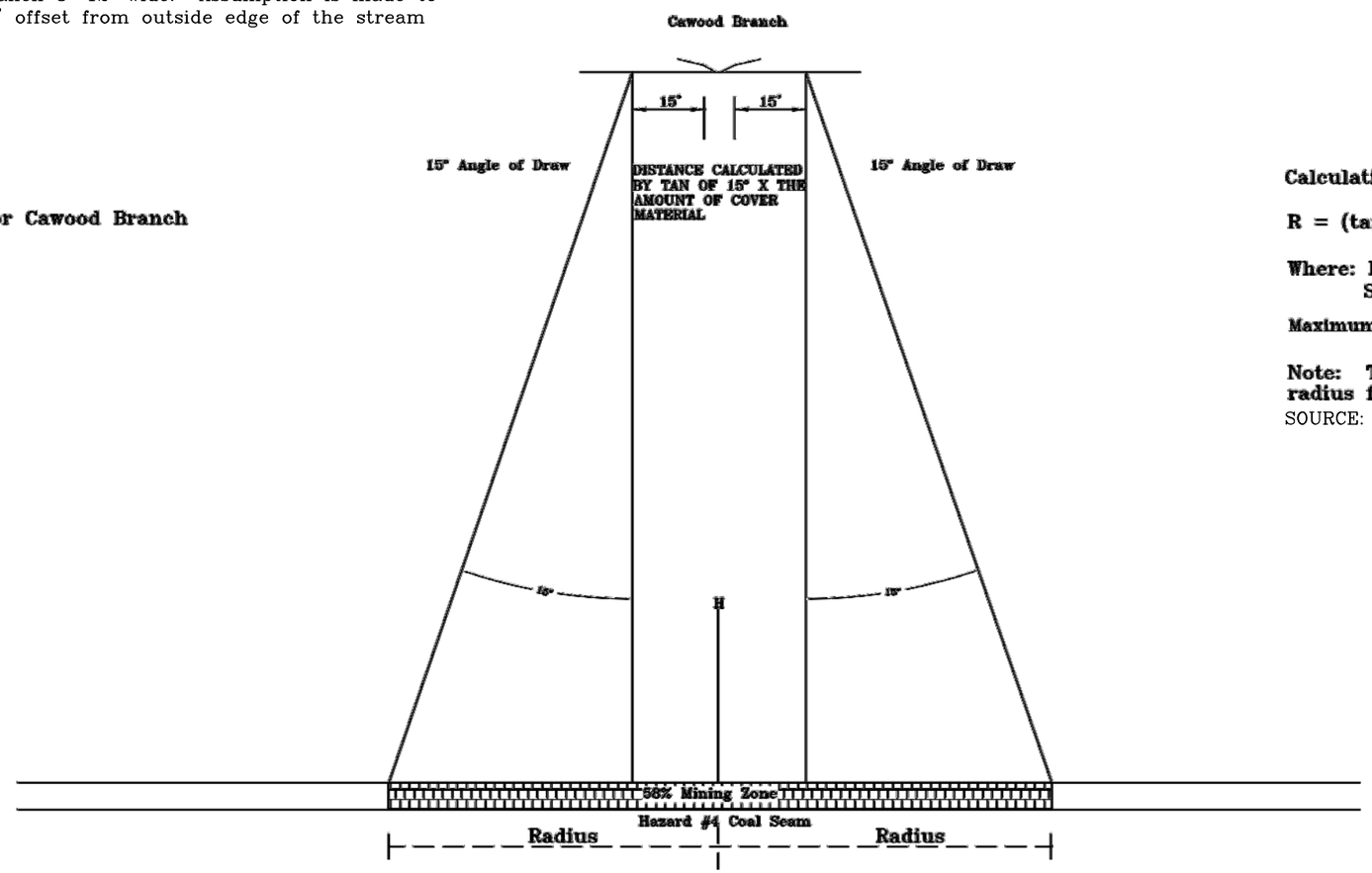
FIGURE 2.2-3

Drawing File: N:\10\103-81786_A NEPA SUPPORT FIGURES\ 10381786A005.dwg | Layout: Layout1 | Modified: Jun 01, 2012 11:05 MTMarks | Plotted: 06/01/12 11:06am MTMarks

Cawood branch 8'–12' wide. Assumption is made to provide 15' offset from outside edge of the stream bank.

Calculation for Protection Zone for Cawood Branch

Maximum depth of cover = 300'



Calculation for Protection Zone for Cawood Branch

R = (tan 15° * H) + 15 ft. + (0.5)S

Where: H = depth of surface to coal seam in feet
S = width of stream in feet

Maximum Depth of cover = 50' * coal seam thickness + 150'

Note: This radius shown is the maximm radius for this protection zone.

SOURCE: SHAMROCK 2011

TITLE

TYPICAL STRAM AND STRUCTURE PROTECTION DESIGN

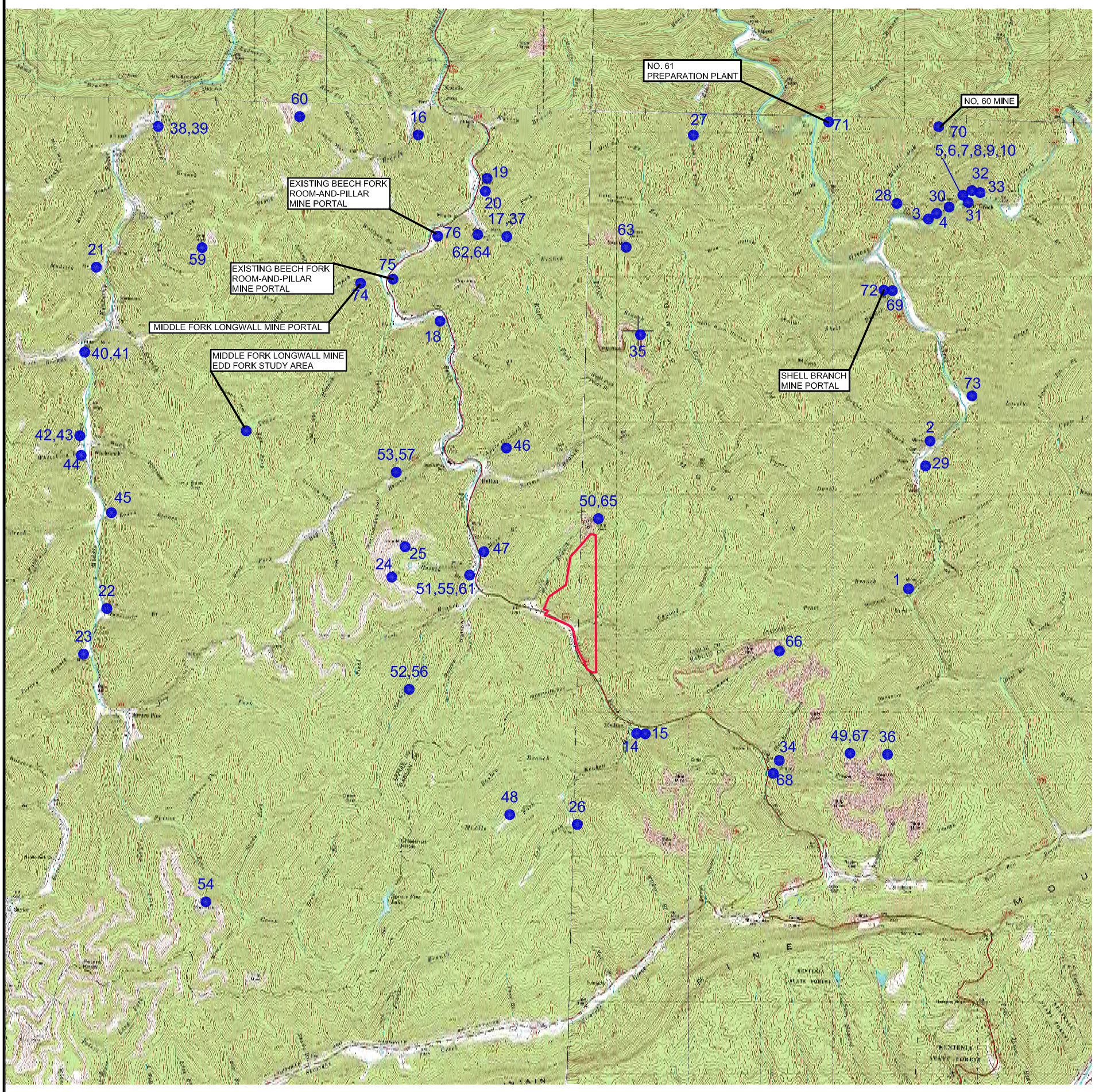
NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT

BLEDSOE LEASE BY APPLICATION
EA (KYES-5386)
LESLIE COUNTY, KY

PROJECT No.		103–81786	FILE No.	10381786A003	
DESIGN	TWM	04/05/12	SCALE	N\A	REV. A
CADD	TWM	04/05/12			
CHECK	ASM	04/05/12	**FIGURE 2.2-4**		
REVIEW	MWB	04/05/12			

Drawing File: N:\10\103–81786_A NEPA SUPPORT FIGURES\ 10381786A003.dwg | Layout: Layout1 | Modified: Apr 11, 2012 14:52 MMarks | Plotted: 06/01/12 11:20am MMarks



LEGEND

PROPOSED ACTION BOUNDARY

48

HISTORICAL MINE SITE
(SEE ATTACHED TABLE ON FIGURE 2.6–1B
FOR DESCRIPTION).

5000 0 5000 10000

1" = 5000' Feet

TITLE

MINING ACTIVITY IN THE VICINITY OF THE TRACT (PAGE 1 OF 2)

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No.	103–81786		FILE No.	10381786A008
DESIGN	MWB	06/21/12	SCALE N\A	REV. A
CADD	MTM	06/21/12		
CHECK	ASM	06/21/12		
REVIEW	MWB	06/21/12		

FIGURE 2.4-1A

Drawing File: N:\10\103–81786_A NEPA SUPPORT FIGURES\ 10381786A008.dwg | Layout: FIG 2.6–1A | Modified: Jun 22, 2012 14:07 MTMarks | Plotted: 06/22/12 2:41pm MTMarks

Site Number	USGS 7.5' Quad	Description*	Distance From Proposed Action (miles)
1	Bledsoe	mouth of Trace Fork, valley floor of Laurel Fork of Greasy Creek	2.8
2	Helton	mouth of Lower Double Branch, valley floor of Laurel Fork of Greasy Creek	3.0
3	Helton	1 of 10 other locations along main Greasy Creek where seam opened	4.1
4	Helton	2 of 10 other locations along main Greasy Creek where seam opened	4.2
5	Helton	3 of 10 other locations along main Greasy Creek where seam opened	4.3
6	Helton	4 of 10 other locations along main Greasy Creek where seam opened	4.3
7	Helton	5 of 10 other locations along main Greasy Creek where seam opened	4.3
8	Helton	6 of 10 other locations along main Greasy Creek where seam opened	4.3
9	Helton	7 of 10 other locations along main Greasy Creek where seam opened	4.3
10	Helton	8 of 10 other locations along main Greasy Creek where seam opened	4.3
11	Helton	9 of 10 other locations along main Greasy Creek where seam opened	4.3
12	Helton	10 of 10 other locations along main Greasy Creek where seam opened	4.3
14	Helton	southeast of Bledsoe post office at mouth of Rueben Branch	0.6
15	Helton	southeast of Bledsoe post office at mouth of Rueben Branch	0.6
16	Helton	two openings at Stone Coal Branch	3.7
17	Helton	mouth of Dug Fork of Peters Branch	2.6
18	Helton	Beech Fork about 2,000 ft east of mouth of Trace Branch	2.2
19	Helton	one of two openings north of the mouth of Peters Branch	3.2
20	Helton	one of two openings north of the mouth of Peters Branch	3.2
21	Helton	at mouth of Mudlick Branch, along Middle Fork to west	4.4
22	Helton	at mouth of Hurricane Branch, along Middle Fork to west	3.7
23	Helton	at mouth of Turkey Branck, along Middle Fork to west	4.0
24	Helton	two openings/mines-one of two seams(Hazard No. 5A?)opened on Hoskin Branch	1.4
25	Helton	strip mine - one of two seams (Hazard No. 9 or 10) opened on Hoskin Branch	1.3
26	Helton	possibly Hazard No. 5A - part of large strip mine? - Left Fork of Rueben Branch	1.3
27	Bledsoe	Hazard No. 4 in two places near mouth of Dug Fork of Elk Creek	3.5
28	Bledsoe	opening at mouth of White Oak Creek	4.4
29	Bledsoe	two openings at mouth of Upper Double Branch of Laurel Fork	2.9
30	Bledsoe	one of several openings on Greasy Creek near White Oak Creek	4.2
31	Bledsoe	one of several openings on Greasy Creek near White Oak Creek	4.3
32	Bledsoe	one of several openings on Greasy Creek near White Oak Creek	4.4
33	Bledsoe	one of several openings on Greasy Creek near White Oak Creek	4.5
34	Bledsoe	two openings approximately 1,000 ft south of the mouth of Daws Branch of the Beech Fork	1.8
35	Bledsoe	opening of unnamed seam - possibly Hazard No. 7 or 8 - near head of Peters Branch (Left Fork?)	1.8
36	Bledsoe	opening of unnamed seam - possibly Hazard No. 7 or 8 - about 3,000 ft south of Opposum Hollow of Laurel Fork	2.6
37	Helton	additional opening near Dug Fork of Peters Branch of Beech Fork	2.6
38	Helton	one of two openings near mouth of Ginseng Branch along Middle Fork	5.1
39	Helton	one of two openings near mouth of Ginseng Branch along Middle Fork	5.1
40	Helton	one of two openings near mouth of Rye Cove Branch along Middle Fork	4.5
41	Helton	one of two openings near mouth of Rye Cove Branch along Middle Fork	4.5
42	Helton	one of two openings near mouth of Buck Hollow along Middle Fork	4.3
43	Helton	one of two openings near mouth of Buck Hollow along Middle Fork	4.3
44	Helton	opening at mouth of Whitehead Branch along Middle Fork	4.2
45	Helton	opening at mouth of Roark Branch along Middle Fork	3.8
46	Helton	opening on Apple Orchard Branch - unnamed seam	1.1
47	Helton	opening near mouth of Mare Branch of the Beech Fork - unnamed seam	0.7
48	Helton	opening 5A seam on Middle Fork of Rueben Branch	1.4
49	Helton	strip mine - unnamed seam - likely Hazard No. 7 or 8 - abut 4,000 ft east of mouth of Oldhouse Branch	2.3
50	Bledsoe	strip mine - head - Hazard No. 9	0.1
51	Helton	Hoskin Branch - Hazard No. 9	0.7
52	Helton	Onemile Branch - Hazard No. 9	1.3
53	Helton	Big Branch - Hazard No. 9	1.7
54	Helton	Spruce Pine Creek - Hazard No. 9	3.8
55	Helton	Hoskin Branch - Hazard No. 10	0.7
56	Helton	Onemile Branch - Hazard No. 10	1.3
57	Helton	Big Branch - Hazard No. 10	1.7
58	Helton	Potato Knob - Hazard No. 10	6.2
59	Helton	4,000 ft southeast of mouth of Elk Branch of Middle Fork - Hazard No. 10	4.2
60	Helton	3,000 ft northwest of mouth of Lizzie Hollow of Stone Coal Branch - entire mountaintop removed - strip mine - Hazard No. 10	4.4
61	Helton	knob at Hoskin Branch - Hazard No. 10	0.7
62	Helton	south side of Peters Branch - prominent highwall from contour strip mine - Hazard No. 7 or 8	2.7
63	Bledsoe	near Peters Gap - Hazard No. 7 or 8	2.5
64	Helton	south side of Peters Branch - prominent highwall from contour strip mine - Hazard No. 9	2.7
65	Bledsoe	Fern Branch - Hazard No. 9	0.1
66	Bledsoe	Chumney Branch - Hazard No. 9	1.6
67	Bledsoe	Oldhouse Branch - Hazard No. 9	2.3
68	Bledsoe	Daws Branch - Hazard No. 9	1.8
69	Bledsoe	Shell Branch - Hazard No. 9	3.3
70	Bledsoe	No. 60 Mine	~4.6
71	Bledsoe	No. 61 Preparation Plant	~4.1
72	Bledsoe	Hazard No. 4; room and pillar; Shell Branch Mine	3.3
73	Bledsoe	Hazard No. 4; room and pillar, inactive; Straight Creek Mine	~3.5
74	Helton	Hazard No. 4; longwall, inactive; Middle Fork Mine	~2.9
75	Helton	Hazard No. 4; room and pillar, active; Beech Fork room-and-pillar mine	2.8
76	Helton	Hazard No. 4; room and pillar, active; Beech Fork room-and-pillar mine	2.9

*** Please see Chapter 2 for more complete descriptions.**

TITLE

MINING ACTIVITY IN THE VICINITY OF THE TRACT (PAGE 2 OF 2)

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No.	103-81786		FILE No.	10381786A009	
DESIGN	MWB	06/21/12	SCALE	N\A	REV. A
CADD	MTM	06/21/12	**FIGURE 2.4-1B**		
CHECK	ASM	06/21/12			
REVIEW	MWB	06/21/12			

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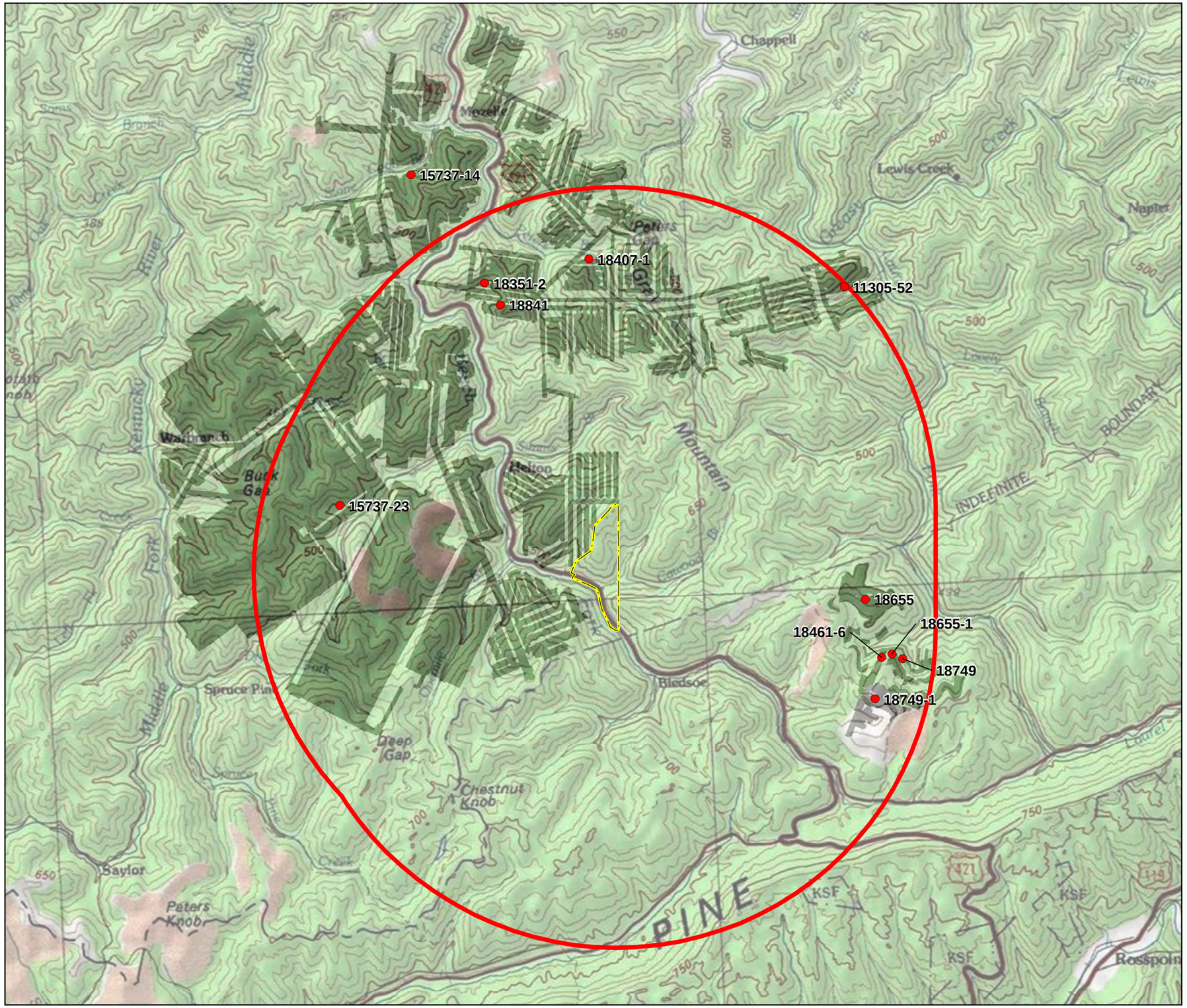

LEGEND

- Mining Activity State File Number
- Lease Boundary (KYES-53865)
- 3-Mile Radius from Lease Boundary
- Underground Mining Extent

NOTES

MINING ACTIVITY STATE FILE NUMBER MAY NOT CONTAIN MOST RECENT MINING ACTIVITY AND IS DISPLAYING CENTER POINT OF MINE EXTENT .

REFERENCES

COORDINATE SYSTEM: NAD 1927 STATEPLANE KENTUCKY SOUTH FIPS 1602. PROPOSED LEASE BOUNDARY FOLLOWS DANIEL BOONE NATIONAL FOREST (DBNF) OWNERSHIP BOUNDARIES, FROM GIS DATA PROVIDED BY DBNF, AND IS NOT FROM A FIELD SURVEY. MINING ACTIVITY STATE FILE NUMBER CENTER POINT LOCATIONS DERIVED FROM UNDERGROUND MINING EXTENT PROVIDED BY KENTUCKY MINE MAPPING INFORMATION SYSTEM (MINEMAPS.KY.GOV) AND DOWNLOADED ON NOVEMBER 11, 2011.

0 5,000 10,000
FEET

1 INCH = 5,000 FEET
IF PRINTED AT 11 X 17 IN

N

TITLE
MINING ACTIVITY WITHIN THREE MILES OF THE LEASE BOUNDARY OCCURRING IN THE LAST 10 YEARS

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT
BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No. 103-81786			FILE No. MiningActivity.mxd	
DESIGN	JMH	6/29/2012	SCALE AS SHOWN	REV 0
GIS	JMH	6/29/2012		
CHECK	ADM	6/29/2012	**FIGURE 2.4-2**	
REVIEW	TWT	6/29/2012		

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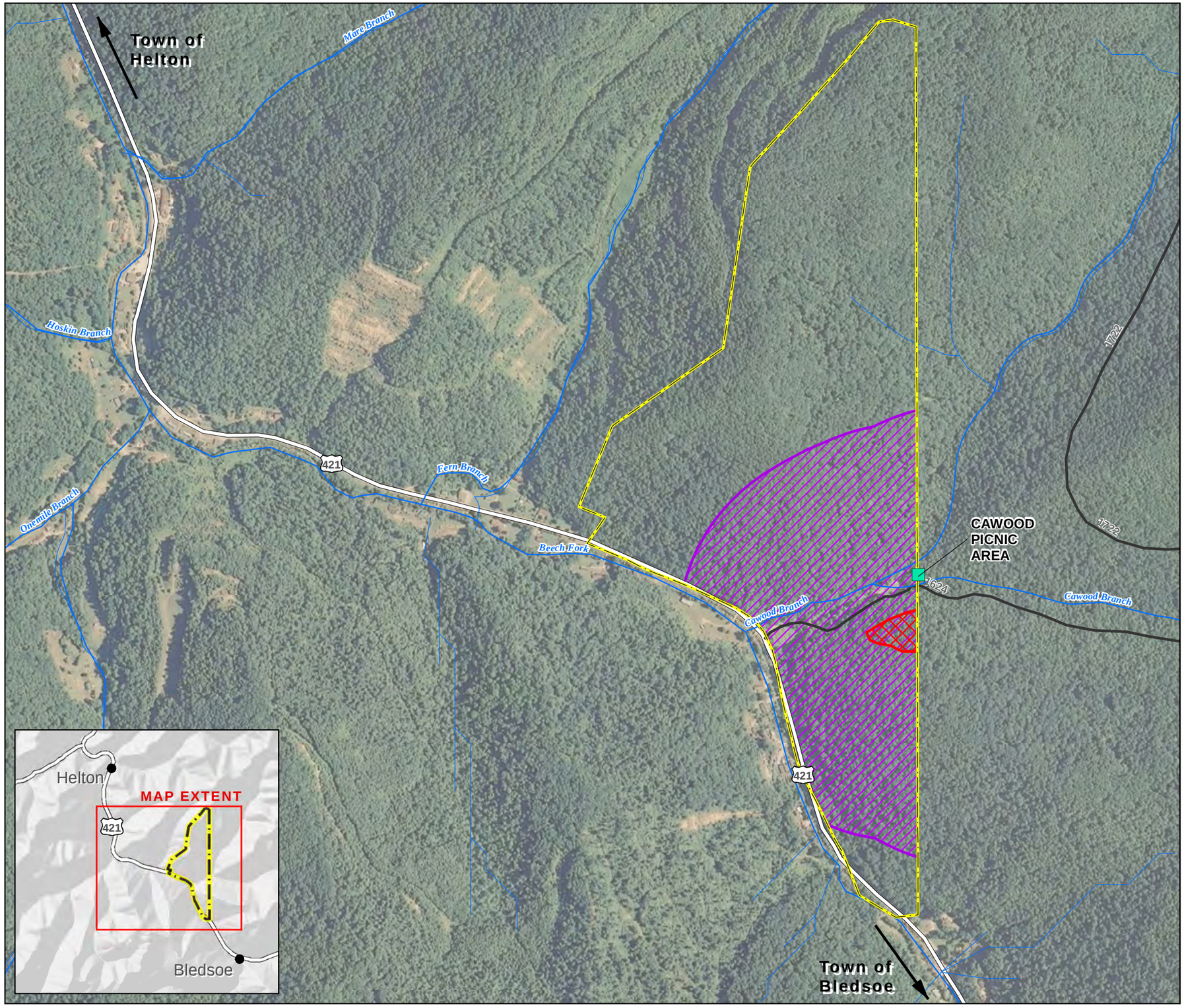

LEGEND

- Recreation Site
- Lease Boundary (KYES-53865)
- Stream
- Hemlock Woolly Adelgid Treatment HCA-Chemical
- Hemlock Woolly Adelgid Treatment HCA-Biological

Roads

- US Highway
- Unimproved

REFERENCES

COORDINATE SYSTEM: NAD 1927 STATEPLANE KENTUCKY SOUTH FIPS 1602. PROPOSED LEASE BOUNDARY FOLLOWS DANIEL BOONE NATIONAL FOREST (DBNF) OWNERSHIP BOUNDARIES, FROM GIS DATA PROVIDED BY DBNF, AND IS NOT FROM A FIELD SURVEY. ROADS, STREAMS, AND TREATMENT AREAS PROVIDED BY THE DBNF.

0 700 1,400
FEET

1 INCH = 700 FEET
IF PRINTED AT 11 X 17 IN

N

TITLE

HEMLOCK WOOLY ADELGID TREATMENT AREAS

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No. 103-81786			FILE No.	Treatment_Areas.mxd
DESIGN	JMH	6/29/2012	SCALE	REV
GIS	JMH	6/29/2012		
CHECK	ADM	6/29/2012	**FIGURE 2.4-3**	
REVIEW	TWT	6/29/2012		

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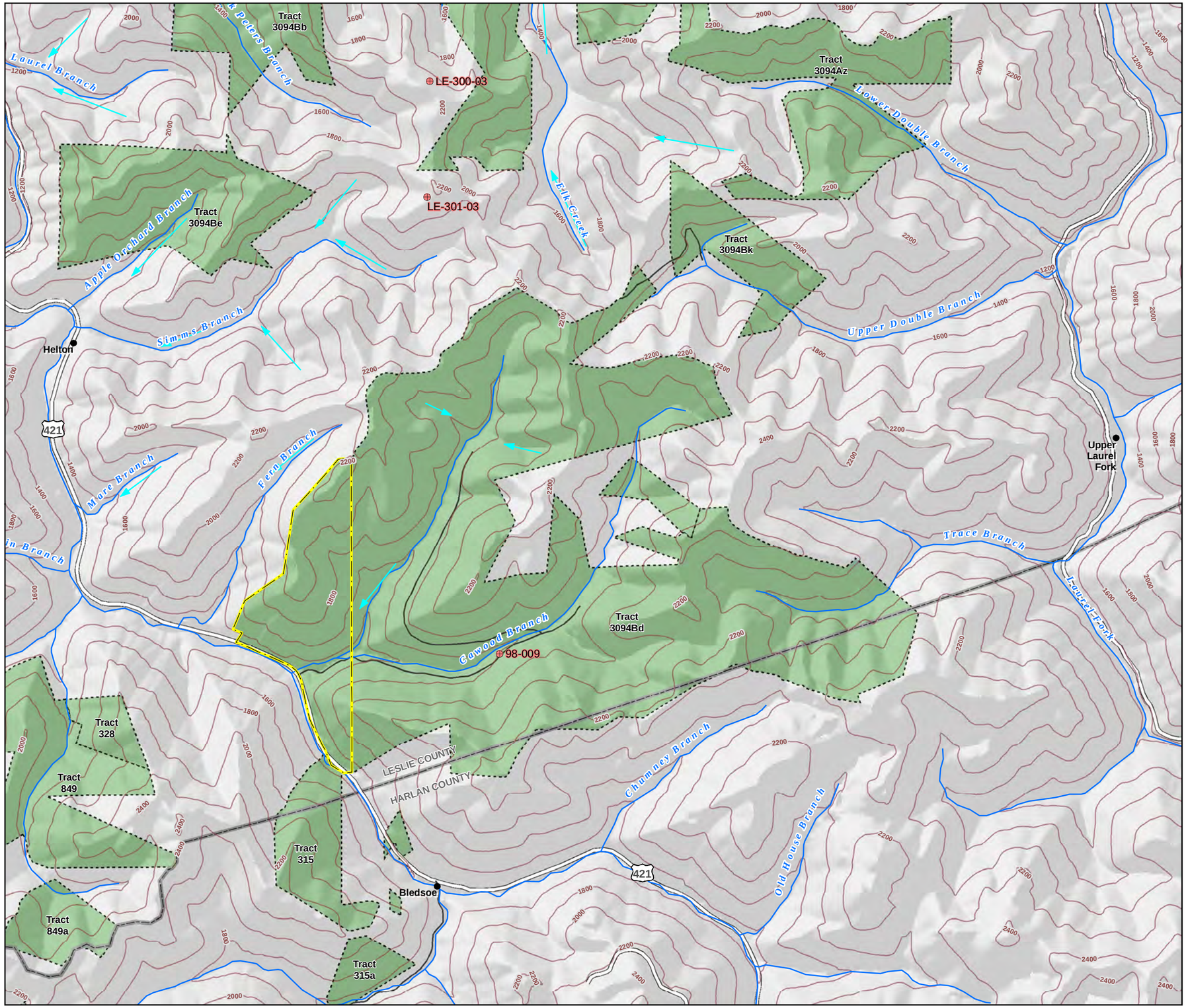

LEGEND

- Lease Boundary (KYES-53865)
- USFS Tract
- Geologic Core Hole
- Groundwater Flow Direction
- Stream
- Surface Elevation (200-foot contour interval)

Road

- US Highway
- Unimproved

NOTES

NO KNOWN SPRINGS WITHIN LEASE BOUNDARY (KENTUCKY GEOLOGICAL SURVEY).

REFERENCES

COORDINATE SYSTEM: NAD 1927 STATEPLANE KENTUCKY SOUTH FIPS 1602. PROPOSED LEASE BOUNDARY FOLLOWS DANIEL BOONE NATIONAL FOREST (DBNF) OWNERSHIP BOUNDARIES, FROM GIS DATA PROVIDED BY DBNF, AND IS NOT FROM A FIELD SURVEY. ROADS AND STREAMS PROVIDED BY THE DBNF. SURFACE ELEVATION CONTOURS DERIVED FROM DIGITAL ELEVATION MODEL PROVIDED BY USGS. OIL AND GAS WELLS PROVIDED BY KENTUCKY GEOLOGICAL SURVEY. GEOLOGIC CORE HOLES, AND GROUNDWATER FLOW DIRECTION PROVIDED BY SHAMROCK COAL CO., INC.

N

0 2,000 4,000
FEET

1 INCH = 2,000 FEET
IF PRINTED AT 11 X 17 IN

TITLE

TOPOGRAPHIC MAP

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No. 103-81786			FILE No.	TopographicMap.mxd
DESIGN	JMH	6/29/2012	SCALE AS SHOWN	REV 0
GIS	JMH	6/29/2012		
CHECK	ADM	6/29/2012	**FIGURE 3.2-1**	
REVIEW	TWT	6/29/2012		

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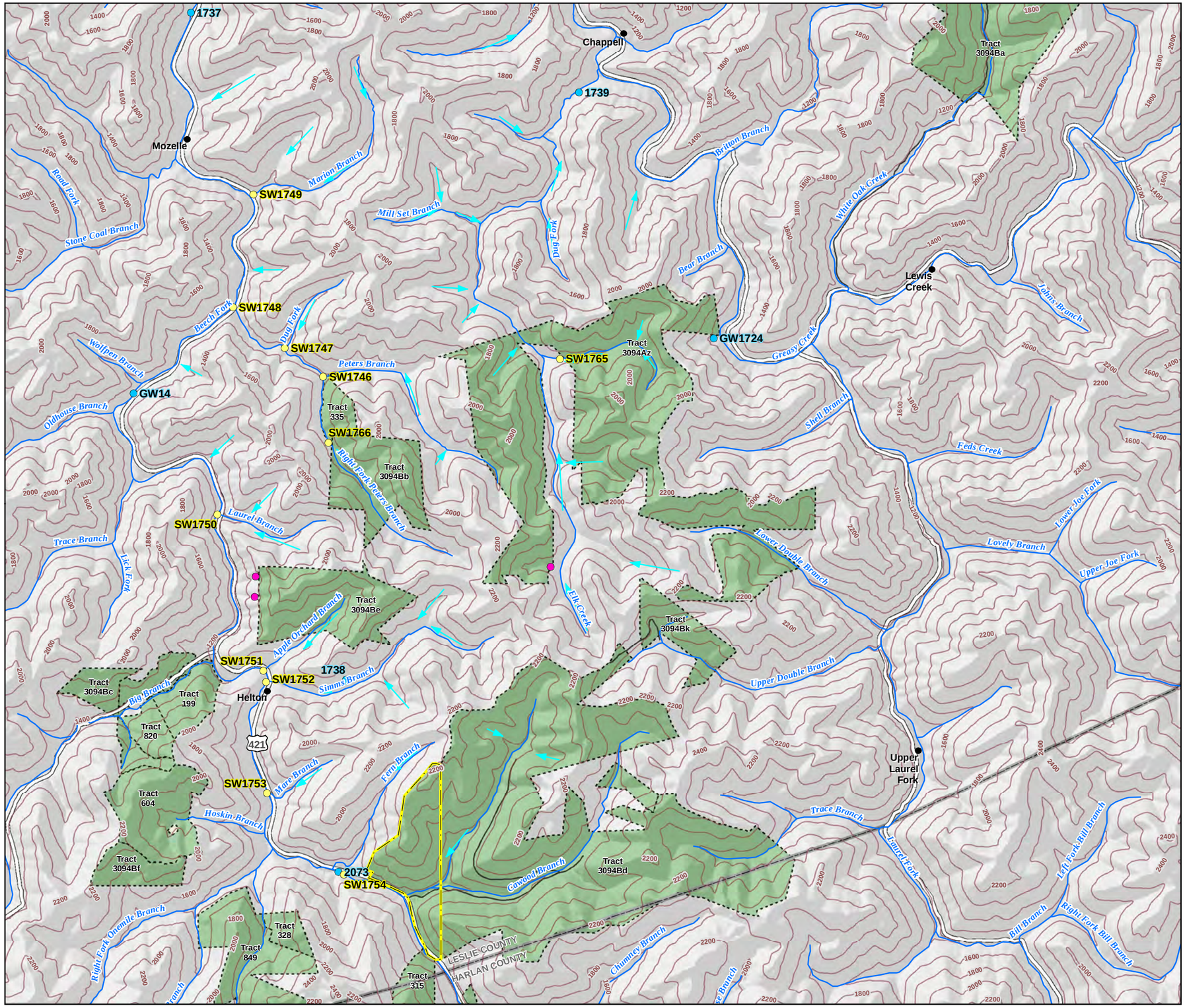

LEGEND

- Lease Boundary (KYES-53865)
- USFS Tract
- Groundwater Monitoring
- Surface Water Monitoring
- Seep
- Groundwater Flow Direction
- Stream
- Surface Elevation (200-foot contour interval)

Road

- US Highway
- Unimproved

NOTES

NO KNOWN SPRINGS WITHIN LEASE BOUNDARY (KENTUCKY GEOLOGICAL SURVEY).

REFERENCES

COORDINATE SYSTEM: NAD 1927 STATEPLANE KENTUCKY SOUTH FIPS 1602. PROPOSED LEASE BOUNDARY FOLLOWS DANIEL BOONE NATIONAL FOREST (DBNF) OWNERSHIP BOUNDARIES, FROM GIS DATA PROVIDED BY DBNF, AND IS NOT FROM A FIELD SURVEY. ROADS AND STREAMS PROVIDED BY THE DBNF. SURFACE ELEVATION CONTOURS DERIVED FROM DIGITAL ELEVATION MODEL PROVIDED BY USGS. OIL AND GAS WELLS PROVIDED BY KENTUCKY GEOLOGICAL SURVEY. GROUNDWATER AND SURFACE WATER MONITORING STATIONS, GEOLOGIC CORE HOLES, GROUNDWATER FLOW DIRECTION, AND WATERSHED BOUNDARIES LESS THAN 200 ACRES PROVIDED BY SHAMROCK COAL CO., INC.

N

0 3,200 6,400
FEET

1 INCH = 3,200 FEET
IF PRINTED AT 11 X 17 IN

TITLE

GROUNDWATER AND SURFACE WATER MONITORING LOCATIONS

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No. 103-81786			FILE No. GroundandSurface_Water.mxd
DESIGN		6/29/2012	SCALE REV
GIS		6/29/2012	
CHECK		6/29/2012	FIGURE 3.2-2
REVIEW		6/29/2012	

M:\BledsoeArcMap\EA\GroundandSurface_Water.mxd | Modified: KJCarpenter 6/29/2012 2:14:33 PM | Denver, CO

LEGEND

Lease Boundary (KYES-53865)

USFS Tracts

Cross-section Location

AREA NORTH OF PINE MOUNTAIN

Qal — Alluvium

Qlc — Landslide debris and colluvium

Lower and Middle Pennsylvanian

IPb — Breathitt Formation

k, coal bed in Knob coal zone
c, unnamed coal bed
lcl, base of Lost Creek Limestone of Morse (1931)
hi, Hindman coal bed
hs, Hazard No. 8 coal bed
hz, coal bed in Hazard coal zone
m, base of Magoffin Beds of Morse (1931)
fc, Fire Clay coal bed
*w, coal bed in Whitesburg coal zone

IPbu — Breathitt Formation, intensely deformed undivided
*c, unnamed coal bed

*Shown by outcrop or prospect symbol only

REFERENCES

COORDINATE SYSTEM: NAD 1927 STATEPLANE KENTUCKY SOUTH FIPS 1602. PROPOSED LEASE BOUNDARY FOLLOWS DANIEL BOONE NATIONAL FOREST (DBNF) OWNERSHIP BOUNDARIES, FROM GIS DATA PROVIDED BY DBNF, AND IS NOT FROM A FIELD SURVEY. GEOLOGIC MAP OF THE BLEDSOE QUADRANGLE, SOUTHEASTERN KENTUCKY (BELA CSEJTEY, JR., US GEOLOGICAL SURVEY 1971) AND GEOLOGIC MAP OF THE HELTON QUADRANGLE, SOUTHEASTERN KENTUCKY (DUDLEY D. RICE, US GEOLOGICAL SURVEY 1975).

N

0 3,000 6,000
FEET

1 INCH = 3,000 FEET
IF PRINTED AT 11 X 17 IN

TITLE

GEOLOGIC MAP

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No. 103-81786			FILE No. GeologicMap.mxd	
DESIGN	JMH	6/29/2012	SCALE AS SHOWN	REV 0
GIS	JMH	6/29/2012	FIGURE 3.2-3	
CHECK	ADM	6/29/2012		
REVIEW	TWT	6/29/2012		

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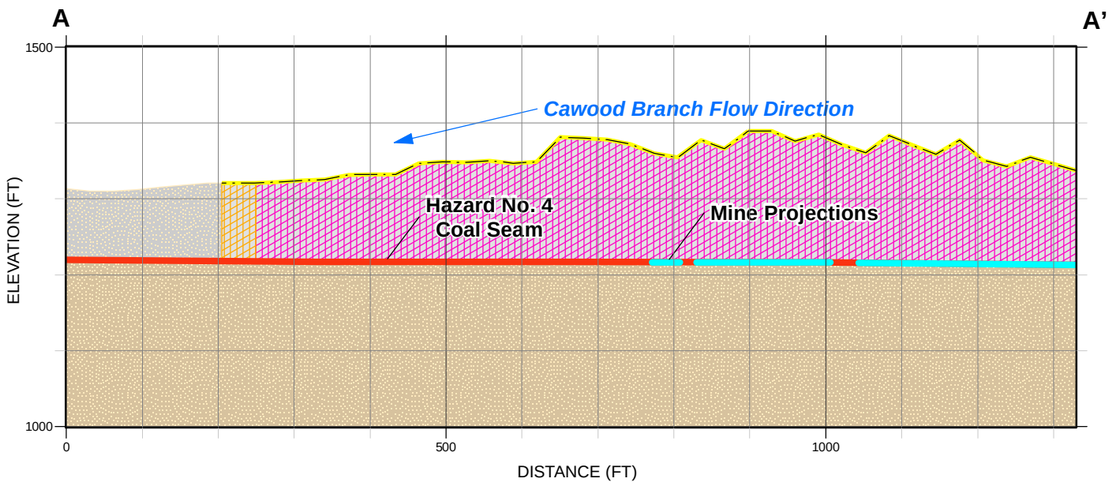
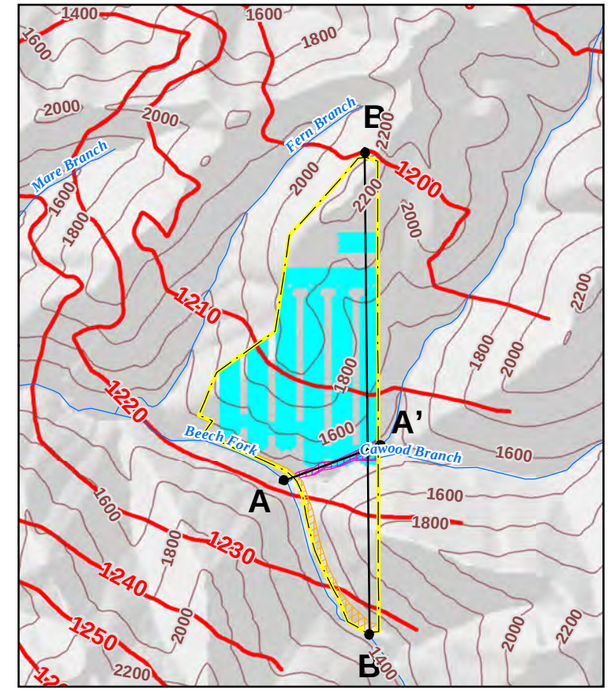


0 200 400 FEET

1 INCH = 200 FEET

IF PRINTED AT 11 X 17 IN



0 2,000 4,000 FEET

1 INCH = 2,000 FEET

IF PRINTED AT 11 X 17 IN

LEGEND

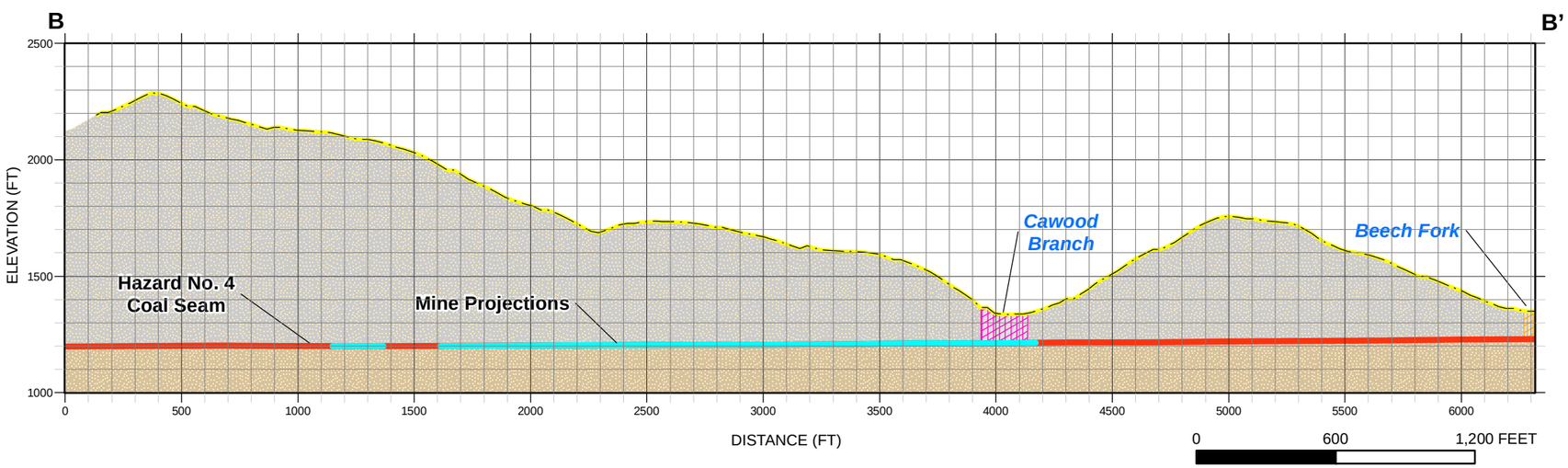
- Cross-section
- Lease Boundary (KYES-53865)
- No Mining
- Approximate Recovery 58% No Total Retreat Mining
- Stream
- Surface Elevation (200-foot contour interval)
- Base of Hazard No. 4 Coal Seam Contour (ft)
- Mine Projections
- Approximate Overburden
- Subsurface

NOTES

CROSS-SECTIONS CREATED USING CROSSVIEW FOR ARCGIS.
VERTICAL EXAGGERATION: NONE

REFERENCES

COORDINATE SYSTEM: NAD 1927 STATEPLANE KENTUCKY SOUTH FIPS 1602. PROPOSED LEASE BOUNDARY FOLLOWS DANIEL BOONE NATIONAL FOREST (DBNF) OWNERSHIP BOUNDARIES, FROM GIS DATA PROVIDED BY DBNF, AND IS NOT FROM A FIELD SURVEY. ROADS AND STREAMS PROVIDED BY THE DBNF. SURFACE ELEVATION CONTOURS DERIVED FROM DIGITAL ELEVATION MODEL PROVIDED BY USGS. MINE PROJECTIONS, PROTECTIVE BOUNDARIES PROVIDED BY SHAMROCK COAL CO., INC. EXISTING UNDERGROUND MINE WORKINGS ARE A COMPILATIONS OF DATA PROVIDED BY SHAMROCK COAL CO. AND KENTUCKY GEOLOGIC SURVEY. BASE OF HAZARD NO. 4 COAL SEAM CONTOURS INTERPOLATED FROM KNOWN UNDERGROUND MINE WORKING ELEVATIONS PROVIDED BY SHAMROCK COAL CO. USING SURFER 9 AND ARCGIS 10.



0 600 1,200 FEET

1 INCH = 600 FEET

IF PRINTED AT 11 X 17 IN

N

TITLE

TYPICAL HAZARD NO. 4 COAL SEAM CROSS SECTION AND PROTECTIVE BOUNDARY

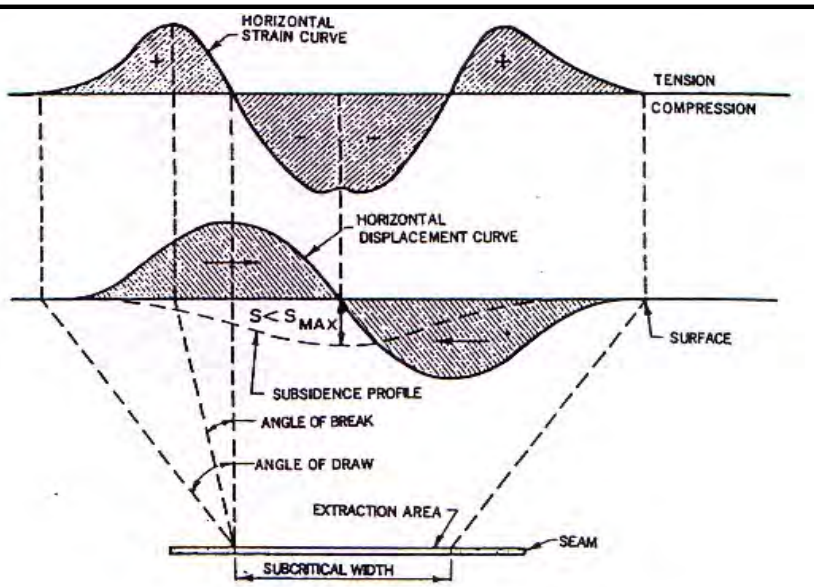
NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No. 103-81786			FILE No. Coal_Seam_CrossSection.mxd
DESIGN	JMH	6/29/2012	SCALE AS SHOWN REV 0
GIS	JMH	6/29/2012	FIGURE 3.2-4
CHECK	ADM	6/29/2012	
REVIEW	TWT	6/29/2012	

M:\Bledsoe\ArcMap\EA\Coal_Seam_CrossSection.mxd | Modified: JHesker 6/29/2012 11:39:54 AM | Denver, CO



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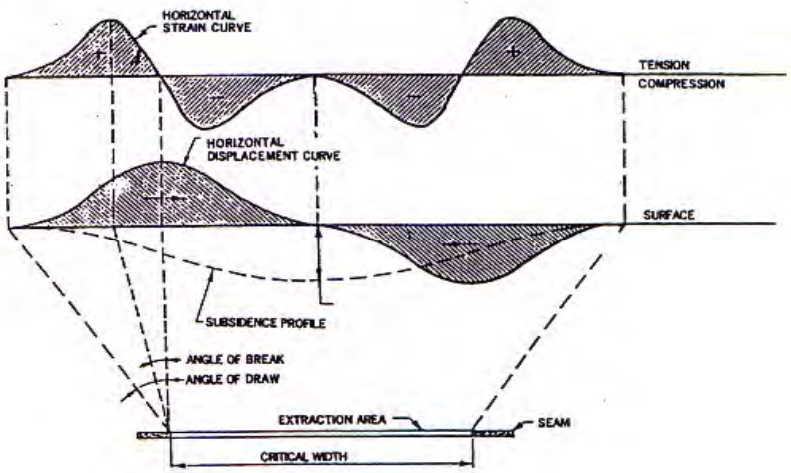
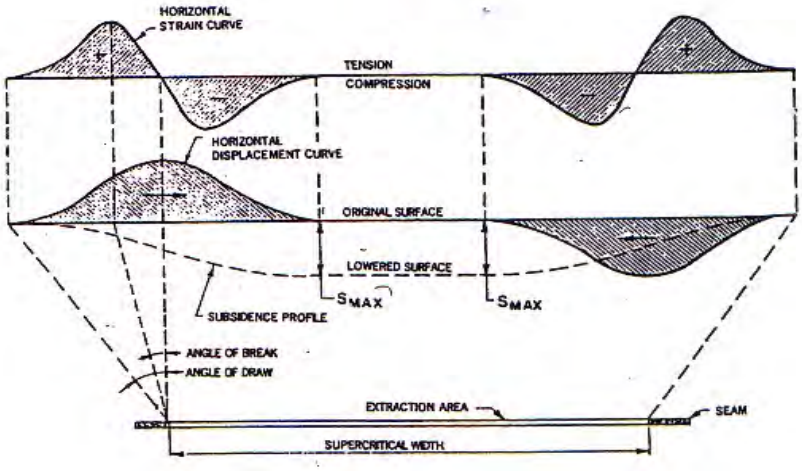


(b)

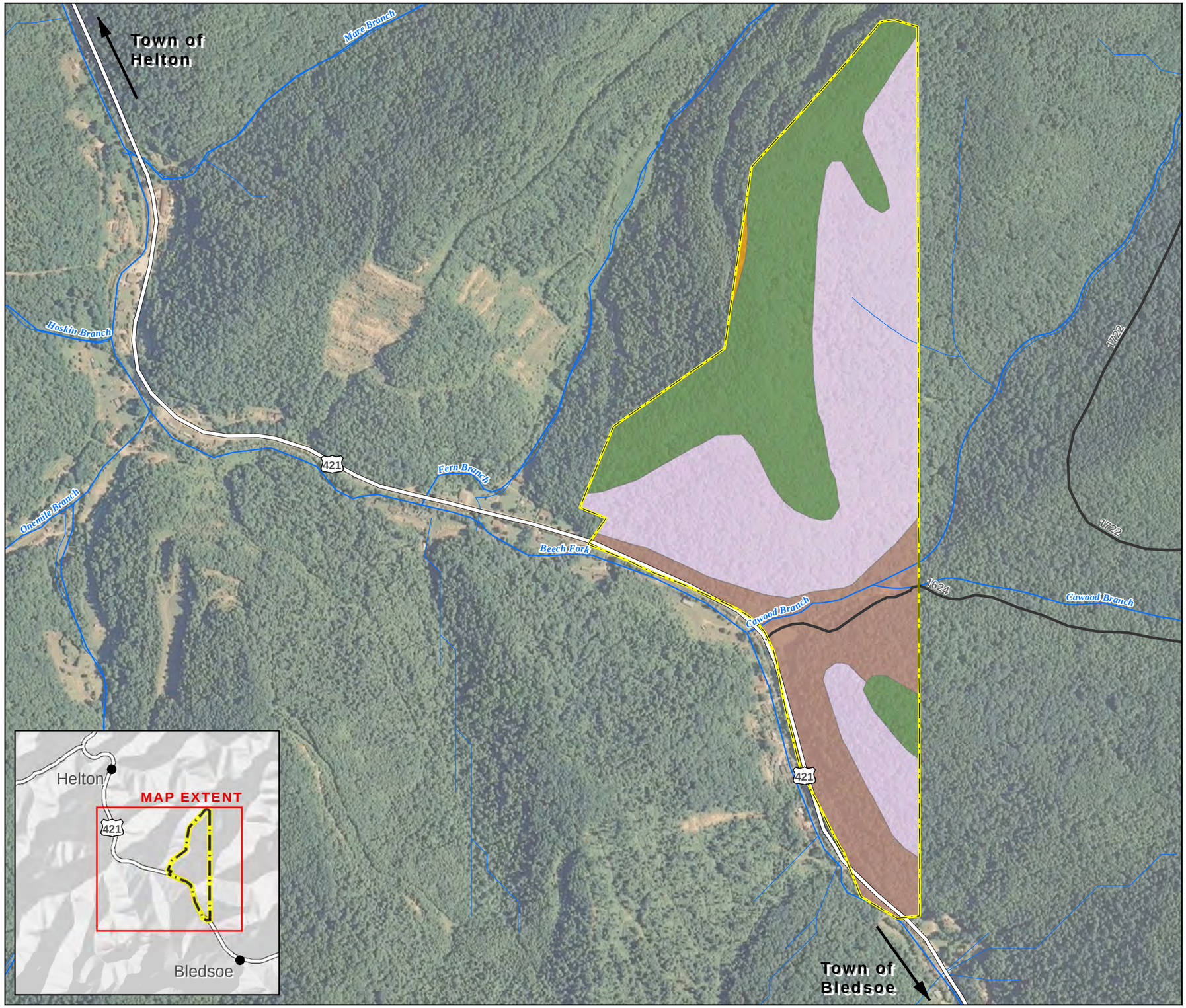


SCHEMATIC OF DISPLACEMENT AND STRAIN CURVE FOR VARIOUS WORKING WIDTHS

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT NO.	103-81786		FILE	Figure 3.2-5.xlsx	
DESIGN	JMH	04/10/2012	SCALE	AS SHOWN	REV. 0
GIS		04/10/2012			
CHECK	ADM	04/10/2012			
REVIEW	TWT	04/10/2012			

FIGURE 3.2-5



LEGEND

Lease Boundary (KYES-53865)

Roads

US Highway

Unimproved

Stream

Soil Types

Dekalb-Rock outcrop-Latham association, steep

Fairpoint soils, steep, benched

Shelocta-Cutshin association, steep

Shelocta-Gilpin association, steep

REFERENCES

COORDINATE SYSTEM: NAD 1927 STATEPLANE KENTUCKY SOUTH FIPS 1602. PROPOSED LEASE BOUNDARY FOLLOWS DANIEL BOONE NATIONAL FOREST (DBNF) OWNERSHIP BOUNDARIES, FROM GIS DATA PROVIDED BY DBNF, AND IS NOT FROM A FIELD SURVEY. ROADS AND STREAMS PROVIDED BY THE DBNF. SOILS PROVIDED BY NRCS.

N

0 700 1,400

FEET

1 INCH = 700 FEET

IF PRINTED AT 11 X 17 IN

TITLE

SOILS

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

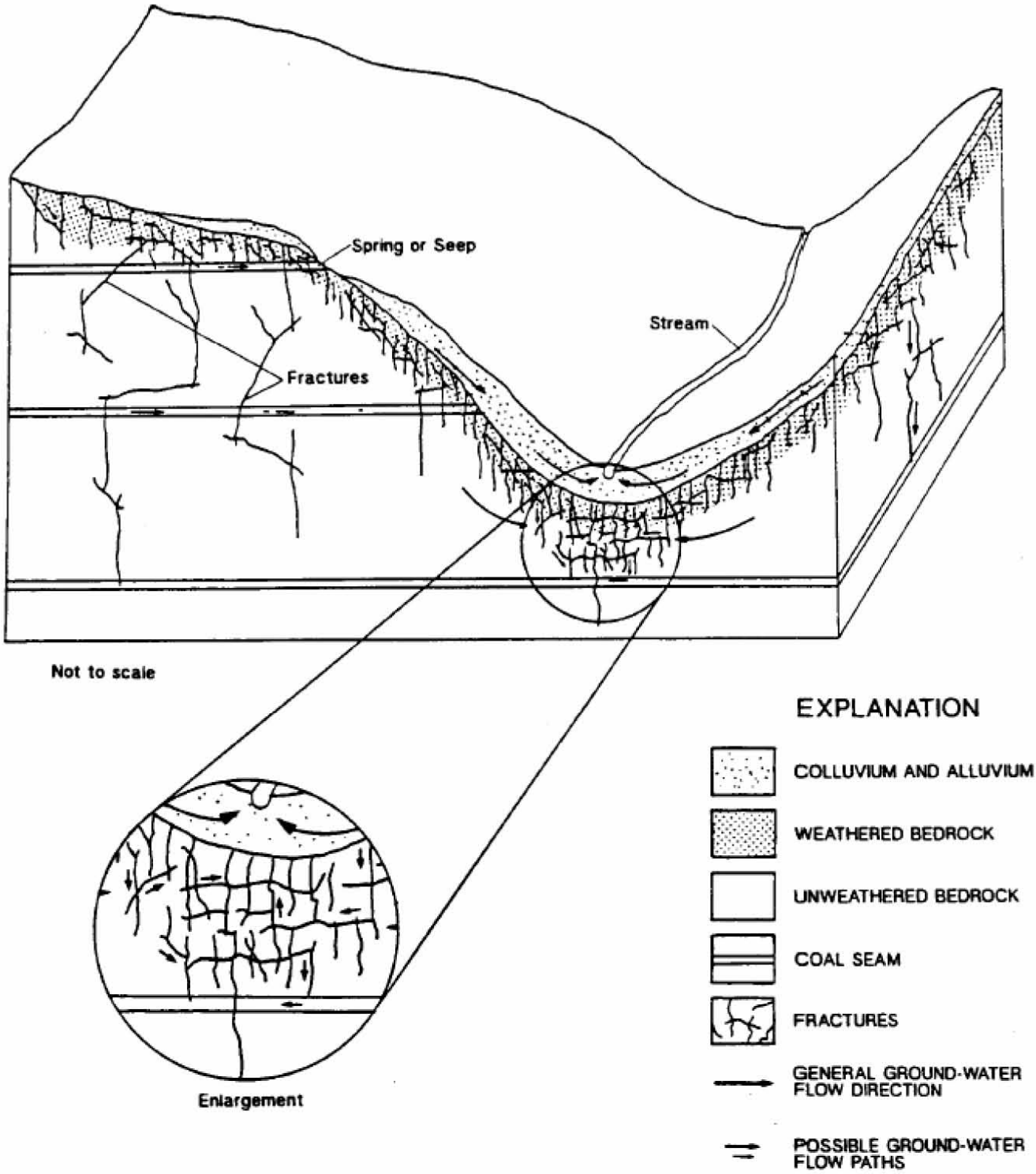
PROJECT

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No. 103-81786			FILE No.	SoilTypes.mxd
DESIGN	JMH	6/29/2012	SCALE AS SHOWN	REV 0
GIS	JMH	6/29/2012		
CHECK	ADM	6/29/2012		
REVIEW	TWT	6/29/2012		

FIGURE 3.3-1

M:\BledsoeArcMap\EA\SoilTypes.mxd | Modified: KJCarpenter 6/29/2012 11:42:41 AM | Denver, CO

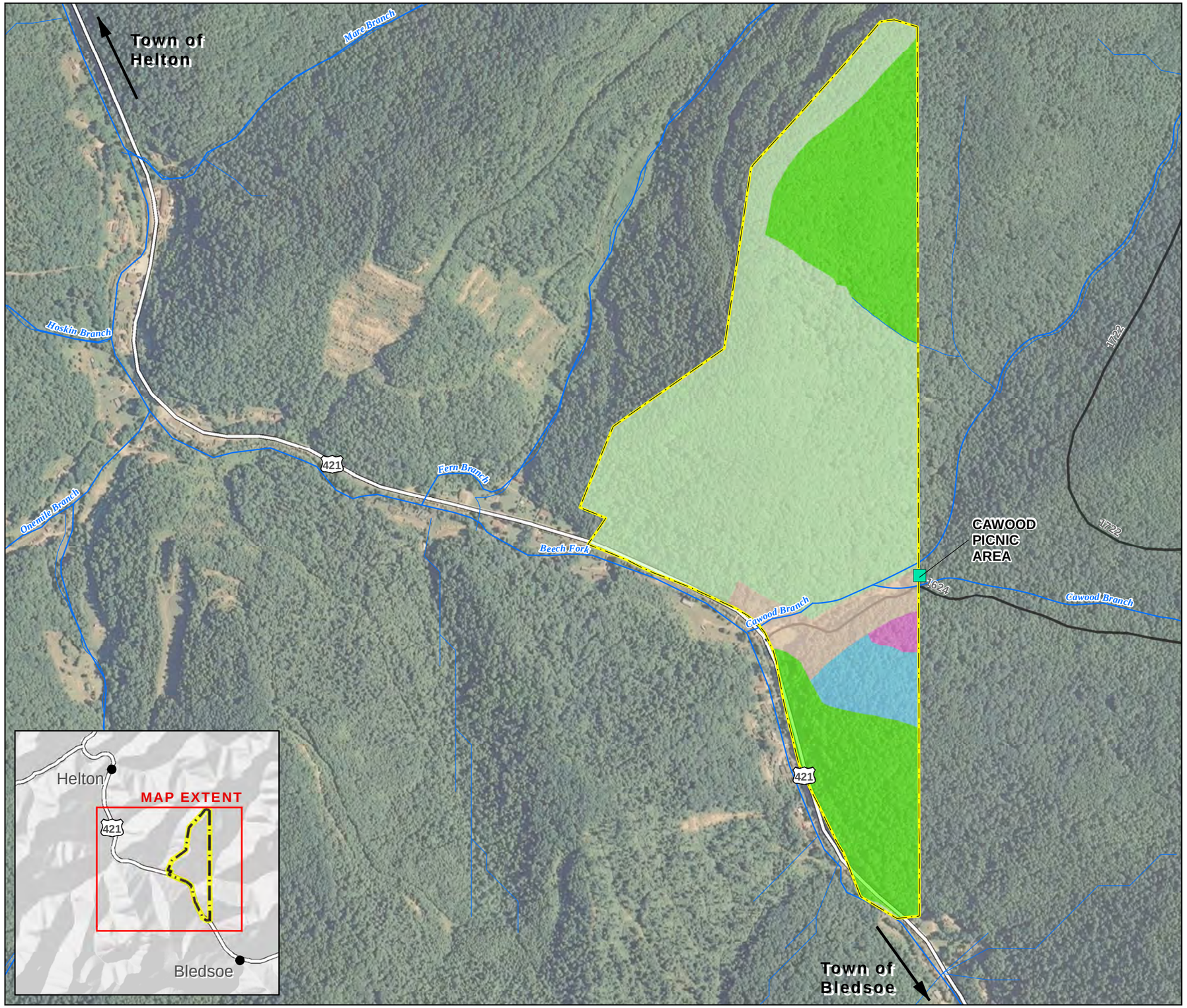


CONCEPTUAL COAL-FIELD GROUNDWATER FLOW MODEL

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT NO.		103-81786	FILE	Figure 3.4-1.xls
DESIGN	JMH	04/10/2012	SCALE AS SHOWN	REV. 0
GIS		04/10/2012		
CHECK	ADM	04/10/2012	**FIGURE 3.4-1**	
REVIEW	TWT	04/10/2012		



LEGEND

- Recreation Site
- Lease Boundary (KYES-53865)
- Stream

Forest Type

- Cove hardwoods-white pine-hemlock
- Hemlock-hardwood
- Sugar maple-beech-yellow birch
- White oak-northern red oak-hickory
- Yellow poplar-white oak-northern red oak

Roads

- US Highway
- Unimproved

REFERENCES

COORDINATE SYSTEM: NAD 1927 STATEPLANE KENTUCKY SOUTH FIPS 1602. PROPOSED LEASE BOUNDARY FOLLOWS DANIEL BOONE NATIONAL FOREST (DBNF) OWNERSHIP BOUNDARIES, FROM GIS DATA PROVIDED BY DBNF, AND IS NOT FROM A FIELD SURVEY. ROADS, STREAMS, AND FOREST TYPES PROVIDED BY THE DBNF.

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FEET

1 INCH = 700 FEET
IF PRINTED AT 11 X 17 IN

TITLE

VEGETATION

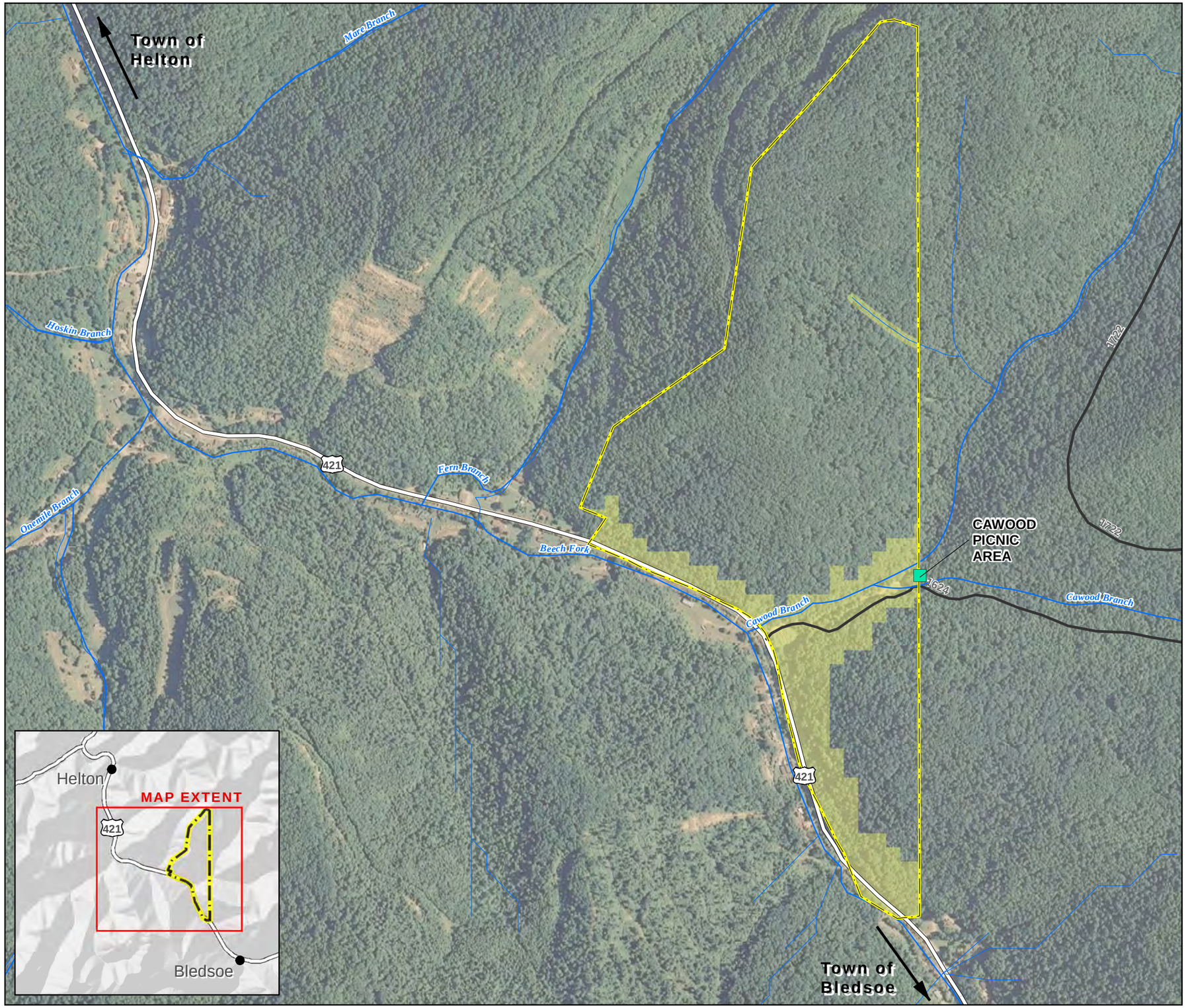
NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No. 103-81786			FILE No.	Vegetation.mxd
DESIGN	JMH	6/29/2012	SCALE AS SHOWN	REV 0
GIS	JMH	6/29/2012	FIGURE 3.6-1	
CHECK	ADM	6/29/2012		
REVIEW	TWT	6/29/2012		

M:\Bledsoe\ArcMap\EA\Vegetation.mxd | Modified: KJCarpenter 6/29/2012 11:42:35 AM | Denver, CO



LEGEND

- Recreation Site
- Lease Boundary (KYES-53865)
- Stream
- Riparian (provided by DBNF)

Roads

- US Highway
- Unimproved

REFERENCES

COORDINATE SYSTEM: NAD 1927 STATEPLANE KENTUCKY SOUTH FIPS 1602. PROPOSED LEASE BOUNDARY FOLLOWS DANIEL BOONE NATIONAL FOREST (DBNF) OWNERSHIP BOUNDARIES, FROM GIS DATA PROVIDED BY DBNF, AND IS NOT FROM A FIELD SURVEY. ROADS, STREAMS AND RIPARIAN PROVIDED BY THE DBNF.

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1 INCH = 700 FEET
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TITLE

RIPARIAN AREAS

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

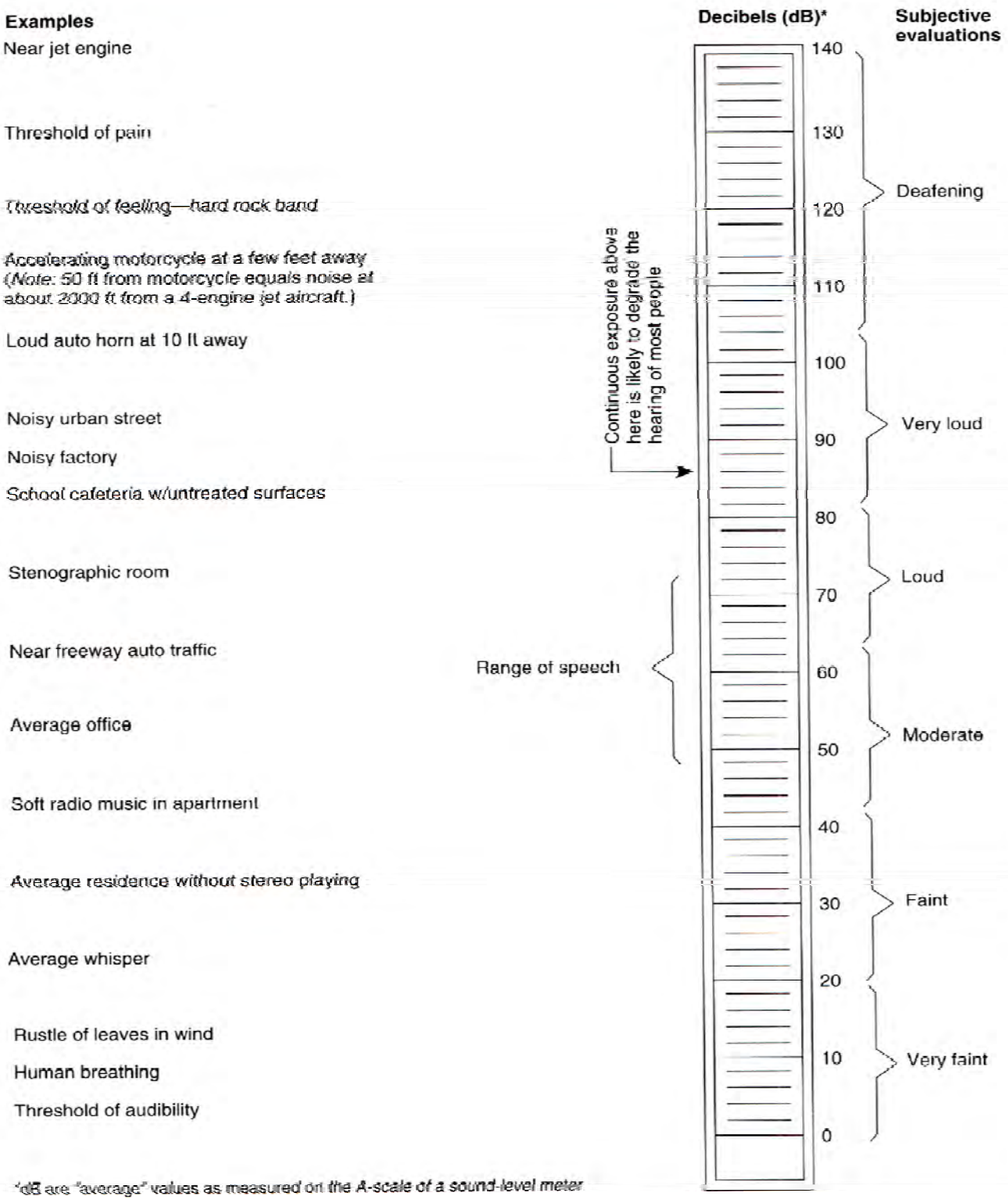
PROJECT

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No.	103-81786		FILE No.	Riparian Areas.mxd
DESIGN		6/29/2012	SCALE	REV
GIS		6/29/2012		
CHECK		6/29/2012		
REVIEW		6/29/2012		

FIGURE 3.10-1

M:\BledsoeArcMap\EA\Riparian Areas.mxd | Modified: KJCarpenter 6/29/2012 11:42:56 AM | Denver, CO



SOURCE: THE NOISE GUIDEBOOK, U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT 1985.

TITLE

EXAMPLES OF COMMON SOUNDS IN DECIBELS AND SUBJECTIVE EVALUATIONS OF IMPACT

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT

BLEDSOE LEASE BY APPLICATION
EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No.	103-81786		FILE No.	10381786A007	
DESIGN	MWB	06/21/12	SCALE	N\A	REV. A
CADD	MTM	06/21/12			
CHECK	ASM	06/21/12			
REVIEW	MWB	06/21/12			

FIGURE 3.14-1

Drawing File: N:\10\103-81786_A NEPA SUPPORT FIGURES\ 10381786A007.dwg | Layout: Layout1 | Modified: Jun 21, 2012 11:29 MTMarks | Plotted: 06/21/12 11:50am MTMarks

APPENDIX A
UNSUITABILITY CRITERIA ANALYSIS

COAL UNSUITABILITY ANALYSIS AND REPORT
Bledsoe Coal Leasing Co.
Part of USA Tract R-3094Bd
KYES-053865

DESCRIPTION OF FEDERAL LANDS INVOLVED

The review area includes the westernmost 174.36 acres of USA Tract R-3094Bd, in Leslie County, KY. R-3094Bd, consisting of 1,510.55 acres, was acquired in December 1966 as part of the Redbird Ranger District of the Daniel Boone National Forest (DBNF). All minerals were reserved or outstanding at the time of acquisition. In 2003, the administrative rights to the coal owned by the Tennessee Valley Authority underlying the DBNF were transferred the USDA Forest Service, Southern Region. An existing federal coal lease (KYES-051005) known as the Cawood Branch Coal Lease, was awarded to Straight Creek Coal in 1998. KYES-051005 included all of R-3094Bd except for the westernmost 174.36-acre portion. In 2005, Bledsoe Coal Leasing Company submitted a coal lease application to the Bureau of Land Management with the following description:

> *Being the western portion of the United States Forestry* (sic) *Service Tract No. 3094Bd, and being the remainder of land not included in the Caywood* (sic) *Branch Coal Lease, TVA Tract No. XEKCR-39L (Parcel No. 1), and having an area of 7,595,121.20 square feet, 174.36 acres.*

The tract is located within the coal resources of the Hazard District in the central part of the Eastern Kentucky Coal Field.

The Unsuitability Criteria (43 CFR 3461) were applied in the Land and Resource Management Plan for the DBNF (Forest Plan) lands, in general. This analysis looks specifically at the lands included in the referenced tract.

ANALYSIS OF THE UNSUITABILITY CRITERIA

Possible exemptions to these criteria are: 1) lands that are subject to valid existing rights, 2) lands where surface coal mining operations existed on August 3, 1977 and were permitted, or 3) lands to which the operator made substantial legal and financial commitments prior to January 4, 1977, pursuant to obtaining a permit. None of these exemptions apply to lands under review in this analysis.

Exceptions to these 20 criteria are described in 43 CFR 3461.5 but are described here only if they have been determined to apply.

Leasing of coal on the Daniel Boone National Forest is consistent with the Daniel Boone National Forest Land and Resource Management Plan (LRMP) Goal 9 and Goal 9.1.

- Goal 9 – Provide mineral commodities for current and future generations commensurate with the need to sustain the long-term health and biological diversity of ecosystems.
- Goal 9.1 – Facilitate federal mineral development in a timely manner while protecting other resources.

<u>Criterion 1</u>

All Federal lands included in the following land systems or categories shall be considered unsuitable: National Park System, National Wildlife Refuge System, National System of Trails, National Wilderness Preservation System, National Wild and Scenic Rivers System, National Recreation Areas, lands acquired with money derived from the Land and Water Conservation Fund, National Forests, and federal lands incorporated cities, town, and villages.

Exceptions

(i) A lease may be issued within the boundaries of any National Forest if the Secretary [of the Interior] finds no significant recreational, timber, economic or other values which may be incompatible with the lease; and:

(A) surface operations and impacts are incident to an underground coal mine, or

(B) where the Secretary of Agriculture determines, with respect to lands which do not have significant forest cover within those National Forests west of the 100th Meridian, that surface mining may be in compliance with the Multiple Use-Sustained Yield Act of 1960, the Federal Coal Leasing Amendments Act of 1976 and the Surface Mining Control and Reclamation Act of 1977.

<u>Analysis</u>

30 CFR 761.5 defines significant recreational, timber, economic, or other values incompatible with surface coal mining as "…*those values to be evaluated for their significance which could be damaged by, and are not capable of existing together with, surface coal mining operations because of the undesirable effects mining would have on those values, either on the area included in the permit application or on other affected areas. Those values to be evaluated for their importance include:*

(a) Recreation, including hiking, boating, camping, skiing or other related outdoor activities;
(b) Timber manager (sic) *and silviculture;*
(c) Agriculture, aquaculture or production of other natural, processed or manufactured products which enter commerce;

(d) Scenic, historic, archeologic (sic), *esthetic, fish, wildlife, plants or cultural interests.*"

Additionally, 30 CFR 761.200 states that subsidence due to underground coal mining is not included in the definition of surface coal operations and therefore is not prohibited in areas protected under Section 522(e) of the Surface Mining Control and Reclamation Act of 1977 (SMCRA).

The subject lands are acquired national forest system lands. Exception (i)(A) applies because the review area would be mined by underground methods only, with no surface impacts. Based on data and information in the Forest Plan, the lands are managed for outdoor recreation, minerals, timber, watersheds, fish and wildlife, wilderness and other uses, and to promote sustained yields of forest products and services.

Criterion 2

Federal lands that are within rights-of-way or easements or within surface leases for residential, commercial, industrial, or other public purposes, on Federally-owned surface shall be considered unsuitable.

Analysis

There are no rights-of-way, easements, or surface leases for residential, commercial, industrial, or other public purposes within the review area.

Criterion 3

Federal lands affected by Section 522(e) (4) and (5) of SMCRA shall be considered unsuitable. This includes lands within 100 feet of the outside line of the right-of-way of a public road, or within 100 feet of a cemetery, or within 300 feet of any public building, school, church, community or institutional building or public park, or within 300 feet of an occupied dwelling.

Exceptions

A lease may be issued for lands

(i) Used as mine access roads or haulage roads that join the right-of-way for a public road,
(ii) For which the Office of Surface Mining Reclamation and Enforcement has issued a permit to have public roads relocated,
(iii) if, after public notice and opportunity for public hearing in the locality, a written finding is made by the Authorized Officer that the interests of the public and the landowners affected by mining within 100 feet of a public road will be protected, or

(iv) For which owners of occupied dwellings have given written permission within 300 feet of their buildings.

Analysis

All proposed mining is by underground methods only. Additionally, there are no cemeteries, public buildings, schools, churches, or community or institutional buildings within the review area. Along US 421 (adjacent to the boundary of the review area), no mining would be conducted under the road and therefore the road would be protected.

Criterion 4

Federal lands designated as wilderness study areas shall be considered unsuitable while under review by the Administration and Congress for possible wilderness designation. For any Federal land which is to be leased or mined prior to completion of the wilderness inventory by the surface management agency, the environmental assessment or impact statement on the lease sale or mine operations plan shall consider whether the land possesses the characteristics of a wilderness study area. If the finding is affirmative, the land shall be considered unsuitable, unless issuance of noncompetitive coal leases and mining on leases is authorized under the Wilderness Act and the Federal Land Policy and Management Act of 1976.

Analysis

The coal within the review area is federally owned and available for lease, consistent with Goal 9 of the Forest Plan. There are no designated Wilderness Study Areas on or near the tract. The nearest wilderness area is the Beaver Creek Wilderness, located approximately 46 air miles to the southwest.

Criterion 5

Scenic Federal lands designated by visual resource management analysis as Class 1 (an area of outstanding scenic quality or high visual sensitivity) but not currently on the National Register of Natural Landmarks shall be considered unsuitable.

Analysis

No lands within the review area are designated as visual resource management Class 1 areas. All proposed mining would be conducted by underground methods only.

Criterion 6

Federal lands under permit by the surface management agency, and being used for scientific studies involving food or fiber production, natural resources, or technology demonstrations and

experiments shall be considered unsuitable for the duration of the study, demonstration, or experiment except where mining could be conducted in such a way as to enhance or not jeopardize the purposes of the study, as determined by the surface management agency, or where the principal scientific use or agency give written concurrence to all or certain methods of mining.

Analysis

No lands within the review area are under permit for scientific study. All proposed mining would be by underground methods only.

Criterion 7

All publicly or privately owned places which are included in the National Register of Historic Places shall be considered unsuitable. This shall include any areas that the surface management agency determines, after consultation with the Advisory Council on Historic Preservation and the State Historic Preservation Officer, are necessary to protect the inherent values of the property that made it eligible for listing in the National Register.

Analysis

No publicly or privately owned places within the review area are included in the National Register of Historic Places.

Criterion 8

Federal lands designated as natural areas or as National Natural Landmarks shall be considered unsuitable.

Analysis

No lands within the review area are designated as natural areas or as National Natural Landmarks.

Criterion 9

Federally designated critical habitat for listed threatened or endangered plant and animal species, and habitat proposed to be designated as critical for listed threatened or endangered plant and animal species or species proposed for listing, and habitat for Federal threatened or endangered species which is determined by the Fish and Wildlife Service and the surface management agency to be of essential value and where the presence of threatened or endangered species has been scientifically documented, shall be considered unsuitable.

Exceptions:

A lease may be issued and mining operations approved if, after consultation with the Fish and Wildlife Service, the Fish and Wildlife Service determines that the proposed activity is not likely to jeopardize the continued existence of the listed species and/or its critical habitat.

Analysis

The following list of Federally listed endangered and threatened species are known or suspected to have suitable habitat within or near the review area:

Indiana Bat	*Myotis sodalis*	Endangered
Snuffbox	*Epioblasma triquetra*	Endangered

No lands within the review area are designated as critical habitat, proposed to be designated as critical habitat, or determined to be essential habitat for any Federally listed threatened, endangered or candidate plant or animal species, or species proposed for listing. Suitable habitat may exist on or near the review area.

If there is reason to believe that Federally listed endangered or threatened species of plants or animals are present, or become present in the proposed lease area, the Lessee/Operator shall be required to conduct an intensive field inventory of the area to be impacted. The inventory shall be conducted by a qualified specialist, and a report of findings prepared. A plan shall be made that recommends protection for these species or action necessary to mitigate the disturbance. The cost of conducting such inventory, preparing reports and carrying out mitigation measures shall be borne by the Lessee/Operator.

For the Indiana Bat, the main threat is loss of winter habitat due to disturbance of caves used as hibernacula. No known winter habitat exists on the review area, so the proposed underground mining would not have a direct effect on the Indiana Bat population. The proposed underground mining is not expected to impact the hydrology of the review area and no loss of habitat is expected, therefore there are no indirect effects expected. There are no surface impacts associated with the proposed underground mining and no cumulative impacts are expected.

For the Snuffbox Mussel, there are no surface impacts associated with the proposed underground mining, therefore there will be no direct effects expected. While habitat exists in Beech Fork, which is downgradient of the review area, no indirect effects are expected due to changes in hydrology. No cumulative impacts are expected since there will be no surface impacts associated with the proposed underground mining.

Criterion 10

Federal lands containing habitat determined to be critical or essential for plant or animal species listed by a state pursuant to state law as endangered or threatened shall be considered unsuitable.

Analysis

The Commonwealth of Kentucky does not have a law that identifies state-listed threatened or endangered species. All proposed mining would be conducted by underground methods only.

Criterion 11

A bald or golden eagle nest site on Federal lands that is determined to be active and an appropriate buffer zone on land around the nest site shall be considered unsuitable. Consideration of availability of habitat for prey species and of terrain shall be included in the determination of buffer zones. Buffer zones shall be determined in consultation with the Fish and Wildlife Service.

Analysis

No bald or golden eagle nest sites exist on Federal lands on or near the review area.

Criterion 12

Bald and golden eagle roost and concentration areas on Federal lands used during migration and wintering shall be considered unsuitable.

Analysis

No bald or golden eagle roost sites are known to exist on Federal lands on or near the review area.

Criterion 13

Federal lands containing a falcon (excluding kestrel) cliff nesting site with an active nest and buffer zone of Federal land around the nest site shall be considered unsuitable. Consideration of availability of habitat for prey species and of terrain shall be included in the determination of buffer zones. Buffer zones shall be determined in consultation with the Fish and Wildlife Service.

Analysis

No falcon cliff nesting sites are known to exist on Federal lands on or near the review area.

Criterion 14

Federal lands which are high priority habitat for migratory bird species of high Federal interest on a regional or national basis, as determined jointly by the surface management agency and the Fish and Wildlife Service, shall be considered unsuitable.

Analysis

There are no Federal lands which are high priority habit for migratory bird species of high Federal interest on or near the review area.

Criterion 15

Federal lands which the surface management agency and the state jointly agree are habitat for resident species of fish, wildlife and plants of high interest to the state and which are essential for maintaining these priority wildlife and plant species shall be considered unsuitable. Examples of such lands which serve a critical function for the species involved include:

(i) Active dancing and strutting grounds for sage grouse, sharp-tailed grouse, and prairie chicken;
(ii) Winter ranges crucial for deer, antelope, and elk;
(iii) Migration corridor for elk; and
(iv) Extremes of range for plant species.

Analysis

No Federal lands on or near the review area are considered critical or essential habitat for resident species of fish, wildlife, or plants of high interest to the Commonwealth of Kentucky.

Criterion 16

Federal lands in riverine, coastal, and special floodplains (100-yr recurrence interval) on which the surface management agency determines that mining could not be undertaken without substantial threat of loss of life or property shall be considered unsuitable for all or certain stipulated methods of coal mining.

Analysis

The review area is not within a riverine, coastal, or special floodplain.

Criterion 17

Federal lands which have been committed by the surface management agency to use as municipal watersheds shall be considered unsuitable.

Analysis

None of the lands in the review area are within a municipal watershed.

Criterion 18

Federal lands with National Resource Waters, as identified by states in their water quality management plans, and a buffer zone of Federal lands ¼ mile from the outer edge of the far banks of the water, shall be unsuitable.

Analysis

None of the lands in the review area are identified as a National Resource Water.

Criterion 19

Federal lands identified by the surface management agency, in consultation with the state in which they are located, as alluvial valley floors according to the definition in Subpart 3400.0-5(a) of this title, the standards of 30 CFR Part 822, the final alluvial guidelines of the Office of Surface Mining Reclamation and Enforcement when published, and approved state programs under the Surface Mining Control and Reclamation Act of 1977, where mining would interrupt, discontinue, or preclude farming, shall be considered unsuitable. Additionally, when mining Federal land outside an alluvial valley floor would materially damage the quantity or quality of water in surface or underground water systems that would supply alluvial valley floors, the land shall be considered unsuitable.

Analysis

The review area is not within an alluvial valley floor, as defined in 43 CFR 3400.0-5(a) and 30 CFR 701.5.

Criterion 20

Federal lands in a state to which is applicable a criterion:

(i) proposed by the state or Indian tribe located in the planning area, and
(ii) adopted by rulemaking by the Secretary, shall be considered unsuitable.

Analysis

This criterion is not applicable in the Commonwealth of Kentucky.

SUMMARY

The tract under review for the proposed Bledsoe Coal Lease (KYES-053865) has been determined to be suitable for coal mining, based on the analysis of these 20 criteria.

REFERENCES

A&L Engineering, Bledsoe Coal Lease Application, November 21, 2005.

Department of the Interior, Bureau of Land Management, Case Recordation Serial Register Page, Serial Number KYES-051055.

Golder Associates Inc., Bledsoe Coal Lease Biological Assessment and Evaluation, June 21, 2012.

Kentucky Department of Fish and Wildlife Resources, Kentucky's Threatened and Endangered Species, 1998.

Kentucky Geological Survey, Coal Resources of the Hazard District, Kentucky, 1983.

Shamrock Coal Co., Permit Application No. 866-5130 Amendment #4 (amended to include acreage from KYES-053865), April 2012.

Tennessee Valley Authority and Department of Agriculture, Forest Service, Notice of Transfer Agreement, August 29, 2003.

USDA Forest Service, Daniel Boone National Forest, Land and Resource Plan for the Daniel Boone National Forest, April 2004.

APPENDIX B
SCOPING ISSUE ANALYSIS

Proposal: Bledsoe Coal Lease

Responsible Official's Title: Forest Supervisor

Table 1 – Summary of Scoping Respondents

Letter No.	Commenter's Name	Affiliate (group, agency, etc.)
1	Lisa LaRue	United Keetoowah Band of Cherokee Indians in Oklahoma, Acting Tribal Historic Preservation Officer
2	Lane Boldman	Cumberland Chapter Sierra Club, Mining Chair

Table 2 – Summary of Comments

Letter No.	Comment as presented by the commenter	Group	SCREEN 1 Disagree? Debate? Dispute? (Yes/No) If No, stop.	Clarified Issue Statement from Commenters (cause-effect)	SCREEN 2 Is the Issue SIGNIFICANT? Yes = EIS (Yes/No)	SCREEN 3 If screen 2 = No; Will issue be used to define scope of environmental analysis? (Yes/No) If No, include rationale.
1	*In the event of any inadvertent discoveries of human remain or funerary items, please cease all work and contact us at the number below.*	A	No	If human remains or funerary items are uncovered during project activities, work should be halted in order to notify the appropriate tribe so that recovery and/or documentation may take place	No	**No.** This issue is already decided by law (Native American Graves Protection and Repatriation Act section 3 (d)). Archaeologists will review reports from previous investigations in the project area, and will conduct new investigation for heritage resources in

Letter No.	Comment as presented by the commenter	Group	SCREEN 1 Disagree? Debate? Dispute? (Yes/No) If No, stop.	Clarified Issue Statement from Commenters (cause-effect)	SCREEN 2 Is the Issue SIGNIFICANT? Yes = EIS (Yes/No)	SCREEN 3 If screen 2 = No; Will issue be used to define scope of environmental analysis? (Yes/No) If No, include rationale.
						previously unsurveyed areas. Consultation with the tribes and the Kentucky State Historic Preservation Office will be conducted.
2	*I wish to note that this specific coal company has been cited by the US Department of Labor Mine Safety and Health Administration in April of 2011 for having a pattern of violations that were "significant and substantial" at another Kentucky mine within their operations (see attachment). So we have great concerns on the ability of this coal company to conduct their operations within the Daniel Boone in a responsible manner of appropriate benefit to the public when it comes to this new operation.*	B	Yes	Previously cited mine safety and health issues documented at other mines operated under the umbrella of the Bledsoe company could indicate a pattern of operations carried into this project.	No	**No.** This issue is already decided by law, regulation or other higher-level decision. Bledsoe has filed the application to lease federal coal; if a decision is made to offer federal coal for lease, the coal would be offered through a competitive leasing process, which is covered in 30 CFR and 43 CFR.
2	*There are substantial mining operations south of Hyden that have been shown to have significantly impaired water quality, including problems with acid drainage, high conductivity levels and problems with dissolved solids, plus contamination*	C	Yes	Mining operations south of Hyden, KY, have impaired water quality, including problems with acid drainage, high conductivity levels, problems with dissolved solids, plus contamination with selenium. Water draining from the	No.	**Yes.** The potential impacts to water quality and the surface estate (forested land/wildlife

Letter No.	Comment as presented by the commenter	Group	SCREEN 1 Disagree? Debate? Dispute? (Yes/No) If No, stop.	Clarified Issue Statement from Commenters (cause-effect)	SCREEN 2 Is the Issue SIGNIFICANT? Yes = EIS (Yes/No)	SCREEN 3 If screen 2 = No; Will issue be used to define scope of environmental analysis? (Yes/No) If No, include rationale.
	from Selenium. The watersheds within the Redbird District at the proposed site drain into these same watersheds, and therefore we have concerns of the accumulated effect these additional mining operations will have on this watershed off of the middle fork of the Kentucky River.			proposed lease site will add to this problem in the Middle Fork of the Kentucky River.		habitat) will be addressed in the environmental analysis.
2	*The Sierra Club places the water quality of Kentucky as a high priority and is particularly concerned with the cumulative effect of mike* [sic] *drainage on our Eastern KY. waterways.*					
2	*We also have concerns regarding the biodiversity of the proposed area.*					
2	*Also the forest service already has several restoration actions within its boundaries to address acid mine drainage from old mineworks that have existed for years, and are only being mitigated with marginal success. Because of this, we wish to discourage further impacts within the national forest boundaries.*	D	Yes	These comments reflect a concern regarding the cumulative effects of the proposal when considering previous mining activity. Previous mining operations have resulted in acid mine drainage and reduced the aesthetic value of those areas. Additional mining activity will compound the problems of acid mine drainage and have negative impacts on previously undisturbed area.	No.	**Yes.** Potential impacts to water quality will be addressed in the environmental analysis, and will be compared with the potential impacts for a no action alternative. Many areas of the Redbird District were impacted by prelaw mining, before
2	*While there has been strip mining on the private land adjacent to the lease site, this particular area of the Redbird district itself, in our opinion, shows little surface impact and is within a fairly contiguous*					

Letter No.	Comment as presented by the commenter	Group	SCREEN 1 Disagree? Debate? Dispute? (Yes/No) If No, stop.	Clarified Issue Statement from Commenters (cause-effect)	SCREEN 2 Is the Issue SIGNIFICANT? Yes = EIS (Yes/No)	SCREEN 3 If screen 2 = No; Will issue be used to define scope of environmental analysis? (Yes/No) If No, include rationale.
	canopy of forested land. We believe the higher value for this land is in watershed protection than in energy production, particularly when taking the above-mentioned cumulative impacts to waterways into consideration.					SMCRA and mine permitting. Reclamation efforts on previously mined areas of the Redbird are addressing issues and impacts associated with the surface mining of coal conducted by the private sector prior to the land being obtained by the Forest Service. There is no planned surface disturbance associated with the proposed action. If approved, underground mining methods would be used to extract the coal. Underground coal mining is an approved land use and has been previously analyzed in the EIS for the 2004 Daniel Boone National Forest

Letter No.	Comment as presented by the commenter	Group	SCREEN 1 Disagree? Debate? Dispute? (Yes/No) If No, stop.	Clarified Issue Statement from Commenters (cause-effect)	SCREEN 2 Is the Issue SIGNIFICANT? Yes = EIS (Yes/No)	SCREEN 3 If screen 2 = No; Will issue be used to define scope of environmental analysis? (Yes/No) If No, include rationale.
						Plan.
2	*We also wish to comment on the BLM criteria that "Coal leasing in this area helps meet the nation's growing demand for energy in the generation of electricity for residential and industrial uses. It also supports the President's Energy Initiative and the 1984 MOU on Energy Leasing. Mining of this col would provide economic returns to national, state and local economies.". We question this rationale in the case of Bledsoe Energy since much coal production in Appalachia is being shipped out of state and out of the country.*	E	Yes	Coal leasing would not provide economic returns to state or local economies because coal produced in the area is shipped elsewhere in the United States and the world for use.	No.	**No.** This issue already decided by law, regulation or other higher-level decision. Whether coal to be mined is being shipped out of the country is beyond the scope of this analysis since the lease would be awarded through the competitive leasing process. Coal being shipped out of state would still provide economic returns to national, state and local economies.
2	*Coal as an energy resource has been on the decline in Kentucky and there has been a significant decline in coal jobs as well. By leasing more of the public's resources to prolong support to a declining industry, this prevents broader, more diverse base of job opportunities to come into these*	F	Yes.	Leasing federal coal perpetuates a declining economy and prevents the development of other job opportunities. By not mining these lands, healthy forests will create job opportunities.	No.	**No.** This issue already decided by law, regulation or other higher-level decision. The proposal is a

Letter No.	Comment as presented by the commenter	Group	SCREEN 1 Disagree? Debate? Dispute? (Yes/No) If No, stop.	Clarified Issue Statement from Commenters (cause-effect)	SCREEN 2 Is the Issue SIGNIFICANT? Yes = EIS (Yes/No)	SCREEN 3 If screen 2 = No; Will issue be used to define scope of environmental analysis? (Yes/No) If No, include rationale.
	communities. Maintaining the health of our national lands and forests provides their own job opportunities and we encourage the forest service to take these trade-offs into consideration.					valid, legal federal action, conditionally proposed by the BLM, Forest Service and OSM, pending the results of an environmental analysis. While this comment suggests that the proposed action is supporting a declining industry, it does not demonstrate any cause/environmental effect relationship that may result from the proposal.

SIGNIFICANT ISSUES (Screen 2)

The following issues are considered significant (Screen 2) [40 CFR 1501.7(a)(3) and § 1508.27]:

None

ISSUES TO BE ANALYZED IN DEPTH (Screen 3)

The ID team recommends the issues listed below be used in defining the scope of environmental analysis. Other comments, while important, the ID team felt they would already be covered by the analysis or were beyond the scope of this analysis. Rationale for these recommendations is in the table above.

1) Impacts to water quality. The analysis will evaluate the potential for each alternative to contribute pollutants to surface water and groundwater. Criteria to be evaluated will be increases in pollutants in groundwater or surface water that would violate discharge limits established by Kentucky Energy and Environment Cabinet at 405 KAR3:140 or reduce viability of special status species or aquatic habitat. .

2) Impacts to biodiversity. The analysis will evaluate the potential for each alternative to affect biodiversity. In accordance with the Endangered Species Act, potential effects to listed threatened, endangered and proposed species will be addressed in the environmental analysis. In accordance with Forest Service handbook direction, effects to sensitive species identified by the Regional Forester will be addressed in the environmental analysis. Criteria to be evaluated will include loss of wildlife habitat, species diversity, and effects to aquatic habitat related to erosion or other pollutants.

ALTERNATIVES

Using the issues listed above, the interdisciplinary team identified resource areas to be included in the analysis of the proposal and the no action alternative. The alternatives listed below were either suggested by participants from scoping or were developed by the interdisciplinary team in response to unresolved conflicts related to the proposal.

Alternative A – NO ACTION

Alternative B – PROPOSED ACTION

The ID team recommends detailed consideration of Alternatives A and B, in the environmental analysis.

I have reviewed the analysis presented by the interdisciplinary team in Tables 1 and 2 and in the recommendations above. I agree that none of the issues are significant. I approve the issues and alternatives as described above.

Frank R. Beum

FRANK R. BEUM
Daniel Boone National Forest Supervisor, Forest Service

9/12/12
Date

APPENDIX C
CORE LOGS

LJ HUGHES & SONS, INC.

DIAMOND CORE DRILLING
Pressure Grouting, Foundation & Soil Borings
320 Turnpike Road, Summersville, West Virginia 26651 (304) 872-1111

AUG 18 2003

DRILL HOLE NO. LE-300-03 DRILLER: JOE McCARTHY

DRILLING FOR: BLEDSOE COAL COMPANY
LONDON KY

SURFACE ELEVATION: 2,073.131' GPS STARTED: JULY 17 2003
COMPLETED: JULY 29 2003

LOCATION: KENTUCKY LESLIE COUNTY
N: 239,816.082
E: 2,696,404.172

FORMATION	STRATA THICKNESS	DEPTH FROM SURFACE
CASING	20.00	20.00
CHIPPED	6.00	26.00
GRAY SHALE	9.00	35.00
GRAY SANDY SHALE	15.00	50.00
BROWN SANDSTONE	13.00	63.00
GRAY SANDSTONE	2.80	65.80
COAL	0.40	66.20
GRAY FIRE CLAY	1.00	67.20
GRAY SHALE (BROKEN)	5.80	73.00
BROWN SANDSTONE	7.00	80.00
GRAY SHALE (BROKEN)	20.00	100.00
BROWN SANDSTONE (BROKEN)	7.80	107.80
COAL	0.10	107.90
GRAY SANDSTONE	1.80	109.70
COAL	0.25	109.95
BLACK SHALE	0.30	110.25
COAL	1.20	111.45
GRAY FIRE CLAY	0.35	111.80
COAL	2.75	114.55
GRAY SHALE	2.40	116.95
GRAY SANDSTONE	55.00	171.95
GRAY SHALE	1.05	173.00
GRAY SANDY SHALE	10.50	183.50
COAL	0.20	183.70
GRAY SHALE	1.30	185.00
GRAY SANDY SHALE	6.00	191.00
GRAY SANDSTONE	59.00	250.00

LJ HUGHES & SONS, INC.

BLEDSOE COAL COMPANY

CONTINUATION OF DRILL HOLE NO. LE-300-03

FORMATION	STRATA THICKNESS	DEPTH FROM SURFACE
GRAY SANDY SHALE	9.00	259.00
GRAY SANDSTONE	41.00	300.00
GRAY SANDSTONE WITH SHALE PEBBLES	2.50	302.50
GRAY SANDSTONE WITH SHALE STREAKS	2.00	304.50
GRAY SANDY SHALE	5.70	310.20
COAL	3.20	313.40
GRAY FIRE CLAY	0.60	314.00
GRAY SHALE	16.00	330.00
GRAY SANDY SHALE	47.00	377.00
GRAY SANDSTONE	41.00	418.00
GRAY SANDY SHALE	5.00	423.00
GRAY SANDSTONE	18.00	441.00
GRAY SHALE	17.00	458.00
COAL	1.00	459.00
GRAY SHALE	1.00	460.00
GRAY SANDY SHALE	8.20	468.20
COAL	0.55	468.75
GRAY SHALE	0.90	469.65
COAL	0.55	470.20
GRAY SHALE	3.40	473.60
COAL	0.55	474.15
GRAY SHALE	5.00	479.15
GRAY SANDY SHALE	18.30	497.45
BLACK SHALE	0.60	498.05
COAL	0.20	498.25
GRAY SHALE	0.60	498.85
COAL	0.65	499.50
GRAY SHALE	13.40	512.90
COAL	1.25	514.15
GRAY SHALE	9.40	523.55
COAL	0.20	523.75
GRAY SANDY SHALE	16.00	539.75
GRAY SANDSTONE	75.25	615.00
GRAY SANDY SHALE	3.00	618.00
GRAY SANDSTONE	7.00	625.00
GRAY SANDY SHALE	70.00	695.00
GRAY SHALE WITH FOSSILS	1.00	696.00
GRAY SHALE	4.00	700.00
GRAY SANDY SHALE	6.90	706.90
COAL	1.10	708.00
GRAY SHALE	0.40	708.40
COAL	1.10	709.50
GRAY SHALE	0.35	709.85
COAL	0.20	710.05
GRAY SHALE	1.50	711.55
GRAY SANDSTONE	28.45	740.00

LJ HUGHES & SONS, INC.

BLEDSOE COAL COMPANY
CONTINUATION OF DRILL HOLE NO. LE-300-03

FORMATION	STRATA THICKNESS	DEPTH FROM SURFACE
GRAY SANDSTONE WITH COAL STREAKS	14.00	754.00
GRAY SANDY SHALE	2.55	756.55
COAL	0.40	756.95
GRAY SHALE	0.20	757.15
COAL	1.00	758.15
BLACK SHALE	0.25	758.40
GRAY SHALE	11.60	770.00
GRAY SANDY SHALE WITH SANDSTONE STREAKS	5.00	775.00
GRAY SANDY SHALE	6.00	781.00
GRAY SANDSTONE	38.00	819.00
BLACK SHALE	0.10	819.10
GRAY SANDSTONE	0.90	820.00
GRAY SANDSTONE WITH COAL STREAKS AND SHALE PEBBLES	2.80	822.80
COAL	0.20	823.00
GRAY SHALE	8.20	831.20
COAL WITH SHALE STREAKS. . .	0.80	832.00
GRAY SHALE	9.00	841.00
GRAY SANDSTONE	9.00	850.00
GRAY SHALE	1.00	851.00
GRAY SANDSTONE	43.30	894.30
GRAY SHALE	5.20	899.50
BLACK SHALE	0.70	900.20
COAL	2.30	902.50
GRAY SHALE	0.15	902.65
COAL	0.45	903.10
JACK ROCK	0.45	903.55
COAL	2.35	905.90
GRAY SHALE	1.00	906.90
GRAY SANDY SHALE	3.10	910.00
GRAY SANDSTONE	5.00	915.00
GRAY SANDSTONE WITH SHALE STREAKS	15.00	930.00

TOTAL DEPTH OF HOLE = 930.00 FEET

35 BAGS CEMENT PLACED IN HOLE

LJ HUGHES & SONS, INC.

DIAMOND CORE DRILLING
Pressure Grouting, Foundation & Soil Borings
320 Turnpike Road, Summersville, West Virginia 26651 (304) 872-1111

RECEIVED AUG 18 2003 By

DRILL HOLE NO. LE-301-03 DRILLER: JOE McCARTHY

DRILLING FOR: BLEDSOE COAL COMPANY
LONDON KY

SURFACE ELEVATION: 2,169.465' GPS STARTED: JULY 30 2003
COMPLETED: AUGUST 7 2003

LOCATION: KENTUCKY LESLIE COUNTY

N: 237,504.173
E: 2,696,352.717

FORMATION	STRATA THICKNESS	DEPTH FROM SURFACE
CASING	20.00	20.00
CHIPPED	15.00	35.00
GRAY SHALE	12.00	47.00
BROWN SANDSTONE	12.00	59.00
GRAY SANDY SHALE	5.00	64.00
SOFT BROWN SHALE	4.00	68.00
BROWN SANDSTONE	28.60	96.60
GRAY SANDSTONE	0.70	97.30
BROWN SANDSTONE	1.00	98.30
COAL	1.90	100.20
GRAY SANDY SHALE	19.80	120.00
GRAY SHALE	10.00	130.00
GRAY SANDY SHALE	13.00	143.00
GRAY SANDY SHALE (BROKEN)	7.00	150.00
GRAY SANDSTONE	14.40	164.40
BLACK SHALE	0.40	164.80
GRAY SHALE	9.50	174.30
COAL	1.00	175.30
GRAY SHALE	3.30	178.60
COAL	0.30	178.90
GRAY SHALE	5.50	184.40
GRAY SHALE WITH COAL STREAKS	3.00	187.40
COAL	0.10	187.50
SOFT GRAY SHALE	0.40	187.90
COAL	0.30	188.20
BLACK SHALE	0.50	188.70

LJ HUGHES & SONS, INC.

BLEDSOE COAL COMPANY

CONTINUATION OF DRILL HOLE NO. LE-301-03

FORMATION	STRATA THICKNESS	DEPTH FROM SURFACE
COAL	1.45	190.15
BLACK SHALE	0.50	190.65
COAL	1.75	192.40
GRAY SANDY SHALE	16.60	209.00
GRAY SANDSTONE	16.00	225.00
GRAY SHALE	4.00	229.00
GRAY SANDSTONE	32.00	261.00
GRAY SHALE	1.00	262.00
GRAY SANDSTONE	23.00	285.00
GRAY SANDSTONE WITH COAL STREAKS	2.00	287.00
GRAY SHALE	2.00	289.00
GRAY SANDSTONE	31.00	320.00
GRAY SANDSTONE WITH SHALE STREAKS	10.00	330.00
GRAY SANDSTONE	29.30	359.30
BONY COAL	0.70	360.00
GRAY SHALE	20.00	380.00
GRAY SANDY SHALE	17.10	397.10
COAL	0.50	397.60
BLACK SHALE	0.10	397.70
COAL	2.55	400.25
GRAY SHALE	0.40	400.65
COAL	0.25	400.90
GRAY SHALE	2.85	403.75
COAL	0.15	403.90
GRAY SHALE	11.10	415.00
GRAY SANDY SHALE	26.50	441.50
COAL	2.10	443.60
GRAY SHALE	0.40	444.00
BONY COAL	2.50	446.50
GRAY SHALE	1.00	447.50
GRAY SANDSTONE	49.00	496.50
GRAY SHALE	0.50	497.00
COAL	0.20	497.20
MEDIUM HARD SANDSTONE	2.80	500.00
GRAY SHALE	15.00	515.00
GRAY SANDY SHALE	5.00	520.00
COAL	1.00	521.00
GRAY SHALE	10.00	531.00
COAL	0.70	531.70
GRAY SHALE	0.25	531.95
COAL	0.60	532.55
GRAY SHALE	1.45	534.00
GRAY SANDSTONE	21.00	555.00
GRAY SANDY SHALE	6.00	561.00
GRAY SANDSTONE	18.00	579.00
GRAY SHALE	10.00	589.00

LJ HUGHES & SONS, INC.

BLEDSOE COAL COMPANY

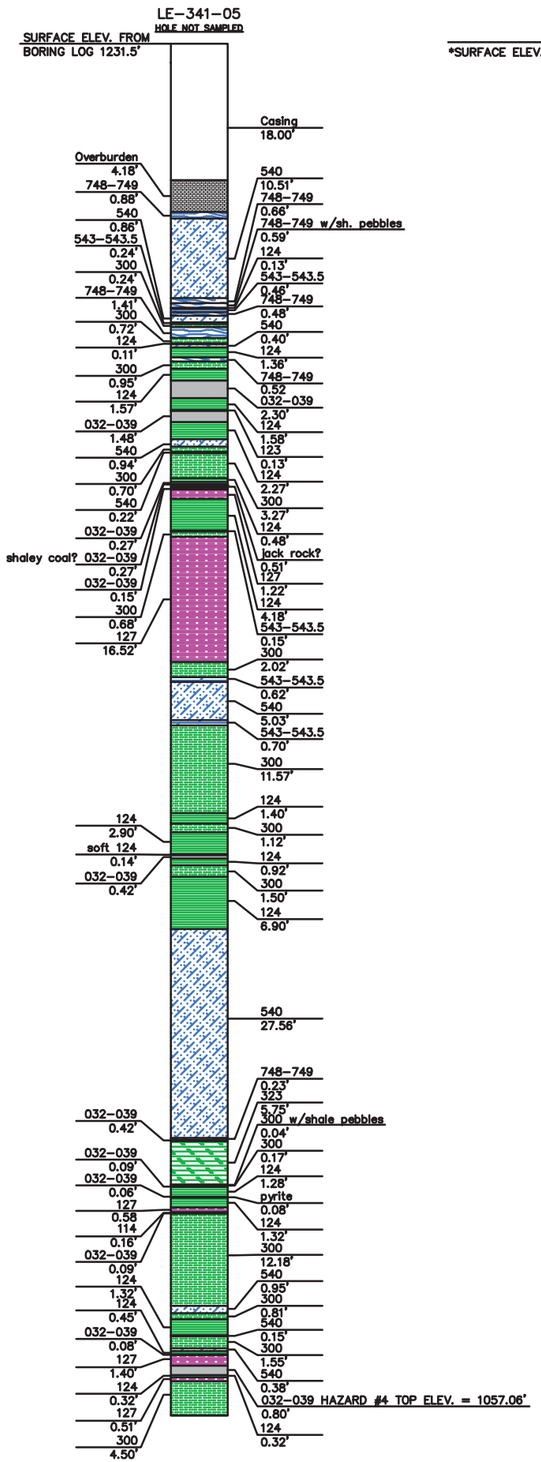
CONTINUATION OF DRILL HOLE NO. LE-301-03

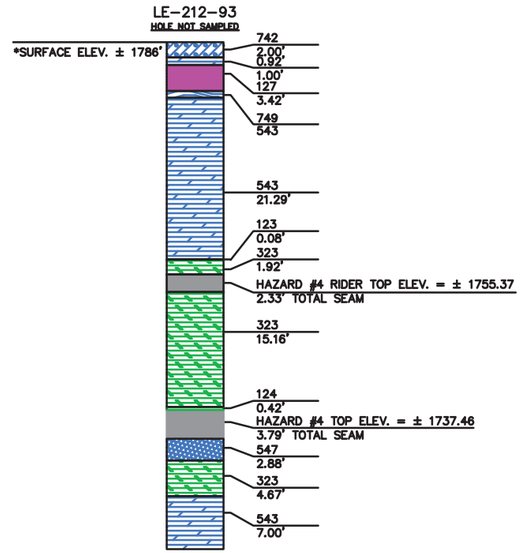
FORMATION	STRATA THICKNESS	DEPTH FROM SURFACE
COAL	1.00	590.00
GRAY SANDY SHALE	9.00	599.00
GRAY SANDSTONE	20.00	619.00
GRAY SANDY SHALE	15.00	634.00
GRAY SANDSTONE	65.00	699.00
GRAY SANDY SHALE	1.00	700.00
GRAY SANDSTONE	2.00	702.00
GRAY SANDY SHALE	70.50	772.50
DARK GRAY SHALE WITH FOSSILS	1.10	773.60
GRAY SHALE	6.40	780.00
GRAY SANDY SHALE	8.25	788.25
COAL	0.50	788.75
GRAY SHALE	0.15	788.90
COAL	0.40	789.30
COAL WITH SHALE STREAKS. . .	0.30	789.60
COAL	1.25	790.85
GRAY SHALE	0.90	791.75
GRAY SANDTSONE	52.25	844.00
GRAY SANDY SHALE	7.60	851.60
COAL	1.20	852.80
GRAY SHALE	0.10	852.90
COAL	0.80	853.70
GRAY SHALE	16.30	870.00
GRAY SANDSTONE	40.00	910.00
GRAY SANDY SHALE WITH COAL STREAKS AND SHALE PEBBLES	4.00	914.00
GRAY SANDSTONE	36.00	950.00
GRAY SHALE	3.00	953.00
GRAY SANDSTONE	24.50	977.50
GRAY SANDY SHALE	1.10	978.60
DARK GRAY SHALE	0.10	978.70
BLACK SHALE	0.10	978.80
COAL	2.40	981.20
GRAY SHALE	7.40	988.60
COAL	0.80	989.40
BLACK SHALE	0.25	989.65
BONE	0.15	989.80
BLACK SHALE	0.20	990.00
COAL	0.60	990.60
JACK ROCK	0.60	991.20
COAL	0.10	991.30
GRAY SANDY SHALE	6.40	997.70
GRAY SANDSTONE	18.30	1016.00

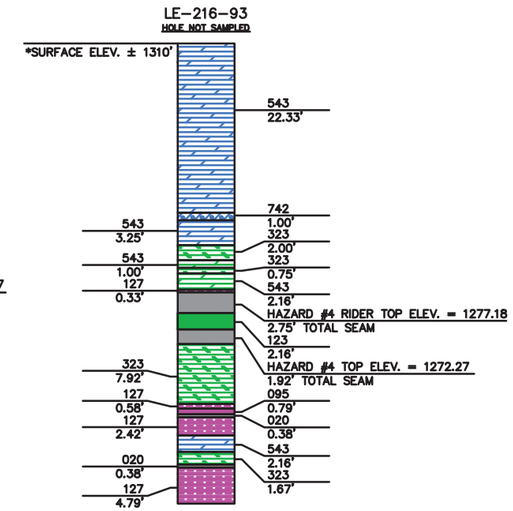
TOTAL DEPTH OF HOLE = 1016.00 FEET

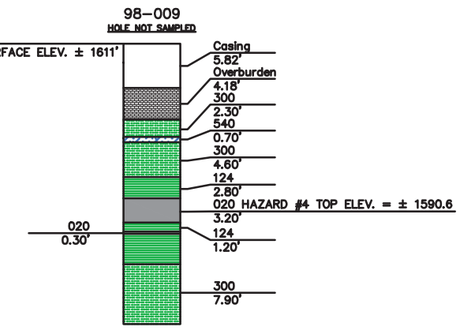
40 BAGS CEMENT PLACED IN HOLE

APPENDIX D-1
STRATIGRAPHIC COLUMNS OF COREHOLES FOR THE BEECH FORK MINE









LEGEND

- Casing
- Overburden – Material Unknown
- 020–030 Coal & Bone
- 032–039 Impure Coal & Bone
- 095 Flint Clay
- 112–113 Black Shale with Coal Streaks
- 114 Black Shale
- 120 Brown Shale
- 122 Dark Gray Layered Shale
- 123 Dark Gray Shale with Coal Streaks
- 124 Dark Gray Shale
- 300 Sandy Shale
- 322–322.8 Dark Gray Shale with Interbedded Sandstone
- 323 Dark Gray Shale with Sandstone Streaks
- 324 Dark Gray Massive Sandy Shale
- 340 Brown Sandstone
- 540 Gray Sandstone
- 541 Gray Crossbedded Sandstone
- 543–543.5 Gray Sandstone with Shale Streaks
- 544 Gray Massive Sandstone
- 546–547 Gray Churned Sandstone
- 563 Hard Sandstone with Shale Streaks
- 742 Gray Shale Pebble Conglomerate
- 748–749 Gray Sandstone with Coal Bands
- 117 Black Fireclay
- 127 Dark Gray Fireclay
- 327 Dark Gray Sandy Fireclay

REFERENCE

* GEOLOGIC COLUMNS BASED ON CORE LOG DATA PROVIDED BY BLEDSOE COAL COMPANY.

TITLE

STRATIGRAPHIC COLUMN OF GEOLOGIC COREHOLES

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT

BLEDSOE COAL CORPORATION
BLEDSOE EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No.		103–81786	FILE No.	10381786A002	
DESIGN	DBS	01/11/12	SCALE	N\A	REV. A
CADD	DBS	01/11/12	FIGURE 3.2-4 1 OF 3		
CHECK		01/11/12			
REVIEW		01/11/12			

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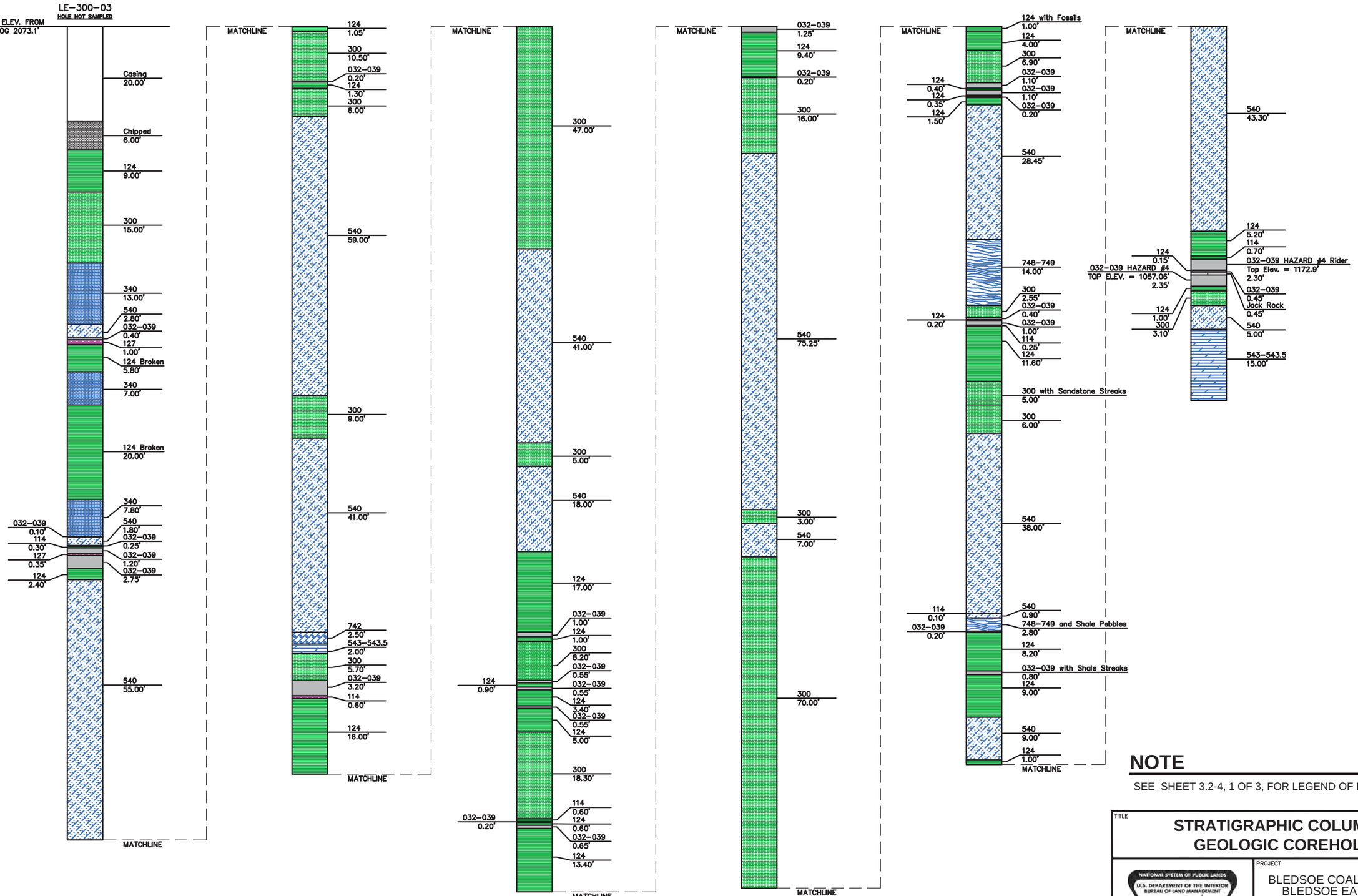


NOTE

SEE SHEET 3.2-4, 1 OF 3, FOR LEGEND OF BORINGS.

REFERENCE

* GEOLOGIC COLUMNS BASED ON CORE LOG DATA PROVIDED BY BLEDSOE COAL COMPANY.

TITLE

STRATIGRAPHIC COLUMN OF GEOLOGIC COREHOLES

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

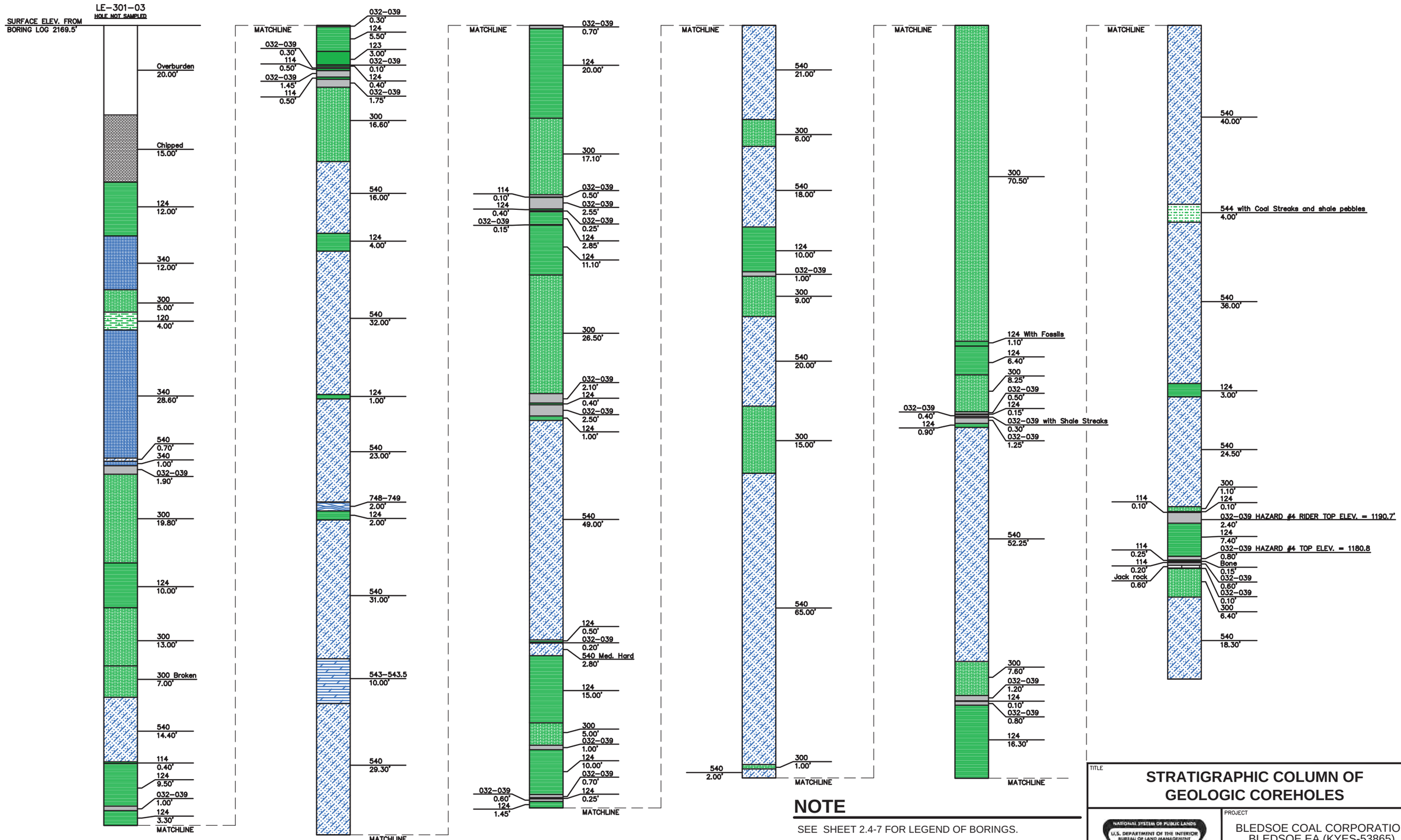
PROJECT

BLEDSOE COAL CORPORATION
BLEDSOE EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No.		103-81786	FILE No.	10381786A002	
DESIGN	DBS	01/11/12	SCALE	N\A	REV. A
CADD	DBS	01/11/12			
CHECK		01/11/12			
REVIEW		01/11/12			

FIGURE 3.2-4
2 OF 3

Drawing File: C:\Users\akwallace\appdata\local\temp\AcPublish_1180\ 10381786A002.dwg | Layout: LE-300-03 | Modified: Jan 26, 2012 11:44 AKWallace | Plotted: 01/26/12 11:51am AKWallace



NOTE

SEE SHEET 2.4-7 FOR LEGEND OF BORINGS.

REFERENCE

* GEOLOGIC COLUMNS BASED ON CORE LOG DATA PROVIDED BY BLEDSOE COAL COMPANY.

TITLE

STRATIGRAPHIC COLUMN OF GEOLOGIC COREHOLES

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PROJECT

BLEDSOE COAL CORPORATION
BLEDSOE EA (KYES-53865)
LESLIE COUNTY, KY

PROJECT No.		103-81786	FILE No.	10381786A002	
DESIGN	DBS	01/11/12	SCALE	N\A	REV. A
CADD	DBS	01/11/12	FIGURE 3.2-4 3 OF 3		
CHECK		01/11/12			
REVIEW		01/11/12			

Drawing File: C:\Users\akwallace\appdata\local\temp\AcPublish_1180\ 10381786A002.dwg | Layout: LE-301-03 | Modified: Jan 26, 2012 11:44 AKWallace | Plotted: 01/26/12 11:51am AKWallace

APPENDIX D-2
AMD EVALUATION

Golder Associates Inc.

44 Union Boulevard, Suite 300
Lakewood, CO USA 80228
Telephone: (303) 980-0540
Fax: (303) 985-2080

FINAL

TECHNICAL MEMORANDUM

TO:	Scott Miller and Tom Williams	**DATE:**	January 20, 2004
FR:	Jacob Waples	**OUR REF:**	023-2425
RE:	**EVALUATION OF REMAINING ACIDITY FROM REMAINING COAL PILLARS AFTER CONTACT WITH COLLAPSED ROOF MATERIALS**		

INTRODUCTION

The Proposed Development Scenario associated with the Proposed Action, which is being evaluated in the *Gray Mountain Coal Lease Land Use Analysis and Environmental Impact Statement* (LUA and EIS) would involve mining of two underground coal seams, the Hazard No. 4 and the Hazard No. 4 Rider. The proposed mining process would involve removal of most of the coal, with the exception of pillars left in place to facilitate mining and minimize subsidence. Following removal of the coal, a void would be left where the coal seam had been, and a zone extending about 50 vertical feet above the roof of the mined area or void would be subject to subsidence in the form of rock collapse. It is anticipated that the majority of the void would be filled by collapsed rock.

Based on acid base accounting (ABA) testing performed on materials from five boreholes (LE-282-00, LE-281-00, LE-198-92, LE-197-92, and LE-207-93), it is assumed that the coal pillars left in place following mining would have negative net neutralization potentials (NNP). Negative NNP values indicate that the material has acid generating potential.

This memorandum describes calculations developed to compare the NNP from pillars remaining following mining to the NNP of the material that is anticipated to collapse into the void following mining. The calculations were designed to determine if the collapsed material would contain sufficient neutralization potential to neutralize the acid generation potential and associated potential acid mine drainage (AMD) from the remaining coal pillars.

DESCRIPTION OF CALCULATIONS

In order to compare the NNP of the coal that would remain in place after mining with that of the material anticipated to collapse into the void, it was necessary to calculate the volumes of the coal and the collapsed material. Once the volumes were estimated, those volumes were converted to mass of rock (coal or collapsed material) by multiplying the values by the respective estimated density of the material. The mass of material was then multiplied by the NNP (reported in $tCaCO_3/1000t$) for the particular rock to establish the total neutralizing capacity (measured in $tCaCO_3$) present for each material. This is summarized in the following set of formulas:

$$\textit{Volume of rock } (ft^3) \times \textit{Density of rock } (t/ft^3) = \textit{Mass of rock } (t)$$

$$Mass\ of\ rock\ (t) \times NNP\ of\ rock\ (tCaCO_3/1000t) = tCaCO_3\ in\ rock$$

In this case, the rock represents either the remaining coal pillars or the collapsed material (shale or sandstone). To determine whether these materials in combination in the void would be acid generating, the following formula is used:

$$tCaCO_3\ of\ coal + tCaCO_3\ of\ collapsed\ material = final\ tCaCO_3$$

If *final* $tCaCO_3$ is negative, the combined materials would be acid generating; if it is positive, then the collapsed materials contain sufficient neutralization potential to neutralize the pillar materials if AMD would develop and if the two are in sufficient contact.

The parameters used are described in greater detail below.

Volume Calculations (Volume = area × height)

- A hypothetical area of 1000 square feet was used. This area was used for both the pillar materials and the collapsed materials. Therefore, while changing the area would change values in the calculation, it would not the change final result of a positive or negative neutralizing capacity ($tCaCO_3$). In other words, it would not affect whether the collapsed materials can neutralize the pillar acidity.

- Heights of coal were obtained from the borehole logs. In cases where the Hazard No. 4 and the Hazard No. 4 Rider are close (within 5 feet of each other), a combined height, including the two seams and any interlying material, was used.

- Heights of collapsed material were based on the amount expected to fill the void space. In the case of shale, it is expected that 90% of the height of the void space would be required to fill the space. For example, if the coal seam is 5.92 feet high, it was assumed that 5.33 feet of shale would be required to fill this space. A value of 75% was used for sandstone.

- The height of the collapsed material usually would incorporate more than one stratigraphic layer. In such cases, the calculated NNP was weighted to appropriately incorporate all stratigraphic layers.

Density

- For shale, a density of 2.7 g/cm^3 was used; for sandstone, a density of 2.6 g/cm^3 was used.

- For coal, a density of 1.3 g/cm^3 was used, based on typical in place values for bitumous coal.

NNP Values

- The NNP values for all materials were obtained from the ABA testing performed on borehole materials.

RESULTS OF CALCULATIONS

The calculations were performed under two assumptions: 1) 85% of the coal would be removed, and 2) 50% of the coal would be removed. Results are summarized in Table 1, attached. Under both scenarios in all boreholes, the *final* $tCaCO_3$, or overall neutralizing capacity, was positive. This result indicates that the collapsed materials would contain enough neutralization potential to neutralize acid generation from the remaining pillars.

Table 1

EVALUATION OF PILLAR ACIDITY VS ACID NEUTRALIZATION POTENTIAL OF COLLAPSED MATERIALS

Borehole	Acidity Remaining in Pillars ($t\ CaCO_3$)*		Net Neutralization Potential of Cave in Material ($t\ CaCO_3$)*	Remaining Net Neutralization Potential ($t\ CaCO_3$)*		Remarks
	Assuming 85% Removal	Assuming 50% Removal		Assuming 85% Removal	Assuming 50% Removal	
LE-281-00	-0.307	-1.025	2.782	2.474	1.757	non-acid generating in both scenarios
LE-282-00	-0.216	-0.721	1.439	1.222	0.717	non-acid generating in both scenarios
LE-197-92	-0.160	-0.533	3.377	3.217	2.844	non-acid generating in both scenarios
LE-198-92	-0.245	-0.816	11.018	10.773	10.201	non-acid generating in both scenarios
LE-207-93	-0.657	-2.191	6.773	6.116	4.582	non-acid generating in both scenarios

Notes:

*Net Neutralization Potential is multiplied by mass of rock; therefore reported as t CaCO3. Assumes an area of 1000 square feet and heights reported on borehole logs (see Technical Memorandum Regarding Evaluation of Remaining Acidity From Coal Pillars Left In-Place After Contact With Collapsed Roof Materials).

Densities used were: 2.6 g/cm^3 for sandstone, 2.7 g/cm^3 for shale, and 1.3 g/cm^3 for coal.

APPENDIX E
GROUNDWATER USERS SURVEY RESULTS

Attachment 16.1
WATER SUPPLY INVENTORY

Well #	Name	Phone Number	Type of Supply (1)	Water Use (2)	Total Depth (ft)	Cased Depth (ft)	Well Diam. (in)	Top Well Elev. (ft msl)	Date Const.	Depth to Water (ft)	Latitude	Longitude	Sampled	Comments
B1	Ellen Simpson	374-7830	DW	DND	40		8	1110		20	37-01-32	83-23-40	yes	Iron content in water
B2	Ruthann Ervin	374-4753	DW	DD	65		6	1054			37-01-42	83-23-23	yes	slight scent in water
B3	Vicky Muncy	374-3277	DW	DD				1059			37-01-20	83-23-36	yes	didn't know about well
B4	Tiffany Simpson	374-5131	DW	DD				1065	1985		37-01-14	83-23-38	no	couldn't sample pump not working
B5	Brandon Hubbard	None						1035			37-02-23	83-24-02	N/A	city water
B6	Kennedy Sizemore	374-3370						1105			37-01-56	83-23-44	N/A	city water
B7	NT							1120			37-01-56	83-23-43	N/A	city water
B8	Orfie Collett	374-3278						1078			37-01-56	83-23-36	N/A	city water
B9	Landry Collett	374-4013						1075			37-01-48	83-23-36	N/A	city water
B10	Handy Stop Market	374-6183						1020			37-01-37	83-23-21	N/A	city water
B11	NT							1079			37-01-48	83-23-36	N/A	city water
B12	Donna Nance	374-5251						1022			37-01-40	83-23-22	N/A	city water
B13	Harvey Muncy	374-5887						1017			37-01-35	83-23-24	N/A	city water
B14	Johnny Muncy	374-3089						1022			37-01-35	83-23-20	N/A	city water
B15	Ellyn Whitehead	374-3439						1137			37-01-01	83-25-21	N/A	city water
B16	Unoccupued							1150			37-01-35	83-23-20	N/A	Abandoned house
B17	NT							1050			37-02-09	83-23-53	N/A	no one available to talk
B18	NT							1028			37-02-01	83-23-47	N/A	no one home
B19	Vance Mosley							1038			37-01-58	83-23-46	N/A	not at home

NOTES:
(1) DW - Drilled Well HD - HandDug Well CS - Coal Seam SP - Spring MW - Municiple Waterline ST - Stream R - Reservoir C - Cistern SS - Sandstone ALV - Alluvial
(2) DD - Domestic Drinking DND - Domestic, non-drinking AG - Agricultural COM - Commercial IND - Industrial

NT - Not Home INA - Information not Available

ATTACTMENT 16.1.A

MAP REF.	NAME OF USER	WATER SOURCE	Elev.	Depth to Water	TOTAL DEPTH	Well Dia. (IN.)	Remarks.
8	Gary Saylor	Spring	1700'	N/A	N/A	N/A	Source is dry now (9-30-99)
11	Willard Saylor	Drilled Well	1280'	28'	120'	6	Domestic non-drinking, GW-311
		Drilled Well	1280'	40'	80''	6	Not in use
	.	Drilled Well	1280'	90'	150'	6	Not in use, GW-1722
12	Eugene Rose	N/A	N/A	N/A	N/A	N/A	No water source
15	Ronnie Napier	Drilled Well	1350'		210'	6	Wash clothes, odor S, Fe
16	Ruby Hoskins	Drilled Well	1340'		120'	6	Domestic, good water
17	Bulis Caldwell	Drilled Well	1350'		80'	6	Domestic Good water
18	Clifford Hoskins	Drilled Well	1520'			6	Domestic, Good water
19	Max Heminway	Drilled Well	1520'			6	Well dry, 10-27-99
21	Rocky Caldwell	Drilled Well	1280'			6	Domestic, Fe, odor
22	Terry Wilson	Drilled Well	1260'			6	Not in use
24	Wayne Asher	Municipal	N/A	N/A	N/A	N/A	N/A
25	Anita Minniard	Municipal	N/A	N/A	N/A	N/A	N/A
26	Anita Minniard	Municipal	N/A	N/A	N/A	N/A	N/A
27	Robert Nantz	Municipal	N/A	N/A	N/A	N/A	N/A
28	Robert Nantz	Municipal	N/A	N/A	N/A	N/A	N/A

ATTACTMENT 16.1.A

MAP REF.	NAME OF USER	WATER SOURCE	Elev.	Depth to Water	TOTAL DEPTH	Well Dia. (IN.)	Remarks.
29	Robert Nantz	Municipal	N/A	N/A	N/A	N/A	N/A
30	Roscoe Asher	Municipal	N/A	N/A	N/A	N/A	N/A
35	Heather Wilson	Municipal	N/A	N/A	N/A	N/A	N/A
36	James Estridge	Municipal	N/A	N/A	N/A	N/A	N/A
37	James Estridge	Municipal	N/A	N/A	N/A	N/A	N/A
38	Sean Wilson	Municipal	N/A	N/A	N/A	N/A	N/A
39	Mike Howard	Municipal	N/A	N/A	N/A	N/A	N/A
40	Dennis Howard	Municipal	N/A	N/A	N/A	N/A	N/A
41	James Estridge	Municipal	N/A	N/A	N/A	N/A	N/A
42	Lonzo Franks	Municipal	N/A	N/A	N/A	N/A	N/A
43	Aleta Roberts	Municipal	N/A	N/A	N/A	N/A	N/A
44	Aleta Roberts	Municipal	N/A	N/A	N/A	N/A	N/A
45A	Chole Simpson	Municipal	N/A	N/A	N/A	N/A	N/A
45	Rick Burkehart	Municipal	N/A	N/A	N/A	N/A	N/A
46	David Burkehart	Same as #48					(GW 2073)
47	Abandoned	N/A	N/A	N/A	N/A	N/A	N/A
48	Reva Hoskins	Drilled Well	1287'	20'	140'	6	Fe, H2S (GW 2073)

ATTACTMENT 16.1.A

MAP REF.	NAME OF USER	WATER SOURCE	Elev.	Depth to Water	TOTAL DEPTH	Well Dia. (IN.)	Remarks.
49	J. Hunt Morgan	Municipal	N/A	N/A	N/A	N/A	N/A
50	Abandoned	Municipal	N/A	N/A	N/A	N/A	N/A
51	Non Existent	Municipal	N/A	N/A	N/A	N/A	N/A
52	Fernie Ellis	Municipal	N/A	N/A	N/A	N/A	N/A
53	J. Hunt Morgan	Municipal	N/A	N/A	N/A	N/A	N/A
54	Ellis Brown	Municipal	N/A	N/A	N/A	N/A	N/A
55	Ellis Brown	Municipal	N/A	N/A	N/A	N/A	N/A
56	Margaret Whitehead	Municipal	N/A	N/A	N/A	N/A	N/A
		Drilled Well	1280'				Fe, H2s
57	Not Home	Municipal	N/A	N/A	N/A	N/A	N/A
58	Gary Stacy	Municipal	N/A	N/A	N/A	N/A	N/A
59	Frank Simpson	Municipal	N/A	N/A	N/A	N/A	N/A
60	Frank Simpson	Municipal	N/A	N/A	N/A	N/A	N/A
61	Non Existent	Municipal	N/A	N/A	N/A	N/A	N/A
62	Gladys Nance	Municipal	N/A	N/A	N/A	N/A	N/A
63	Freddie Brock	Municipal	N/A	N/A	N/A	N/A	N/A
64	Abandoned	N/A	N/A	N/A	N/A	N/A	N/A

ATTACTMENT 16.1.A

MAP REF.	NAME OF USER	WATER SOURCE	Elev.	Depth to Water	TOTAL DEPTH	Well Dia. (IN.)	Remarks.
G8	Angela Spurlock	Municipal	N/A	N/A	N/A	N/A	N/A
G9	Mickey Middleton	Municipal	N/A	N/A	N/A	N/A	N/A
G10	Ollie Davis	Municipal	N/A	N/A	N/A	N/A	N/A
G11	Brock's Market	Municipal	N/A	N/A	N/A	N/A	N/A
G12	Fred Rose	Municipal	N/A	N/A	N/A	N/A	N/A
G13	Randall Rose	Municipal	N/A	N/A	N/A	N/A	N/A
G14	Randall Rose	Municipal	N/A	N/A	N/A	N/A	N/A
G15	Non Existent	N/A	N/A	N/A	N/A	N/A	N/A
G16	Non Existent	N/A	N/A	N/A	N/A	N/A	N/A
G17	Chester Hoskins	Municipal	N/A	N/A	N/A	N/A	N/A
G18	Chester Hoskins	Municipal	N/A	N/A	N/A	N/A	N/A
G19	Herbert Napier	Municipal	N/A	N/A	N/A	N/A	N/A
G20	Dennis Gross	Municipal	N/A	N/A	N/A	N/A	N/A
G21	Jay Adkins	Municipal	N/A	N/A	N/A	N/A	N/A
G22	Non Existent	N/A	N/A	N/A	N/A	N/A	N/A
G23	B&B Auto	Municipal	N/A	N/A	N/A	N/A	N/A
G24	Melanie Baker (Vacant)	N/A	N/A	N/A	N/A	N/A	N/A

ATTACTMENT 16.1.A

MAP REF.	NAME OF USER	WATER SOURCE	Elev.	Depth to Water	TOTAL DEPTH	Well Dia. (IN.)	Remarks.
G25	Melanie Baker	Municipal	N/A	N/A	N/A	N/A	N/A
G26	Paul Nantz	Municipal	N/A	N/A	N/A	N/A	N/A
G27	Paul Nantz	Municipal	N/A	N/A	N/A	N/A	N/A
G28	Ernest Brows	Municipal	N/A	N/A	N/A	N/A	N/A
G29	Larry Fultz	Municipal	N/A	N/A	N/A	N/A	N/A

SHAMROCK COAL CO. INC. PERMIT NUMBER : 866 - 5130, AMENDMENT # 3 GROUNDWATER USERS SURVEY,
FIELD REVISION, * ACCOMPANIED BY DNR INSPECTOR JOHN BLEDSOE, 11/19/2011

MAP NO.	USER NAME	WATER SOURCE	ELEV.	WATER LEVEL	TOTAL DEPTH	GAL. / DAY	AQUIFER ELEV.	AQUIFER TYPE	QUALITY
G25	MELANIE BAKER	MUNICIPAL	1340	N/A	N/A	N/A	N/A	N/A	N/A
		PREVIOUS WATER SOURCE : (WELL) DISCONNECTED FROM USE, INACCESSIBLE							
G24	VACANT	N/A	1343	N/A	N/A	N/A	N/A	N/A	N/A
G23	B & B AUTO	MUNICIPAL	1240	N/A	N/A	N/A	N/A	N/A	N/A
		PREVIOUS WATER SOURCE : (WELL) DISCONNECTED FROM USE, INACCESSIBLE							
G22	NON - EXISTENT	N/A	1240	N/A	N/A	N/A	N/A	N/A	N/A
G21	J. ADKINS	MUNICIPAL	1240	N/A	N/A	N/A	N/A	N/A	N/A
		PREVIOUS WATER SOURCE : (WELL) DISCONNECTED FROM USE, INACCESSIBLE							
G8	ANGELA SPURLOCK	MUNICIPAL	1335	N/A	N/A	N/A	N/A	N/A	N/A
		PREVIOUS WATER SOURCE : (WELL) DISCONNECTED FROM USE, INACCESSIBLE							
36	JAMES ESTRIDGE	WELL	1282	40.0 '	60.0 '	450	1222	STRESS REL. FRAC.	H2S
37	JAMES ESTRIDGE	WELL	1282	N/A	N/A	0	N/A	N/A	N/A
		** SEE INFO. FOR G36*							
41	JAMES ESTRIDGE	WELL	1282	N/A	N/A	450	N/A	N/A	N/A
		** SEE INFO. FOR G36*							
42	JAMES ESTRIDGE	WELL	1320	N/A	N/A	300	N/A	N/A	N/A
		** SEE INFO. FOR G36*							
43	LOYAL FRANKS	J. ESTRIDGE, WELL	1320	N/A	N/A	450	N/A	N/A	N/A
		** SEE INFO. FOR G36*							
44	ALETA ROBERTS	J. ESTRIDGE, WELL	1340	N/A	N/A	300	N/A	N/A	N/A
		** SEE INFO. FOR G36*							
46	DAVID BURKHART	MUNICIPAL	1287	N/A	N/A	N/A	N/A	N/A	N/A
		PREVIOUS WATER SOURCE : (WELL) DISCONNECTED FROM USE, INACCESSIBLE							
47	ABANDONED	N/A	1307	N/A	N/A	N/A	N/A	N/A	N/A
48	REVA HOSKINS	MUNICIPAL	1287	N/A	N/A	N/A	N/A	N/A	N/A
	REVA HOSKINS	WELL * DISCONNECTED *	1287	20.0 '	140.0 '	300	1147	STRESS REL. FRAC.	FE, H2S
49	J. HUNT MORGAN	MUNICIPAL	1287	N/A	N/A	N/A	N/A	N/A	N/A
		PREVIOUS WATER SOURCE : (WELL) DISCONNECTED FROM USE, INACCESSIBLE							
50	ABANDONED	N/A	1310	N/A	N/A	N/A	N/A	N/A	N/A
51	NON - EXISTENT	N/A	1300	N/A	N/A	N/A	N/A	N/A	N/A
52	FERNIE ELLIS	MUNICIPAL	1290	N/A	N/A	N/A	N/A	N/A	N/A
		PREVIOUS WATER SOURCE : (WELL) DISCONNECTED FROM USE, INACCESSIBLE							
53	J. HUNT MORGAN	MUNICIPAL	1320	N/A	N/A	N/A	N/A	N/A	N/A
		PREVIOUS WATER SOURCE : (WELL) DISCONNECTED FROM USE, INACCESSIBLE							
54	ELLIS BROWN	MUNICIPAL	1280	N/A	N/A	N/A	N/A	N/A	N/A
		PREVIOUS WATER SOURCE : (WELL) DISCONNECTED FROM USE, INACCESSIBLE							
55	ELLIS BROWN	MUNICIPAL	1280	N/A	N/A	N/A	N/A	N/A	N/A
		PREVIOUS WATER SOURCE : (WELL) DISCONNECTED FROM USE, INACCESSIBLE							

APPENDIX F-1
AVAILABLE GROUNDWATER DATA

Appendix F-1
Details of Groundwater Monitoring Results

Parameter	Beech Fork 1737																					
	11/9/2001	12/5/2001	1/3/2002	2/6/2002	3/13/2002	4/12/2002	4/15/2002	5/20/2002	6/18/2002	7/25/2002	8/12/2002	9/25/2002	12/27/2002	3/27/2003		1/12/2010	1/26/2010	6/4/2010	8/6/2010	10/20/2010	1/15/2011	4/7/2011	7/3/2011
Total Iron (mg/L)	0.05					0.25		0.28	0.22	0.28	0.30	0.29	0.40	0.69									
Dissolved Iron (mg/L)	0.01	0.93	0.94	1.10	1.15	0.1	1.1	0.19	0.13	0.19	0.17	0.10	0.31	0.4		0.64	0.75	0.53	0.71	0.51	0.2	0.49	1.4
Total Manganese (mg/L)	0.01					0.11		0.10	0.24	0.15	0.05	0.14	0.09	0.18									
Dissolved Manganese (mg/L)	0		0.41	0.26	0.28	0.06	0.26	0.05	0.1	0.06	0.01	0.08	0.01	0.05		0.35	0.28	0.19		0.4	0.86	0.28	0.24
Sulfate (mg/L)	31	34	60	60	42	50	50	44	60	51	47	44	22	57				50	64	34	40	63.8	83.2
pH (standard units)	7.6	7.5	7.6	7.3	7.5	8	7.6	8.3	8.2	8.4	8.4	8.5	8.1	8.5		8	8.4	7.7	7.4	7	7.6	8	7.6
Alkalinity (mg/L $CaCO_3$)	101.5	110.19	110.13	109.3	116.75	120.1	113.07	122.4	121.05	122.19	121.1	120.1	122.57	122.15		122.1	122.1	110.25	114.34	110.15	104.8	116.46	380.8
Acidity (mg/L $CaCO_3$)	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	>5	<5	<5	<5
Specific Conductance (umhos/cm)	371	827	681	827	779	237	525	322	339	372	450	423	305	508				491	516	633	5.1	1258	1750
Total Suspended Solids (mg/L)	3	8	8	3	4	8	6	8	10	11	9	11	5	11									
Total Dissolved Solids (mg/L)	219	488	402	488	460	140	310	190	200	220	266	250	10	300		486	375						
Depth to Water	20	30	30	28	28	15	28	12	15	15	16	16	16	12		15	15						
Well Depth	120	120	120	120	120		120																
Temperature	55					55.5		50.6	51.7	52.9	55.5	60.5	48.2	52.7									

Appendix F-1
Details of Groundwater Monitoring Results

Parameter	Simms Branch 1738																						
	11/9/2001	12/5/2001	1/3/2002	2/6/2002	3/13/2002	4/12/2002	4/15/2002	5/20/2002	6/18/2002	7/25/2002	8/12/2002	9/25/2002	12/27/2002	3/27/2003		1/12/2010	1/26/2010	6/4/2010	8/6/2010	10/20/2010	1/15/2011	4/7/2011	7/3/2011
Total Iron (mg/L)	0.16					0.80		0.95	0.92	0.98	0.99	1.02	0.99	0.87									
Dissolved Iron (mg/L)	0.04	0.16	0.1	0.61	0.74	0.75	0.8	0.8	0.73	0.74	0.84	0.88	0.84	0.62		0.67	0.67	0.85	0.68	0.72	0.19	1.16	1.4
Total Manganese (mg/L)	0.20					0.29		0.74	0.55	0.69	0.12	0.62	0.63	0.22									
Dissolved Manganese (mg/L)	0.11	0.01	0.05	0.7	0.69	0.11	0.4	0.66	0.24	0.58	0.06	0.41	0.4	0.14		0.35	0.34	0.29		0.48	0.15	0.09	0.24
Sulfate (mg/L)	59	62	50	55	36	59	40	78	61	74	71	55	72	50				80	71	55	69	9.6	83.2
pH (standard units)	7.5	7.8	7.4	8.1	8.2	7.4	8.1	7.7	8	7.3	7.5	7.5	7.7	7.6		8.2	8.2	8	7.5	7.7	8.2	7.2	8.7
Alkalinity (mg/L $CaCO_3$)	108.2	106.55	110.42	115.1	110.13	109.56	109.66	105.86	109.47	100.41	101.2	102.55	102.12	103.25		121.9	120.65	116.2	112.45	116.15	121.97	120.6	138.5
Acidity (mg/L $CaCO_3$)	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	>5	<5	<5	<5
Specific Conductance (umhos/cm)	380	506	538	779	372	525	705	602	617	527	664	593	615	489				501	622	718	820	256	221
Total Suspended Solids (mg/L)	4	3	3		2	15	4	12	12	15	12	13	10	9									
Total Dissolved Solids (mg/L)	224	299	318		220	310	416	355	364	311	392	350	363	289		489	493				100	100	100
Depth to Water	9	21	21	20	20	29	20	30	30	30	31	29	30	30		40	40						
Well Depth	80	80	80	80	80		80																
Temperature	60					55.5		50.6	51.7	52.9	55.5	61.5	50.2	52.7									

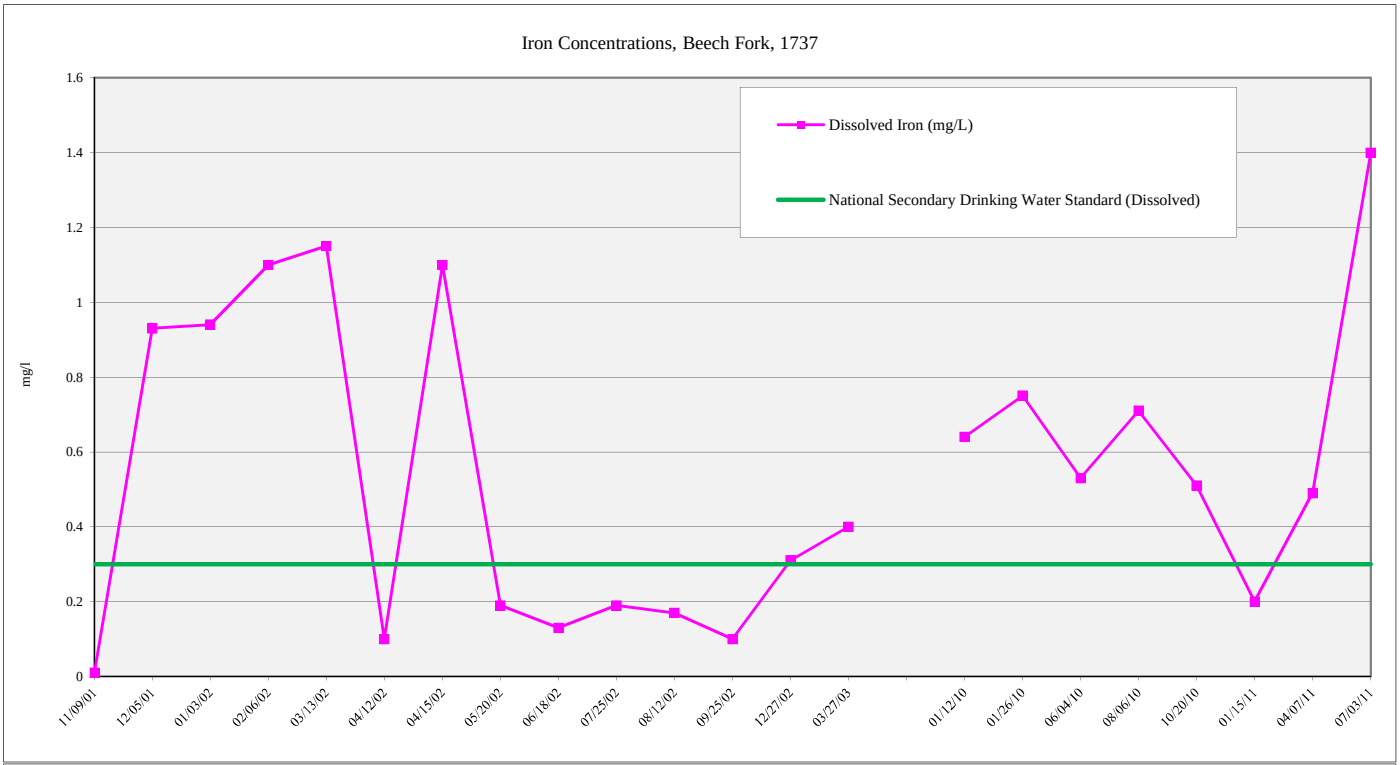
Appendix F-1
Details of Groundwater Monitoring Results

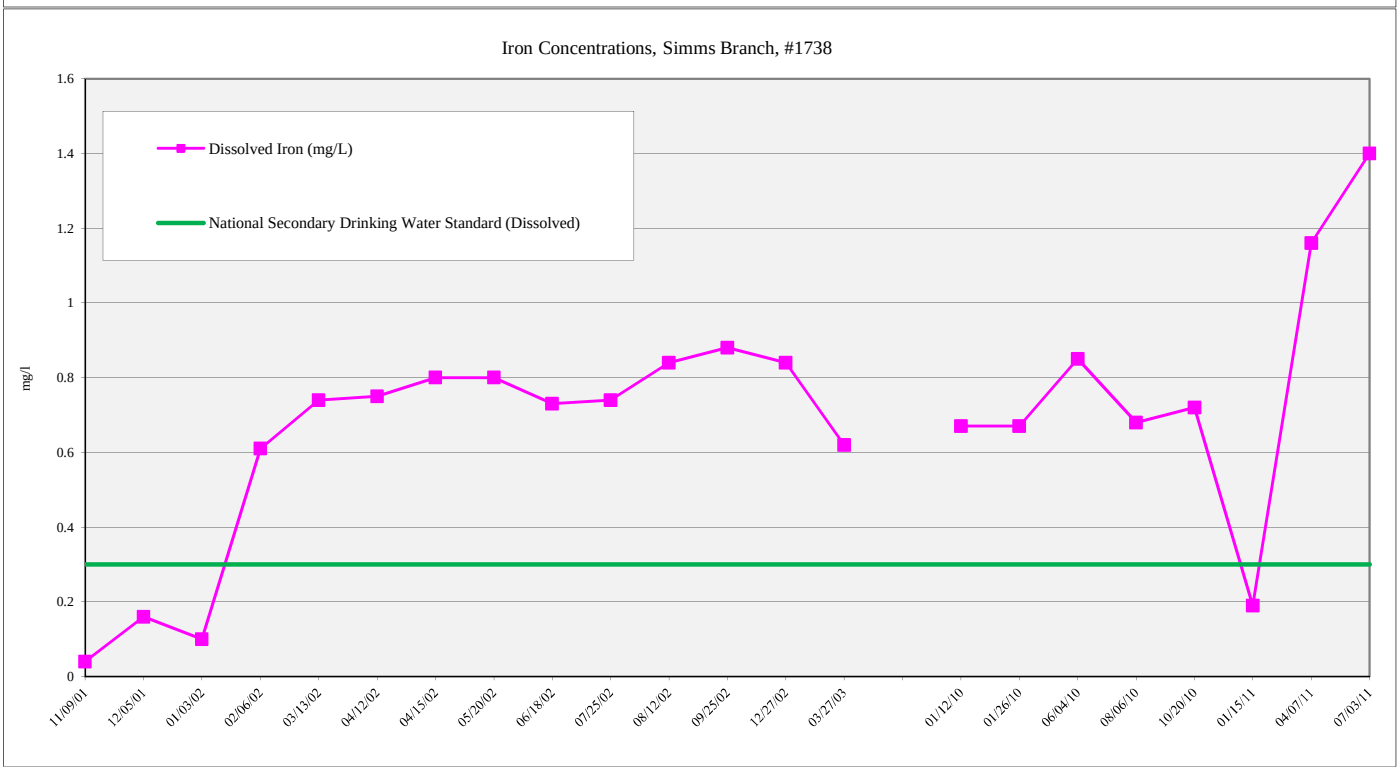
Parameter	Elk Creek 1739																						
	11/9/2001	12/5/2001	1/3/2002	2/6/2002	3/13/2002	4/12/2002	4/15/2002	5/20/2002	6/18/2002	7/25/2002	8/12/2002	9/25/2002	12/27/2002	3/27/2003		1/12/2010	1/26/2010	8/6/2010	6/4/2010	10/20/2010	1/15/2011	4/7/2011	7/3/2011
Total Iron (mg/L)	0.33					0.75		0.72	0.76	0.78	0.77	0.62	0.69	0.70									
Dissolved Iron (mg/L)	0.14	0.05	0.16	0.09	0.44	0.6	0.39	0.61	0.59	0.64	0.69	0.5	0.58	0.65			0.52	0.29	0.15	0.36	0.36	0.785	1.4
Total Manganese (mg/L)	0.08					0.01		0.01	0.01	0.01	0.01	0.01	0.01	0.01									
Dissolved Manganese (mg/L)	0.05	0.18	0.05	0.17	0.06	0.01	0.06	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.08	0.24		0.08	0.29	0.4	0.06	0.24
Sulfate (mg/L)	32	58	63	48	69	41	70	30	32	30	28	26	22	34				75	69	58	81	61.3	83.2
pH (standard units)	7.9	8.1	8.3	7.6	7.4	7	7.5	7	7.2	7.3	7.1	7	7	7		8	8	7.9	7.6	7.4	7.8	7.6	7.8
Alkalinity (mg/L $CaCO_3$)	116.2	120.18	120.61	116.3	120.13	89.1	119.02	86.1	81.5	90.36	100.48	89.45	90.45	90.25		120.7	115.1	114.65	108.11	112.15	118.39	110.56	110.6
Acidity (mg/L $CaCO_3$)	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	>5	<5	<5	<5
Specific Conductance (umhos/cm)	337	677	610	359	593	451	676	483	516	459	439	441	486	475				503	455	615	180.1	151	154.3
Total Suspended Solids (mg/L)	5	2	4	7	7	19	8	9	9	10	9	7	10	9									
Total Dissolved Solids (mg/L)	199	400	360	212	350	266	399	285	305	271	259	260	287	280		492	486						
Depth to Water	Covered	15	15	28	29	22	29	22	22	22	22	22	22	22		25	25						
Well Depth	80	80	80	80	80		80																
Temperature	57					55.5		50.6	52.5	53.5	56.2	60.7	51	55									

Appendix F-1
Details of Groundwater Monitoring Results

Parameter	Greasy Creek and Laurel Fork 1724														Beech Fork GW-14				Fern Branch GW 2073			
	2/13/2002	3/11/2002	4/22/2002	5/14/2002	6/14/2002	7/20/2002	8/10/2002	9/25/2002	12/28/2002	3/25/2003		10/20/2010	1/15/2011	4/7/2011	7/3/2011	10/20/2010	1/15/2011	4/7/2011	7/3/2011	10/20/2010	1/15/2010	4/7/2011	7/4/2011
Total Iron (mg/L)																							
Dissolved Iron (mg/L)	0.23	0.29	0.5	0.63	0.45	0.63	0.68	0.41	0.47	0.39		0.51	0.67	0.52	0.97	0.51	0.77	0.91	0.55	0.72	0.51	0.72	0.8
Total Manganese (mg/L)																							
Dissolved Manganese (mg/L)	0.51	0.47	0.62	0.25	0.31	0.12	0.15	0.5	0.59	0.16		0.4	0.26	0.37	0.05	0.4	0.51	0.63	0.32	0.48	0.33	0.55	0.77
Sulfate (mg/L)	25	41	47	57	62	69	64	40	36	0.61		34	50	72.3	14.8	34	65	32.6	88.9	55	70	38.9	63.2
pH (standard units)	7.4	7.6	7.6	7.5	7.6	7.4	7.2	7.6	7.4	7.8		7	7.5	7.8	7.4	7	7.5	8.2	8	7.7	8	7.7	8
Alkalinity (mg/L $CaCO_3$)	110.66	110.5	112.25	110.19	110.99	110.01	115.74	118.9	120.13	119.14		110.15	115.61	121.3	109.8	110.15	115.31	179.5	125.32	116.15	113.2	106.79	115.63
Acidity (mg/L $CaCO_3$)	0	0	0	0	0	0	0	0	0	0		>5	<5	<5	<5	<5	<5	<5	<5	>5	<5	<5	<5
Specific Conductance (umhos/cm)	560	541	601	552	488	600	522	620	507	593		633	810	987	410	633	815	1148	1386	718	875	561	690
Total Suspended Solids (mg/L)	5	8	4	4	8	9	11	9	12	9													
Total Dissolved Solids (mg/L)	310	305	366	311	300	420	410	368	310	350													
Depth to Water	20	20	21	20	21	20	20	22	22	22					10			10	10				
Well Depth			105	105	105	105	105	105															
Temperature	54	58	59	61	62	64	61	65	50	55													

APPENDIX F-2
GRAPHS OF AVAILABLE GROUNDWATER DATA





Golder Associates

Denver, Colorado

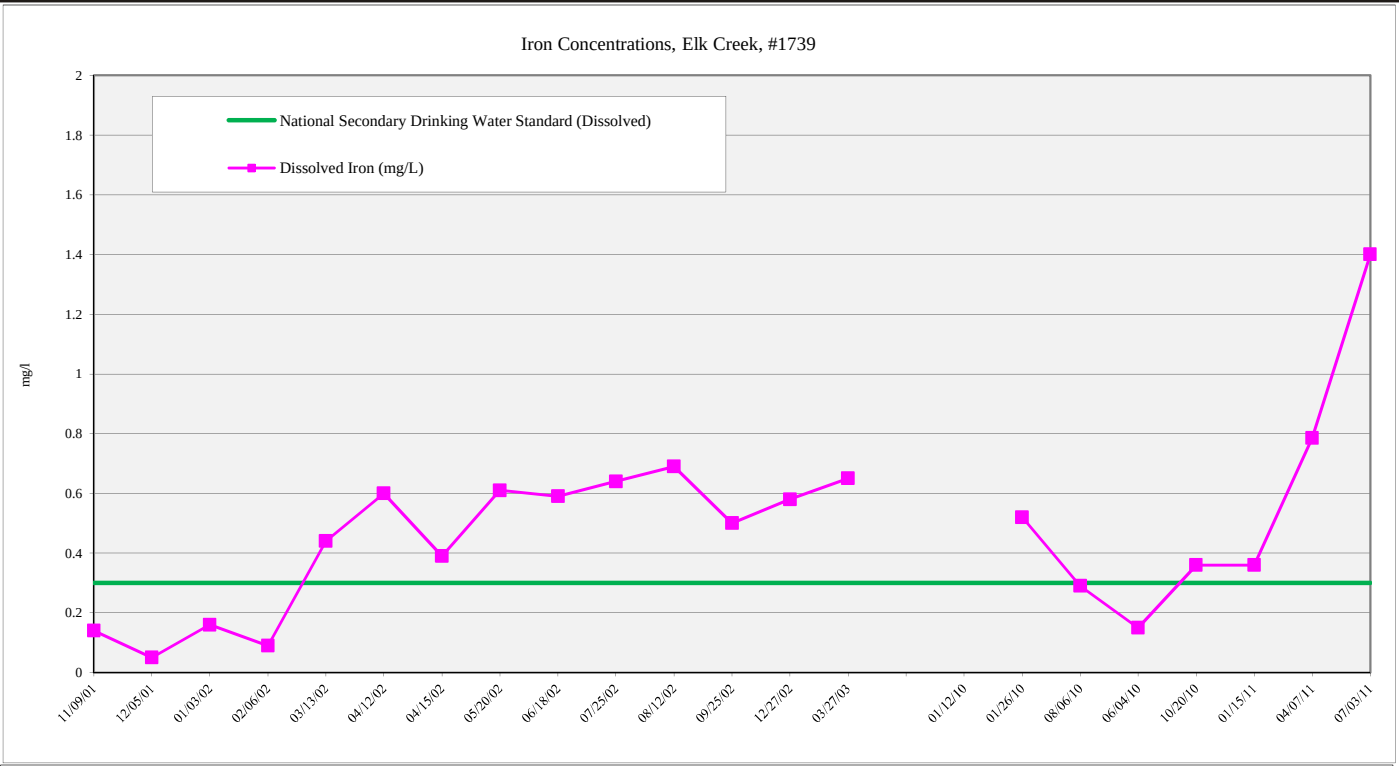
TITLE

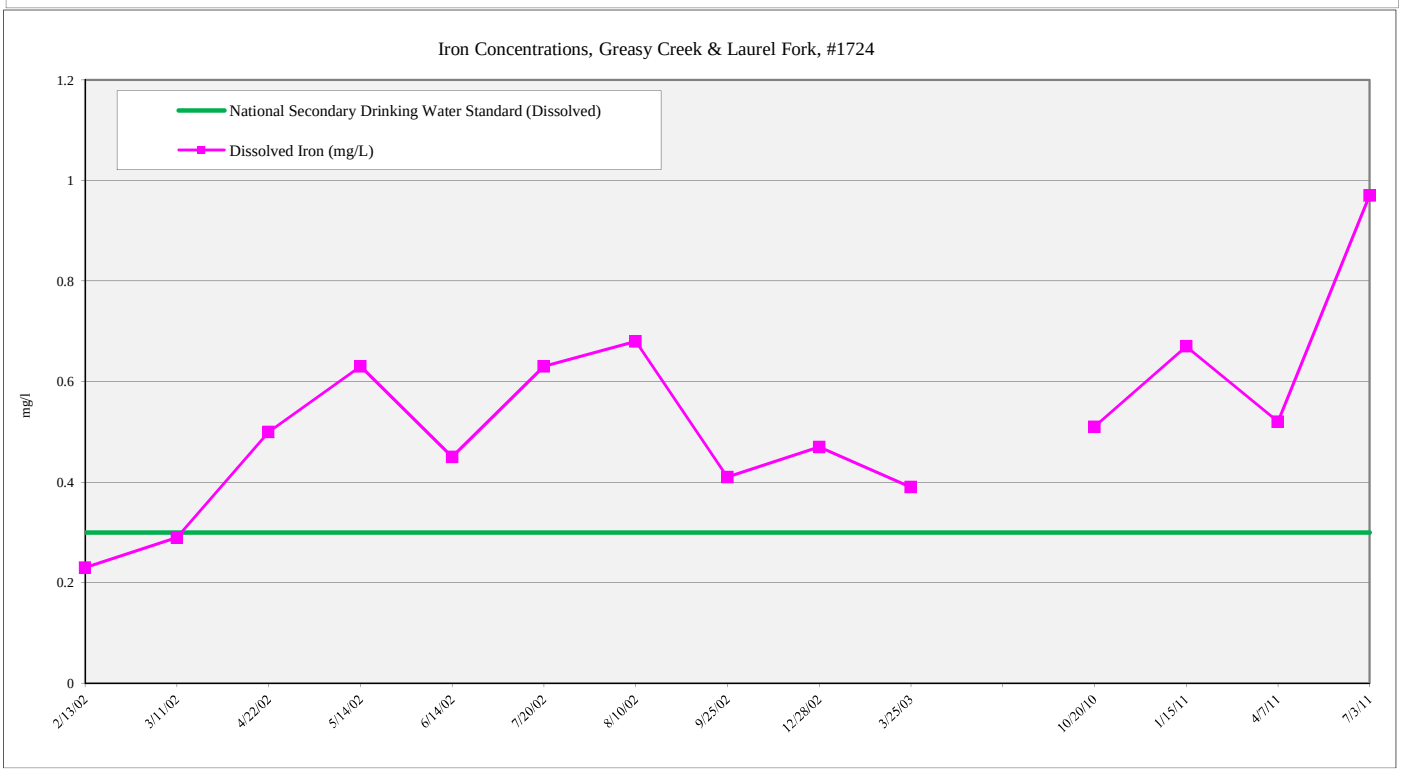
Groundwater Monitoring
Dissolved Iron Concentrations
Beech Fork, Simms Branch

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES5-3865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE NTS	DWG NO./REV. NO.	
REVIEWED MWB	FILE NO. 10381786 RPT-FNL BledsoeCoalEA APP-F.xlsx	FIGURE NO. App F-2.1	





Golder Associates

Denver, Colorado

TITLE

Groundwater Monitoring
Dissolved Iron Concentrations
Elk Creek, Greasy Creek & Laurel Fork

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES5-3865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE NTS	DWG NO./REV. NO.	
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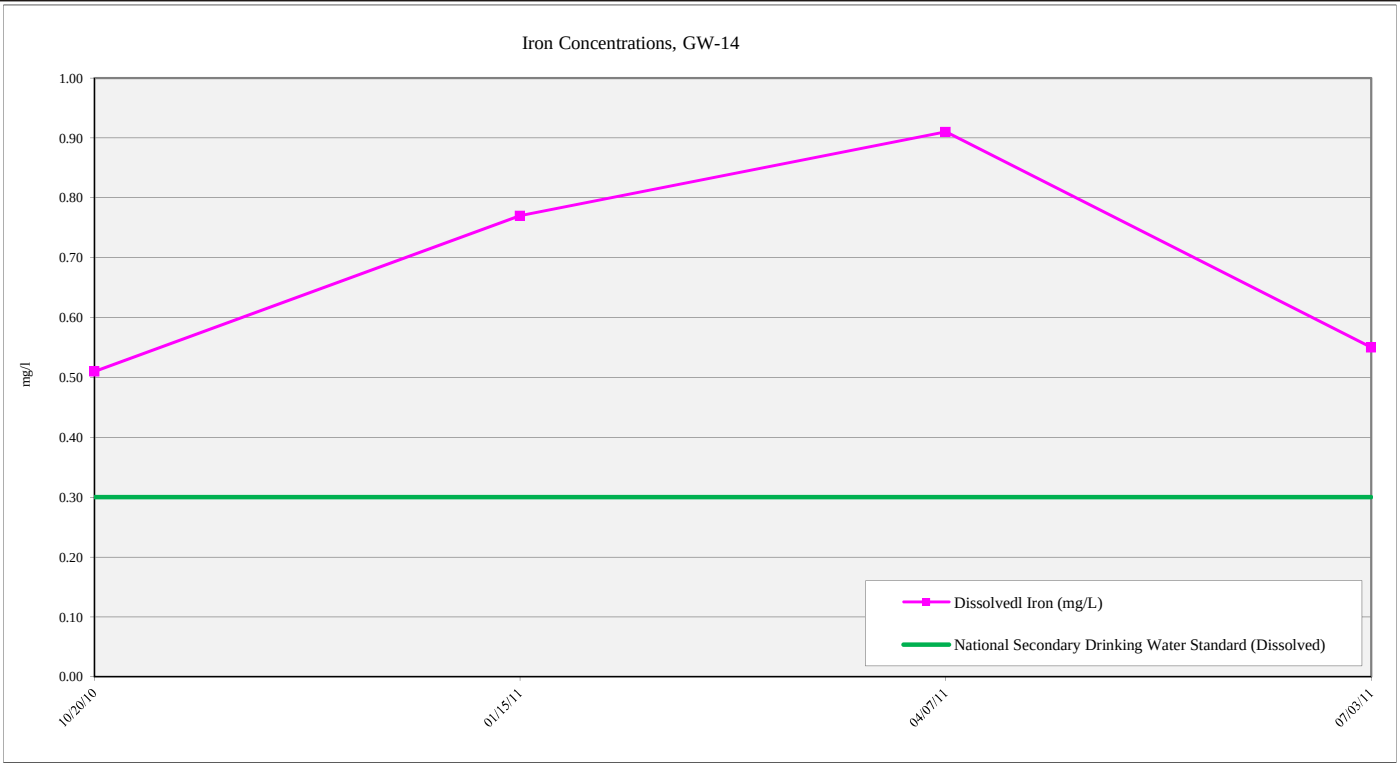

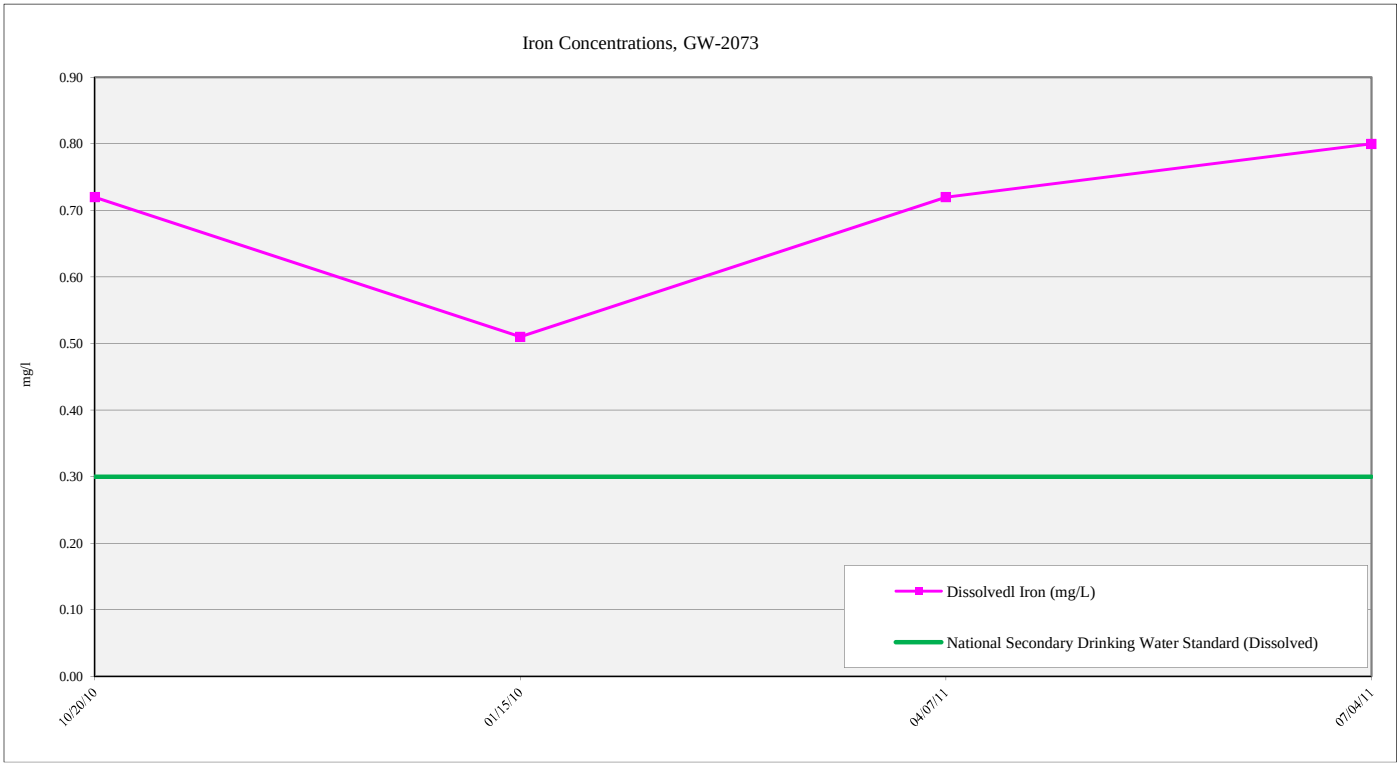

Golder Associates

Denver, Colorado

TITLE

Groundwater Monitoring
Dissolved Iron Concentrations
GW-14 and GW-2073

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES5-3865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE NTS	DWG NO./REV. NO.	
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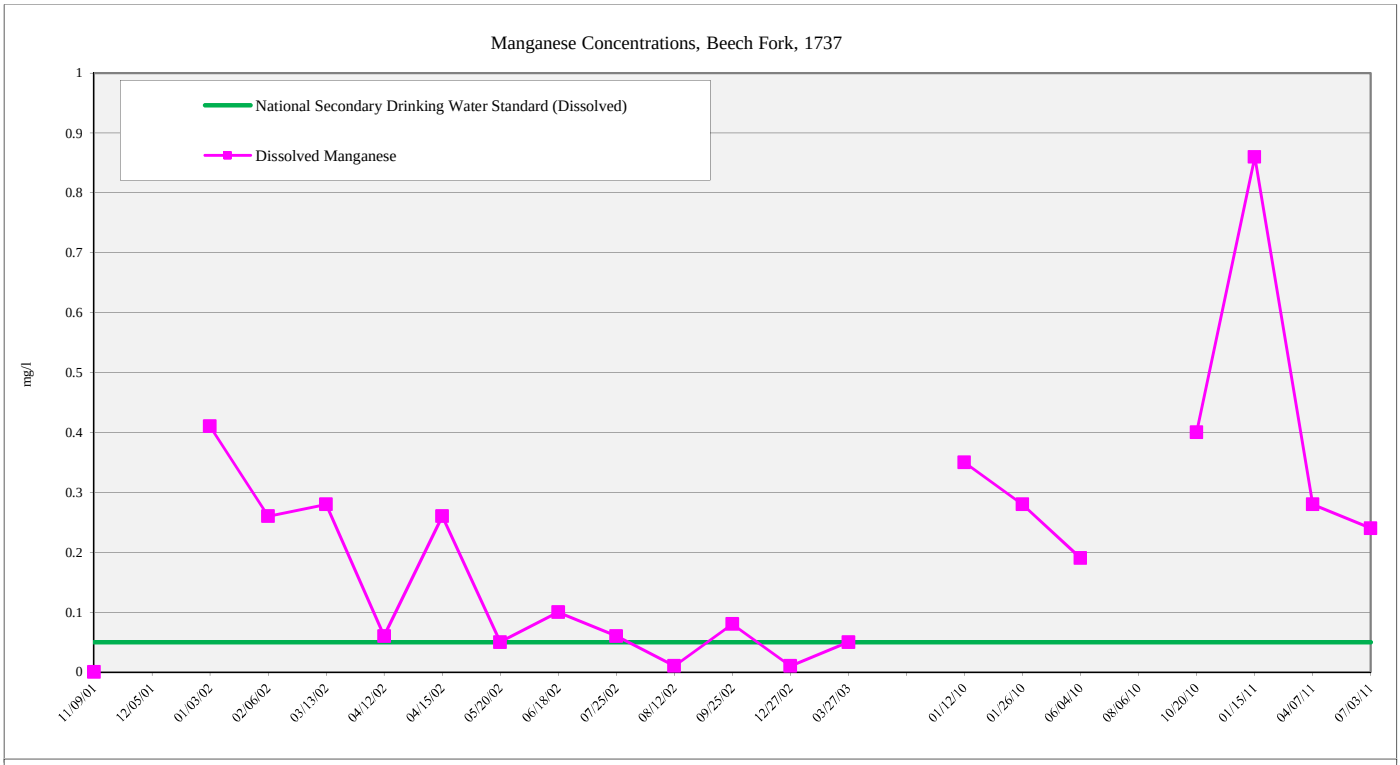
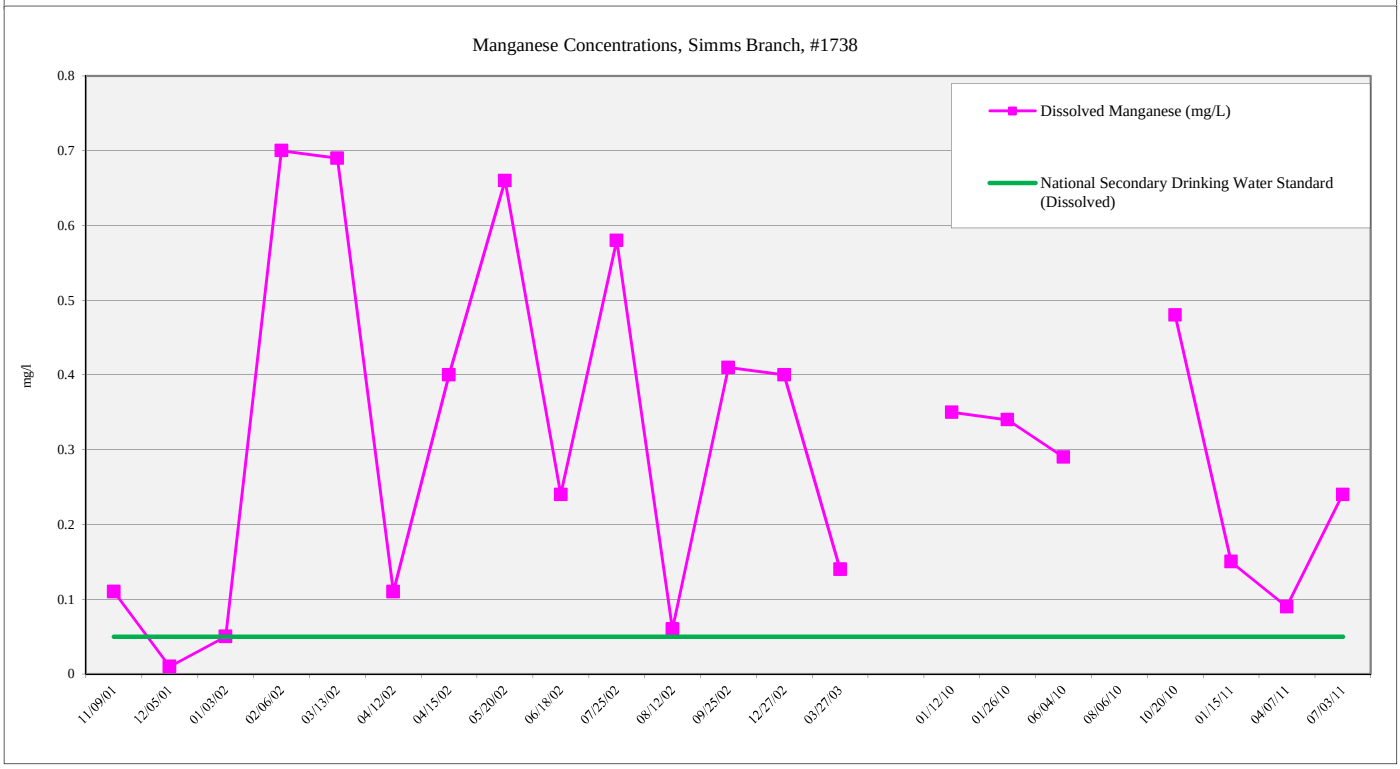


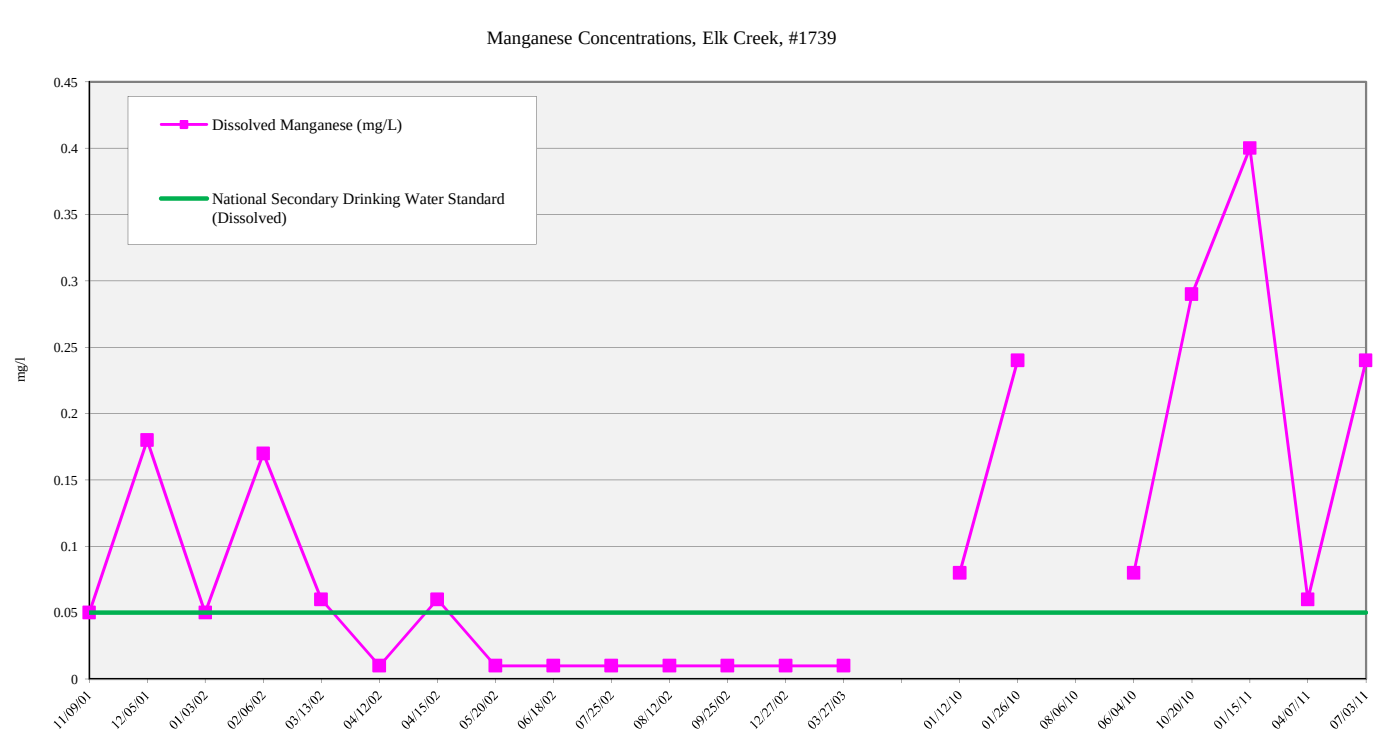


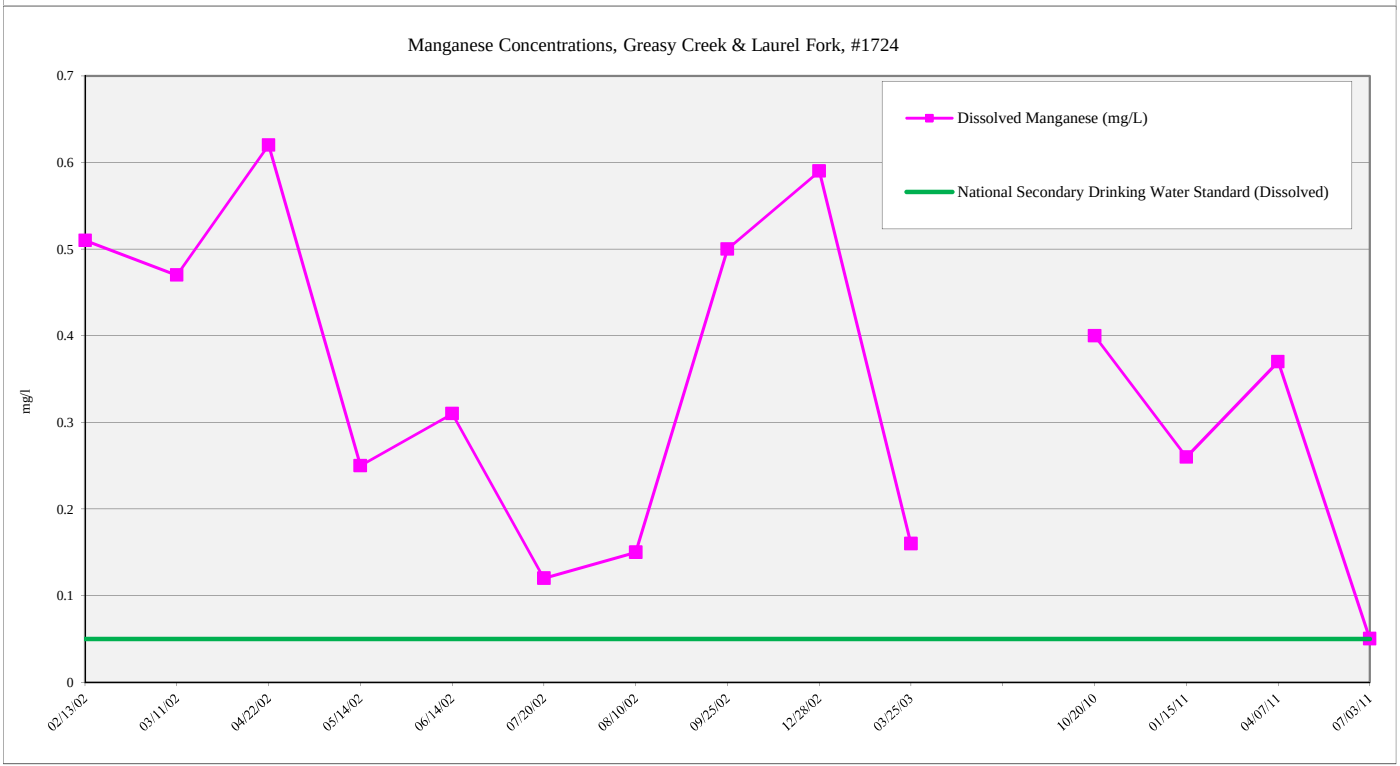
Golder Associates
Denver, Colorado

TITLE
Groundwater Monitoring
Dissolved Manganese Concentrations
Beech Fork, Simms Branch

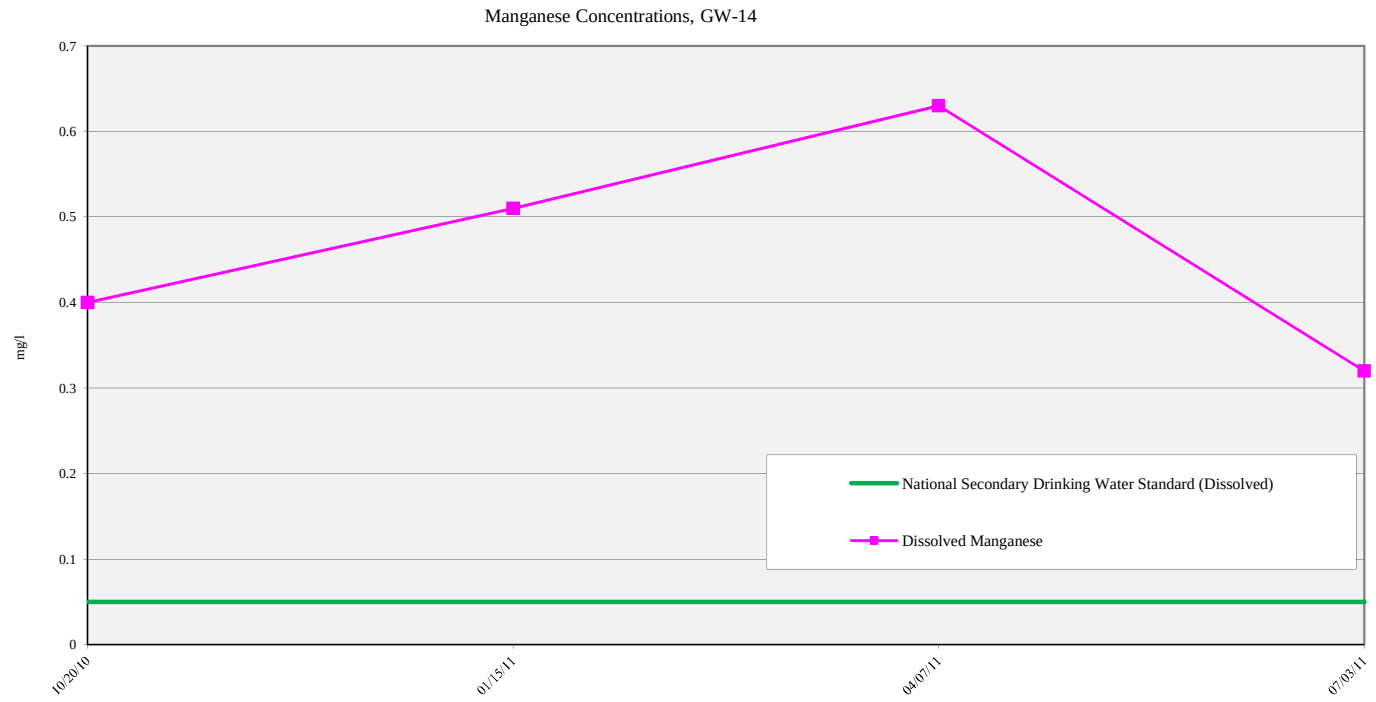
CLIENT/PROJECT
Bledsoe Coal Corporation
Bledsoe EA (KYES5-3865)
Leslie County, KY

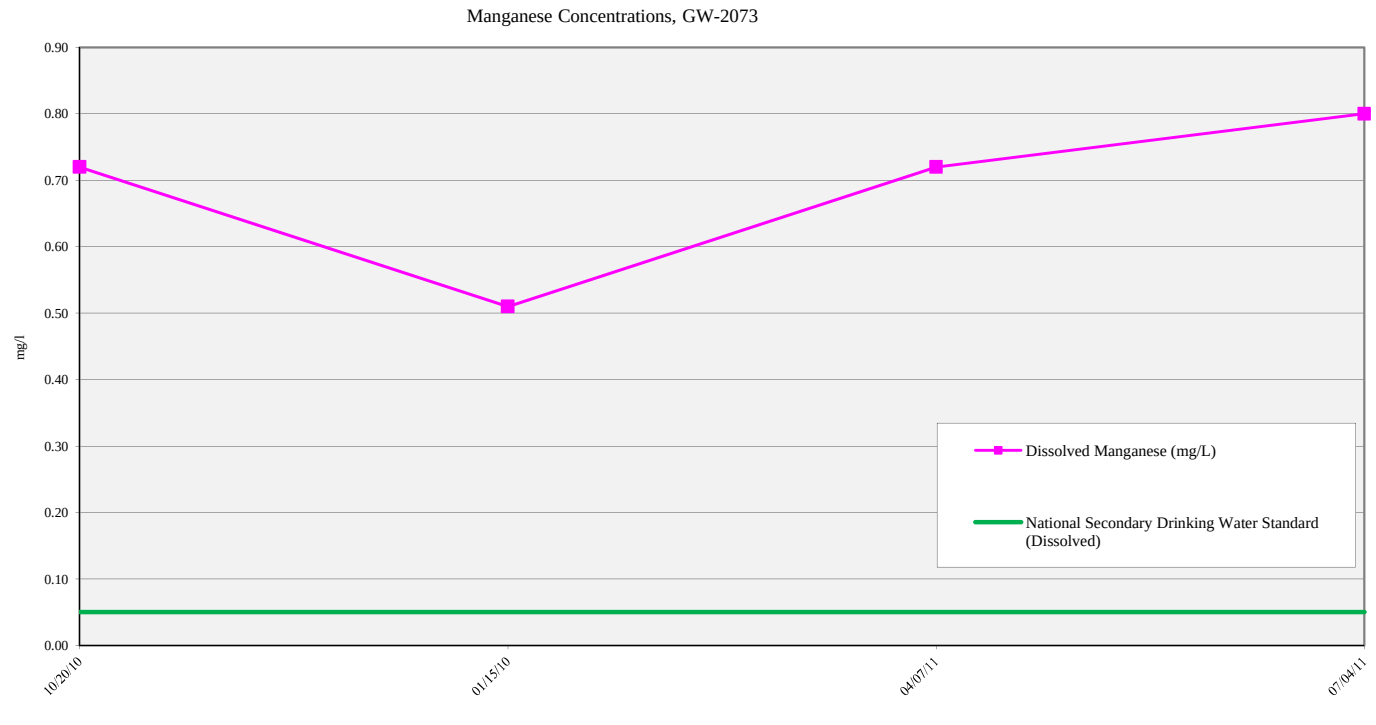
DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE NTS	DWG NO./REV. NO.	
REVIEWED MWB	FILE NO. 10381786 RPT-FNL BledsoeCoalEA APP-F.xlsx	FIGURE NO. App F-2.4	



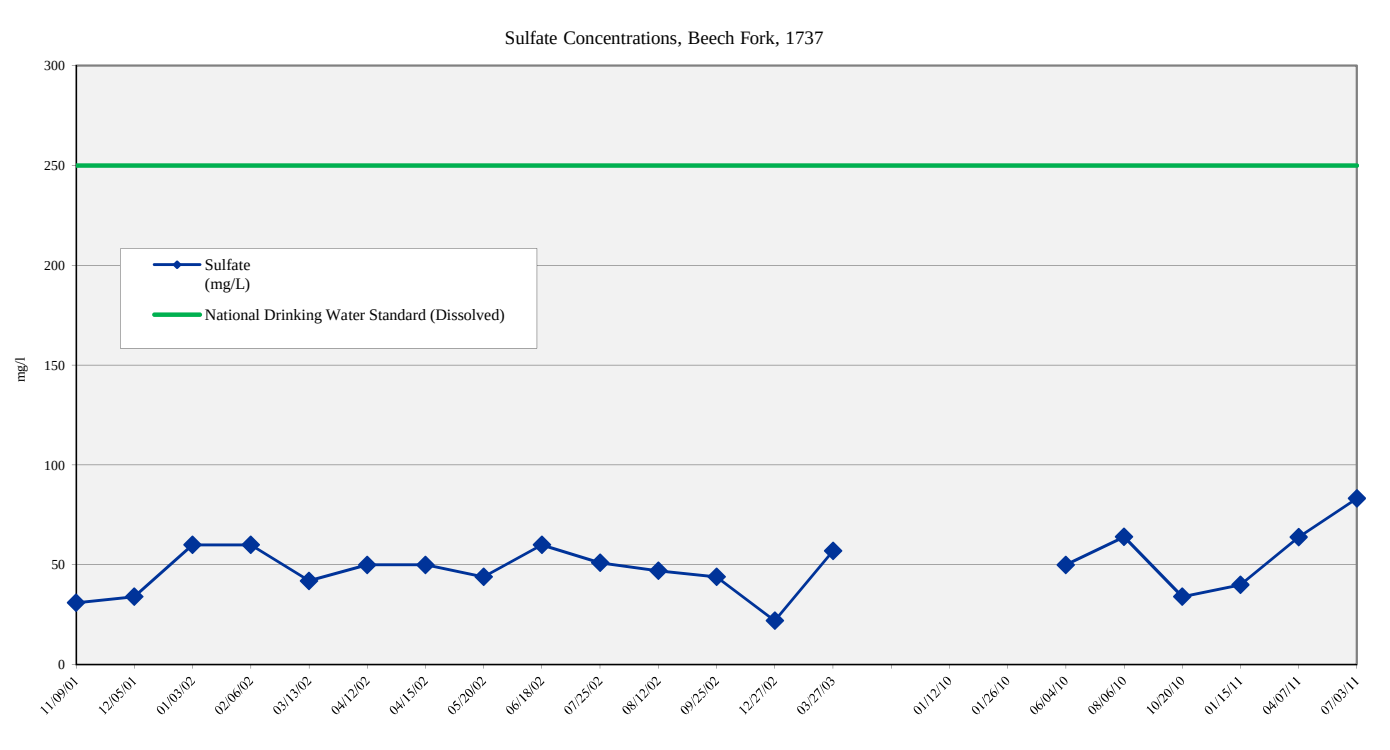


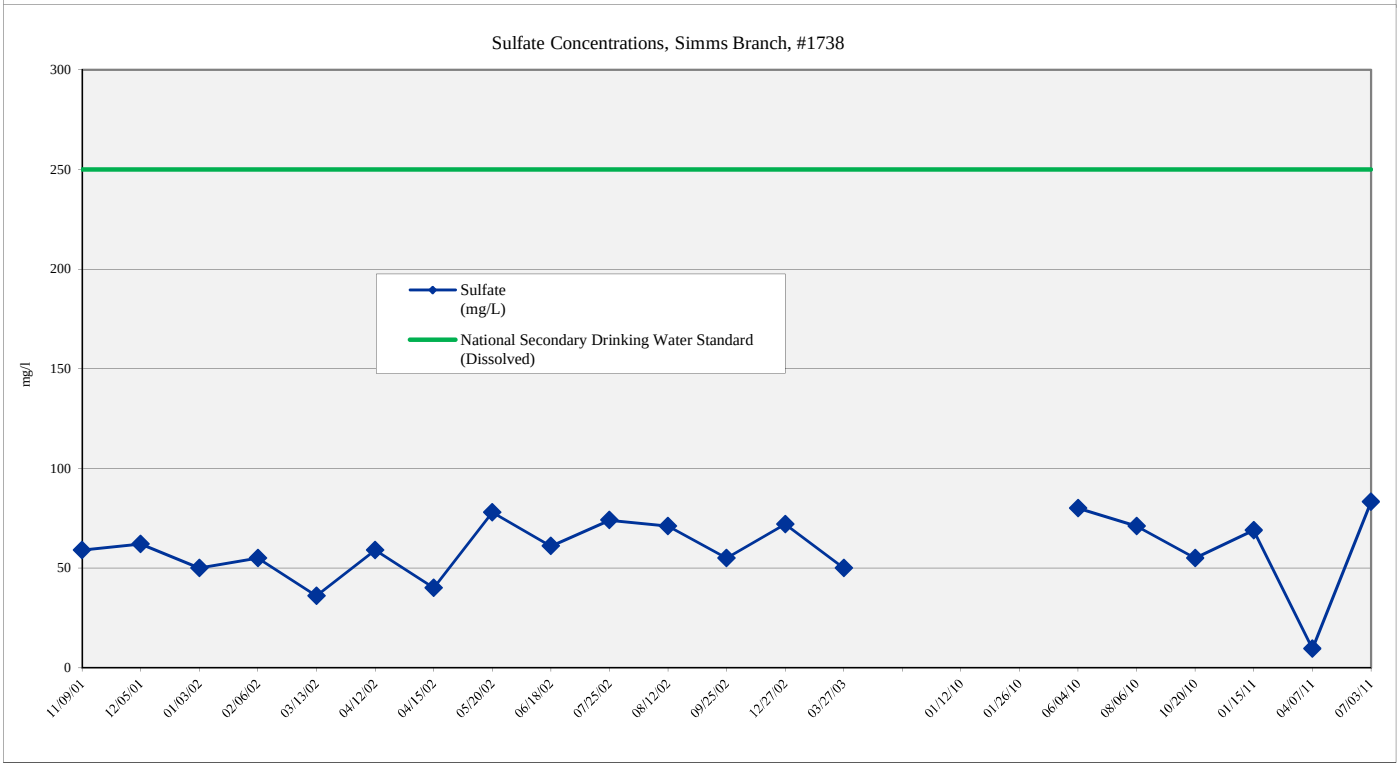
Golder Associates Denver, Colorado	TITLE **Groundwater Monitoring Dissolved Manganese Concentrations Elk Creek, Greasy Creek & Laurel Fork**		
CLIENT/PROJECT **Bledsoe Coal Corporation Bledsoe EA (KYES5-3865) Leslie County, KY**	DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**
	CHECKED **EJP**	SCALE **NTS**	DWG NO./REV. NO.
	REVIEWED **MWB**	FILE NO. 103-81786 RPT-FNL BledsoeCoalEA APP-F.xlsx	FIGURE NO. **App F-2.5**





Golder Associates Denver, Colorado	TITLE Groundwater Monitoring Manganese Concentrations GW-14 and GW-2073		
CLIENT/PROJECT Bledsoe Coal Corporation Bledsoe EA (KYES5-3865) Leslie County, KY	DRAWN SEM	DATE Jun-12	JOB NO. 103-81786
	CHECKED EJP	SCALE NTS	DWG NO./REV. NO.
	REVIEWED MWB	FILE NO. 10381786 RPT-FNL BledsoeCoalEA APP-F.xlsx	FIGURE NO. App F-2.6





Golder Associates
Denver, Colorado

TITLE
Groundwater Monitoring
Sulfate Concentrations
Beech Fork, Simms Branch

CLIENT/PROJECT
Bledsoe Coal Corporation
Bledsoe EA (KYES5-3865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE NTS	DWG NO./REV. NO.	
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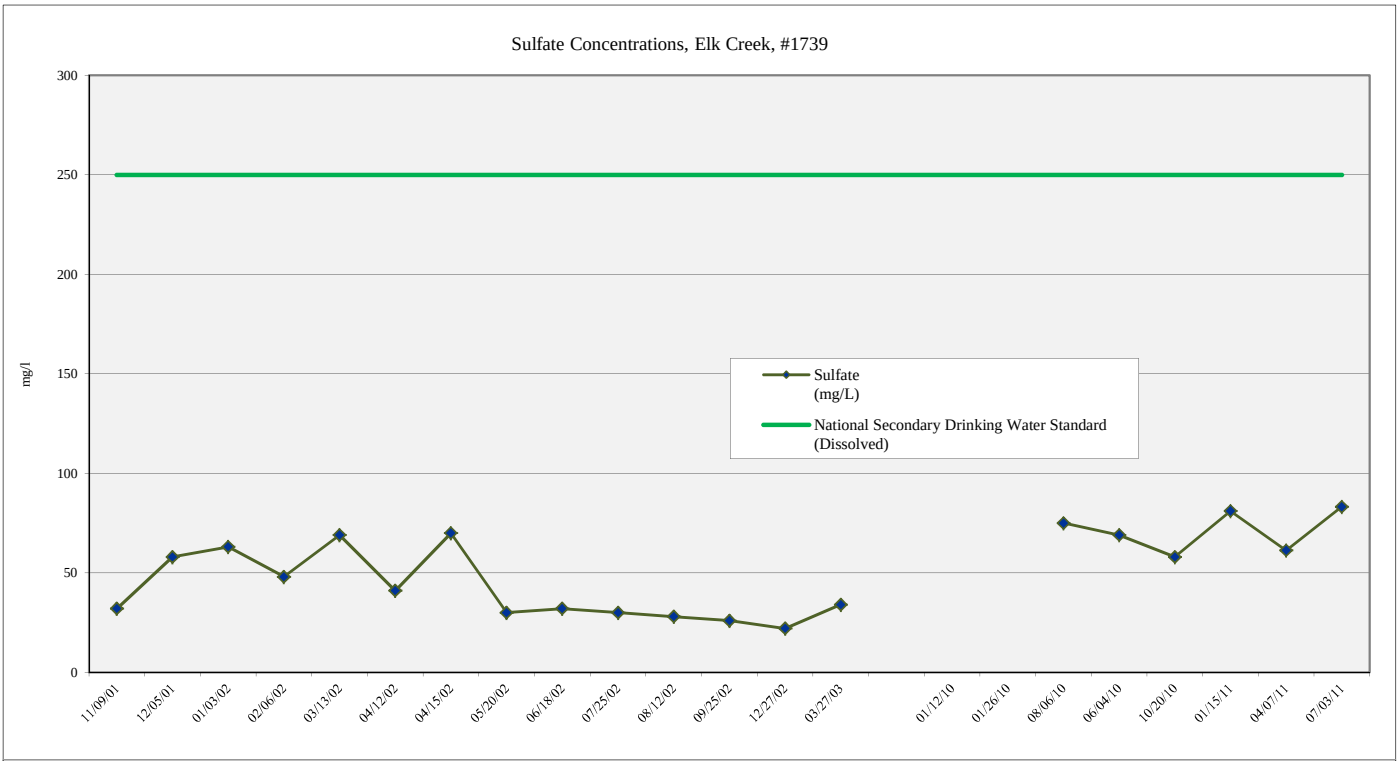

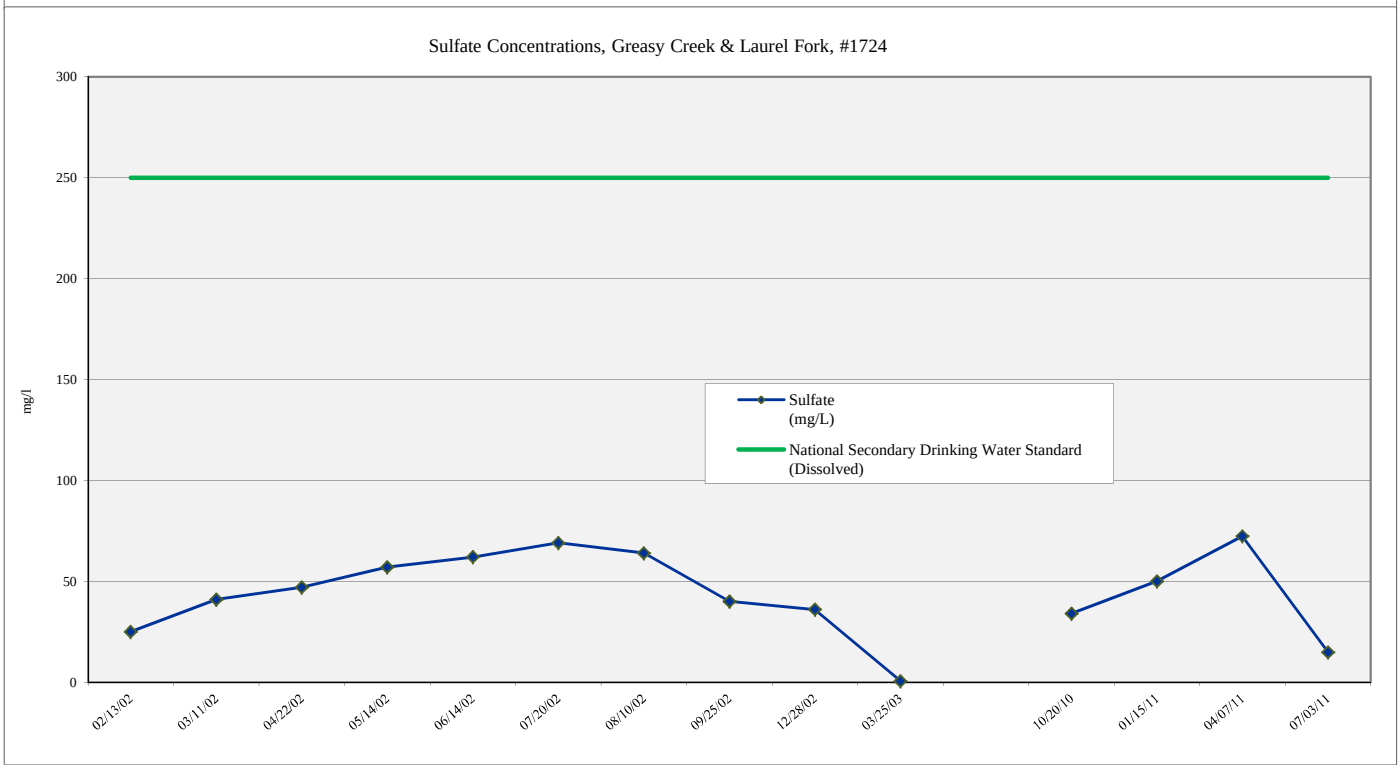

Golder Associates — Denver, Colorado

TITLE: **Groundwater Monitoring Sulfate Concentrations Elk Creek, Greasy Creek & Laurel Fork**

CLIENT/PROJECT: **Bledsoe Coal Corporation Bledsoe EA (KYES5-3865) Leslie County, KY**

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE NTS	DWG NO./REV. NO.	
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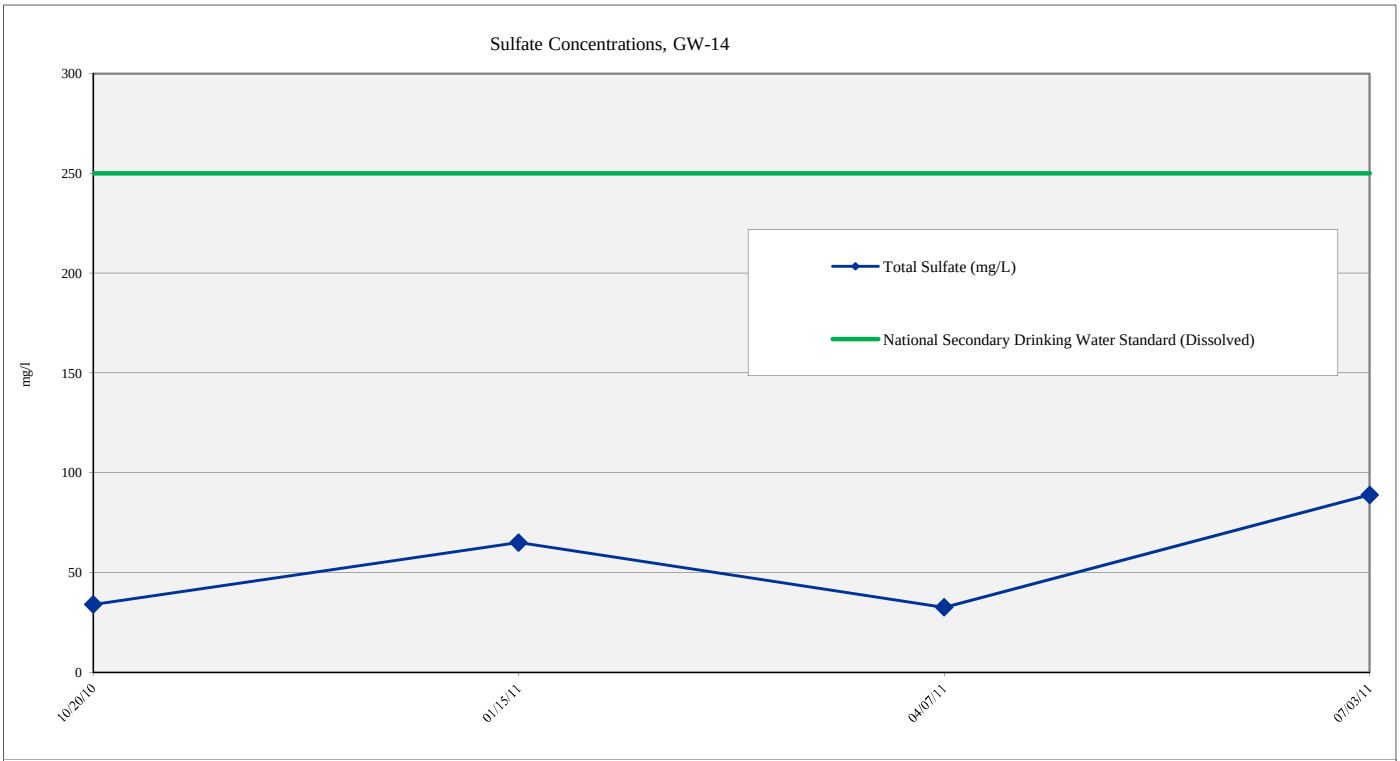

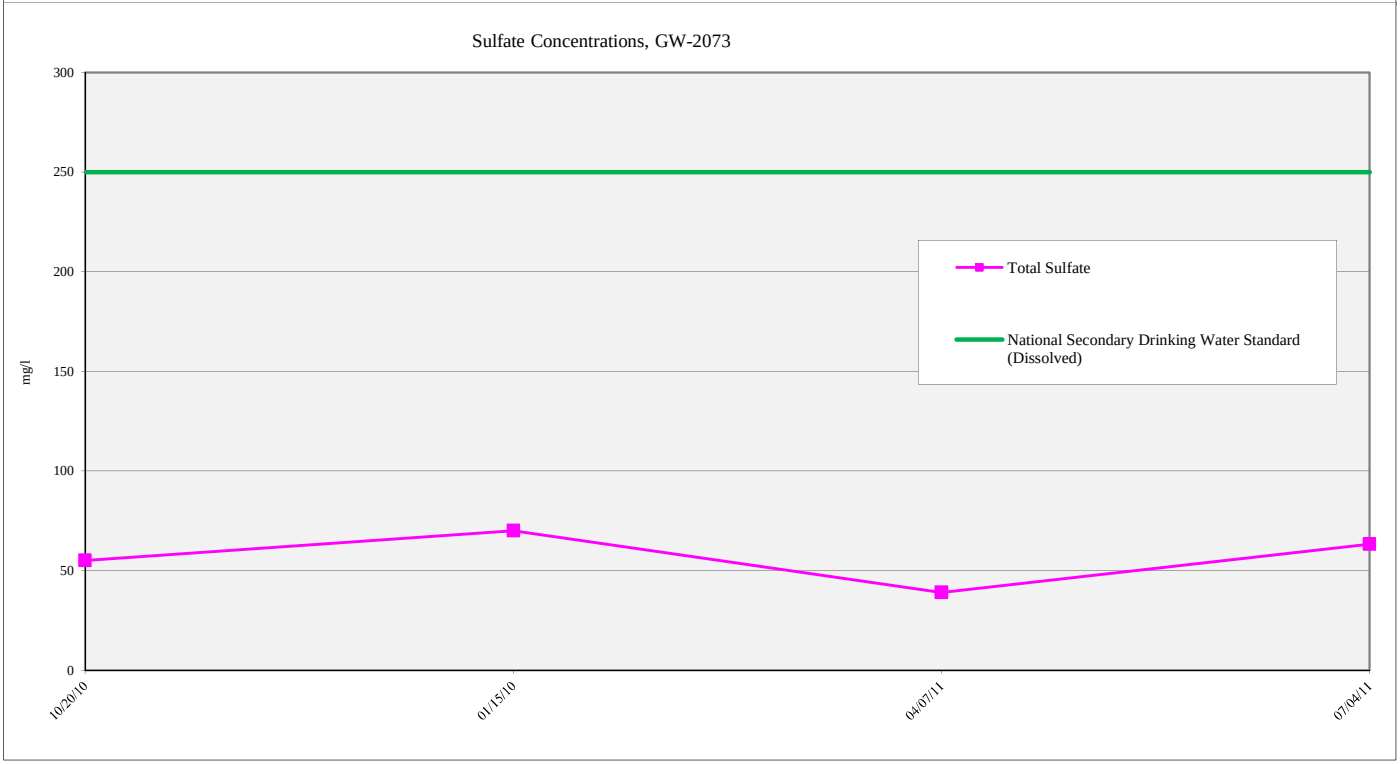

Golder Associates

Denver, Colorado

TITLE

Groundwater Monitoring
Sulfate Concentrations
GW-14 and GW-2073

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES5-3865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE NTS	DWG NO./REV. NO.	
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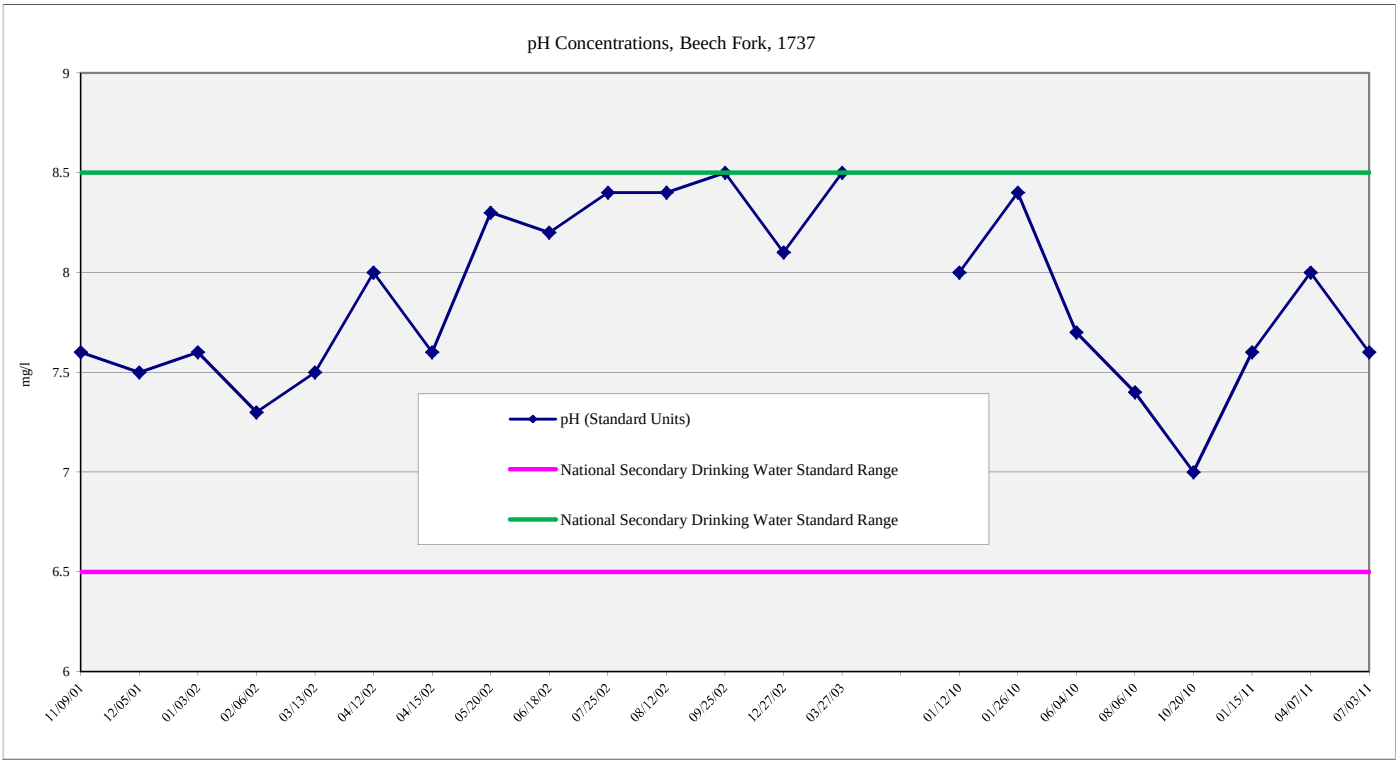
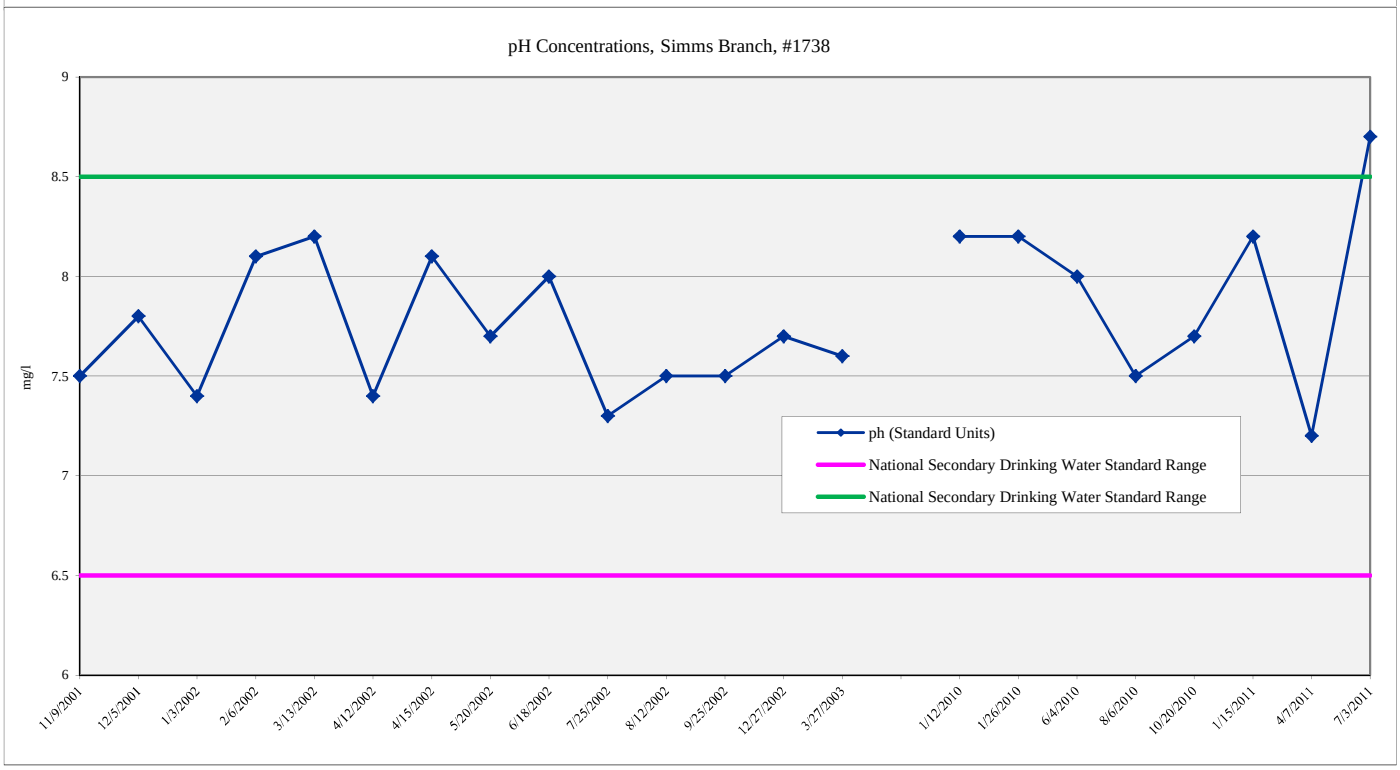
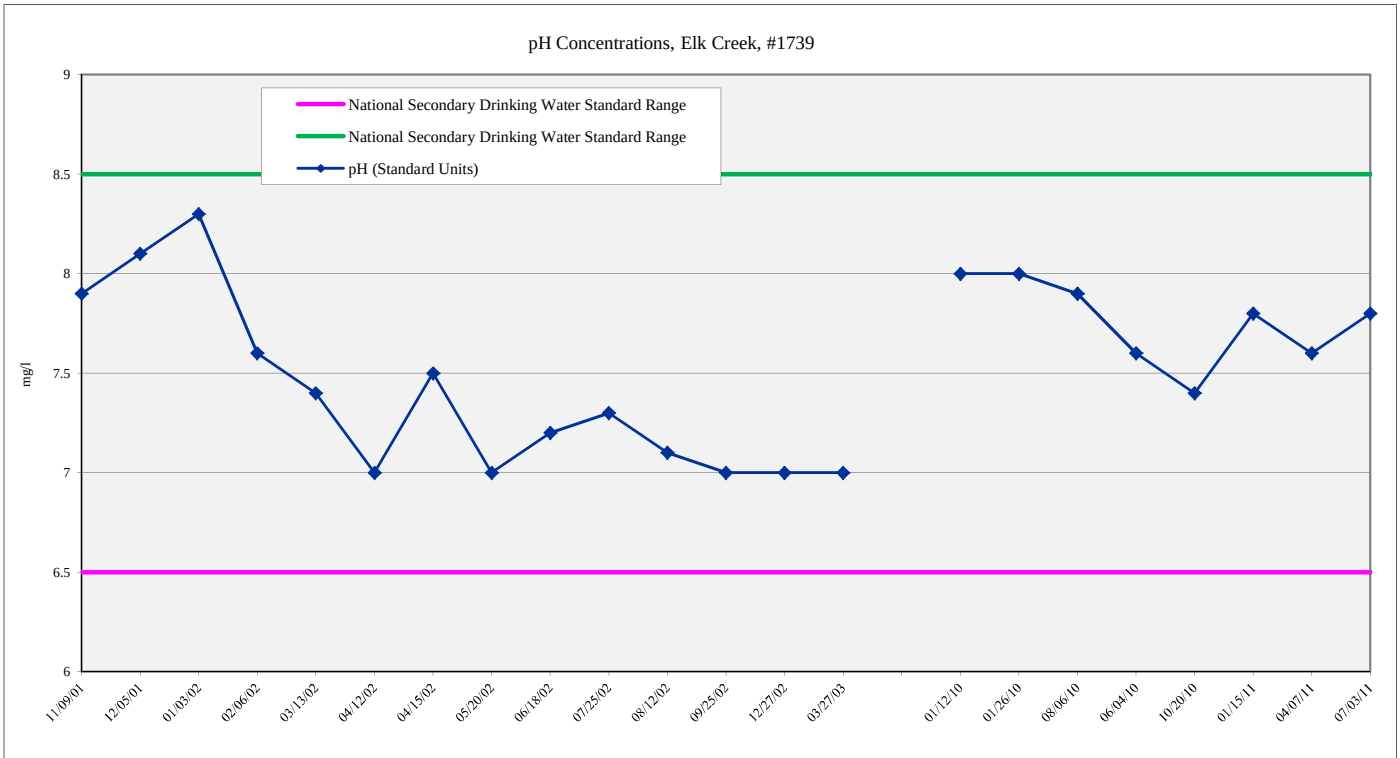
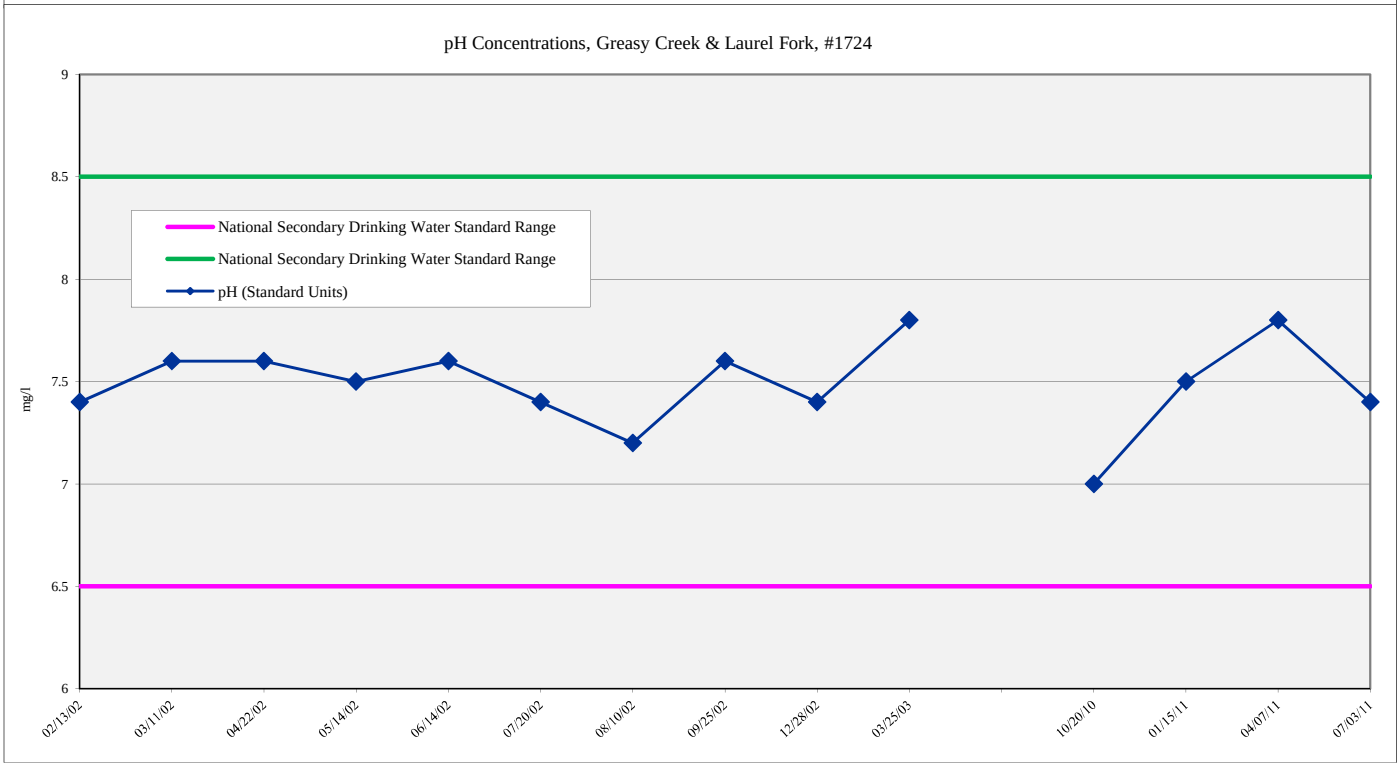




Golder Associates Denver, Colorado	TITLE **Groundwater Monitoring pH Concentrations Beech Fork, Simms Branch**		
CLIENT/PROJECT **Bledsoe Coal Corporation Bledsoe EA (KYES5-3865) Leslie County, KY**	DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**
	CHECKED **EJP**	SCALE **NTS**	DWG NO./REV. NO.
	REVIEWED **MWB**	FILE NO. 103-81786 RPT-FNL BledsoeCoalEA APP-F.xlsx	FIGURE NO. **App F-2.10**



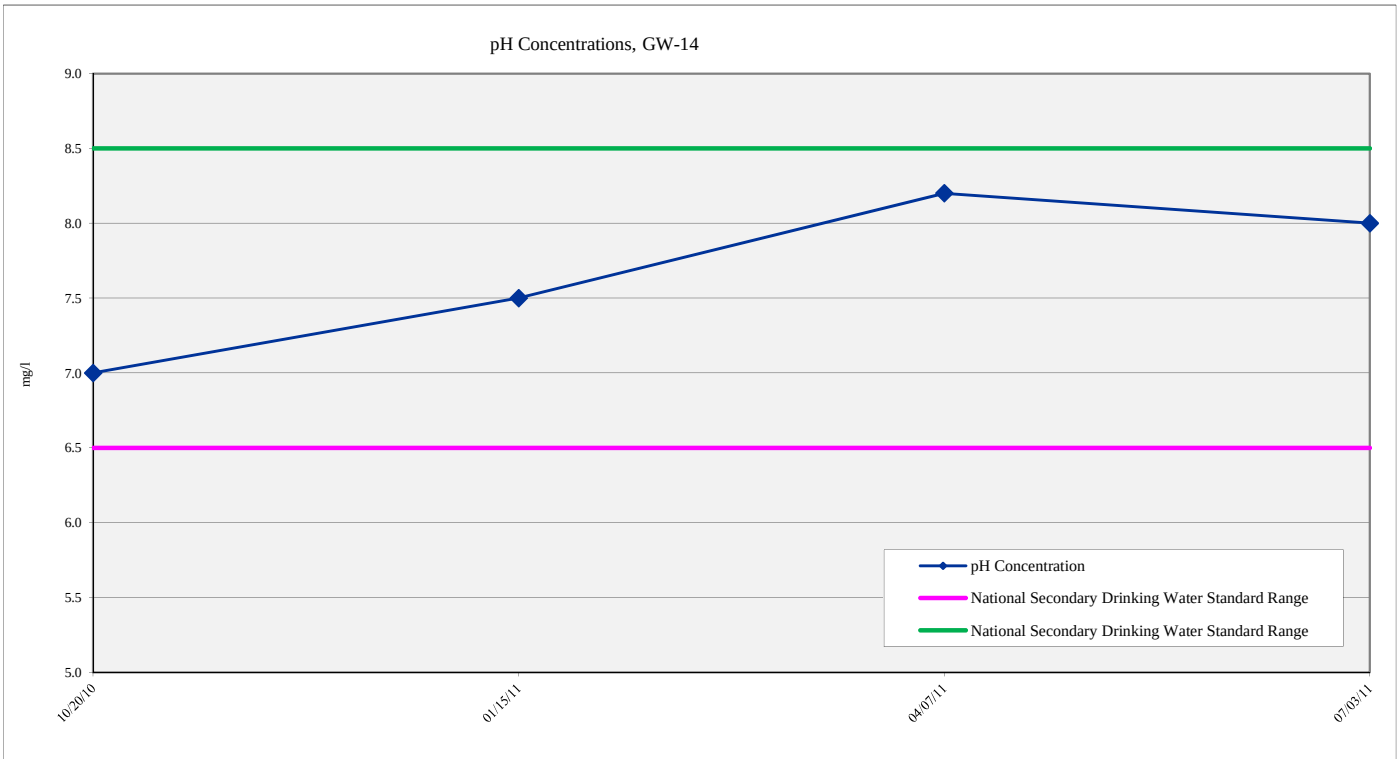


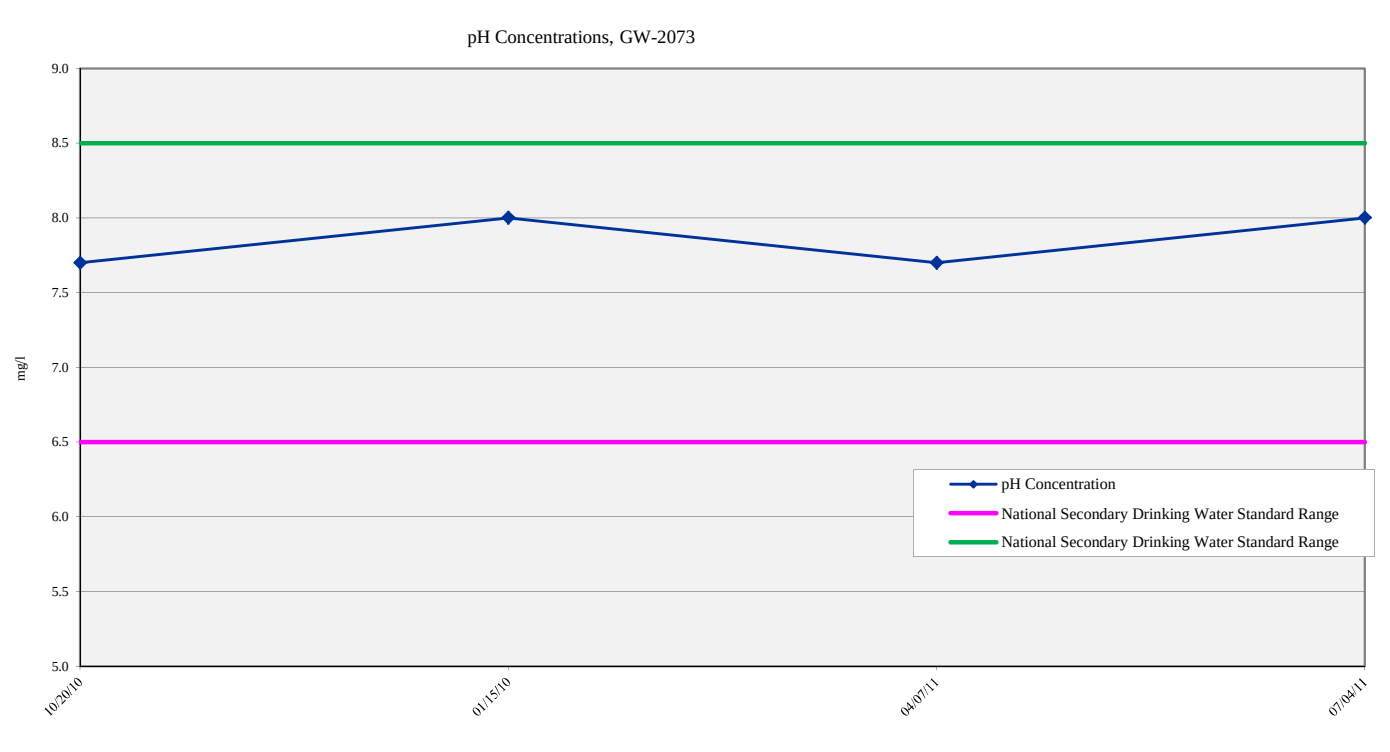
Golder Associates — Denver, Colorado

TITLE: **Groundwater Monitoring pH Concentrations Elk Creek, Greasy Creek & Laurel Fork**

CLIENT/PROJECT: **Bledsoe Coal Corporation Bledsoe EA (KYES5-3865) Leslie County, KY**

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE NTS	DWG NO./REV. NO.	
REVIEWED MWB	FILE NO. 103-81786 RPT-FNL BledsoeCoalEA APP-F.xlsx	FIGURE NO. App F-2.11	





Golder Associates

Denver, Colorado

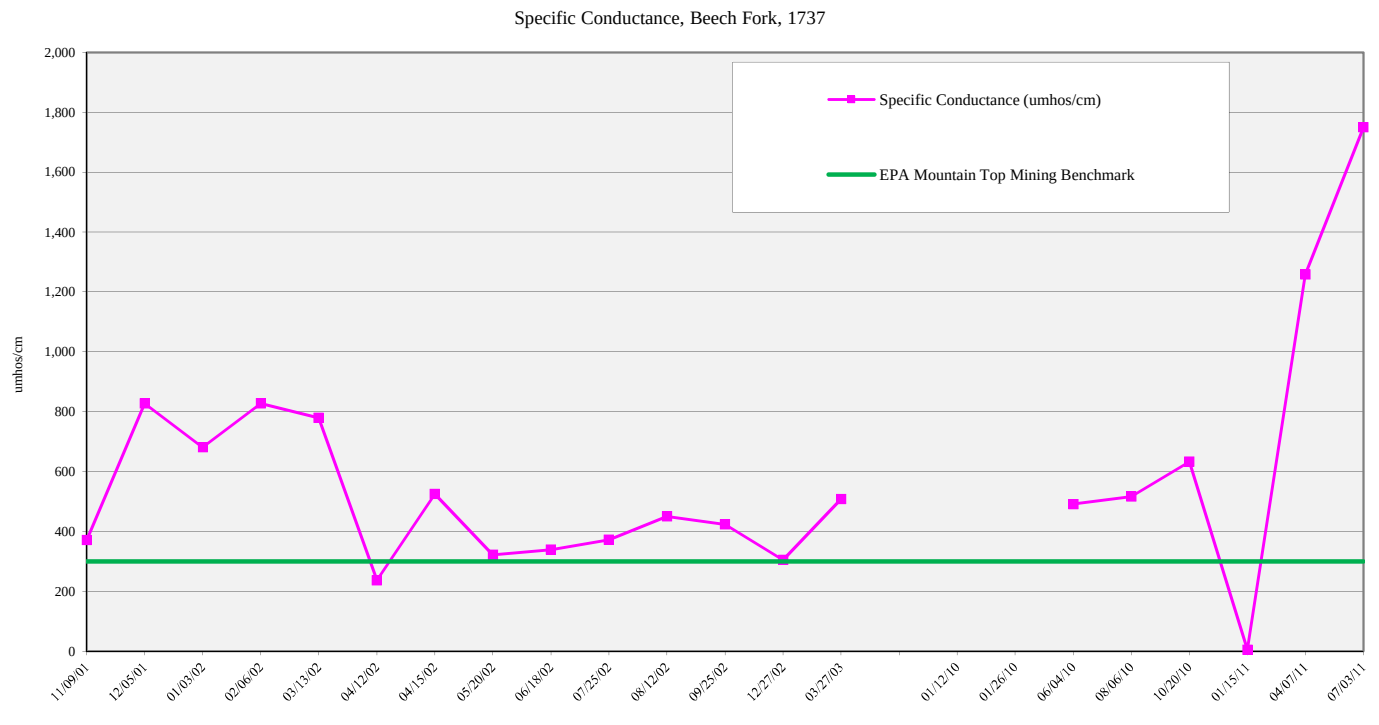
TITLE

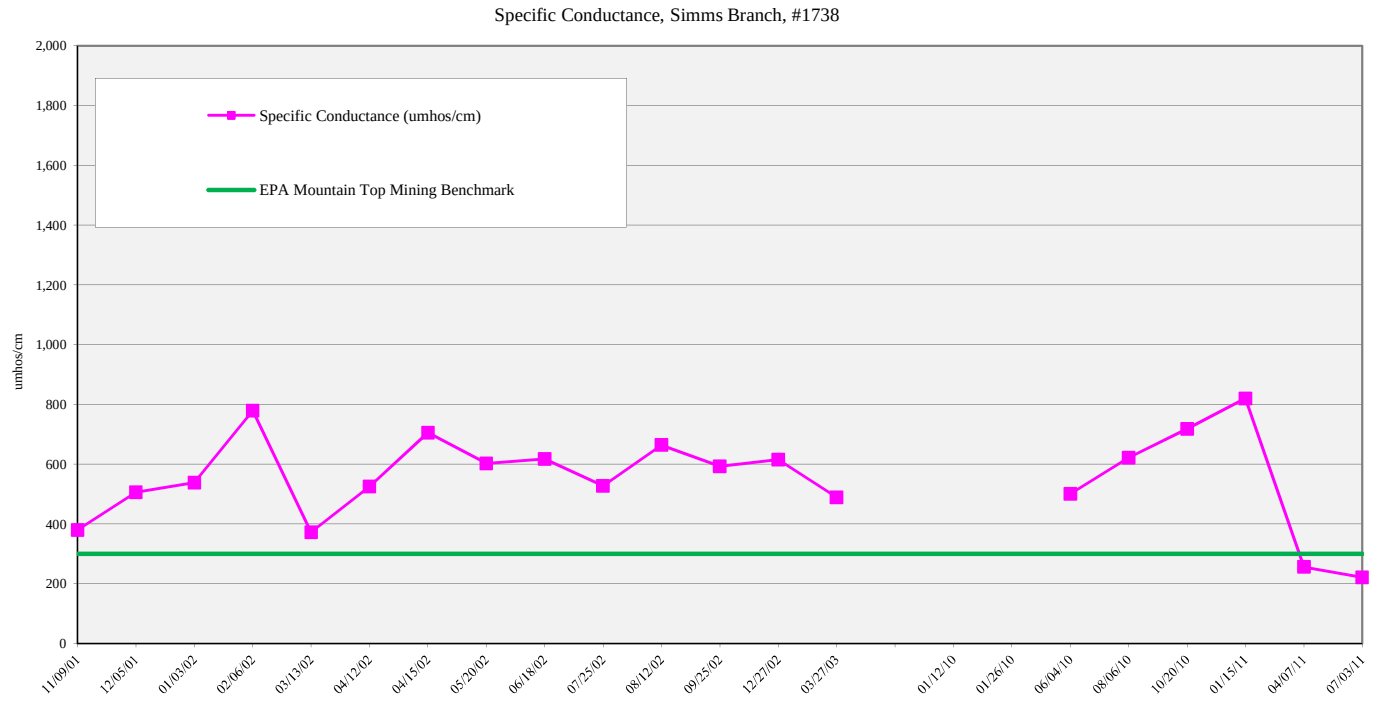
Groundwater Monitoring
pH Concentrations
GW-14 and GW-2073

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES5-3865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE NTS	DWG NO./REV. NO.	
REVIEWED MWB	FILE NO. 10381786 RPT-FNL BledsoeCoalEA APP-F.xlsx	FIGURE NO. App F-2.12	





Golder Associates

Denver, Colorado

TITLE

Groundwater Monitoring
Specific Conductance
Beech Fork, Simms Branch

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES5-3865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE NTS	DWG NO./REV. NO.	
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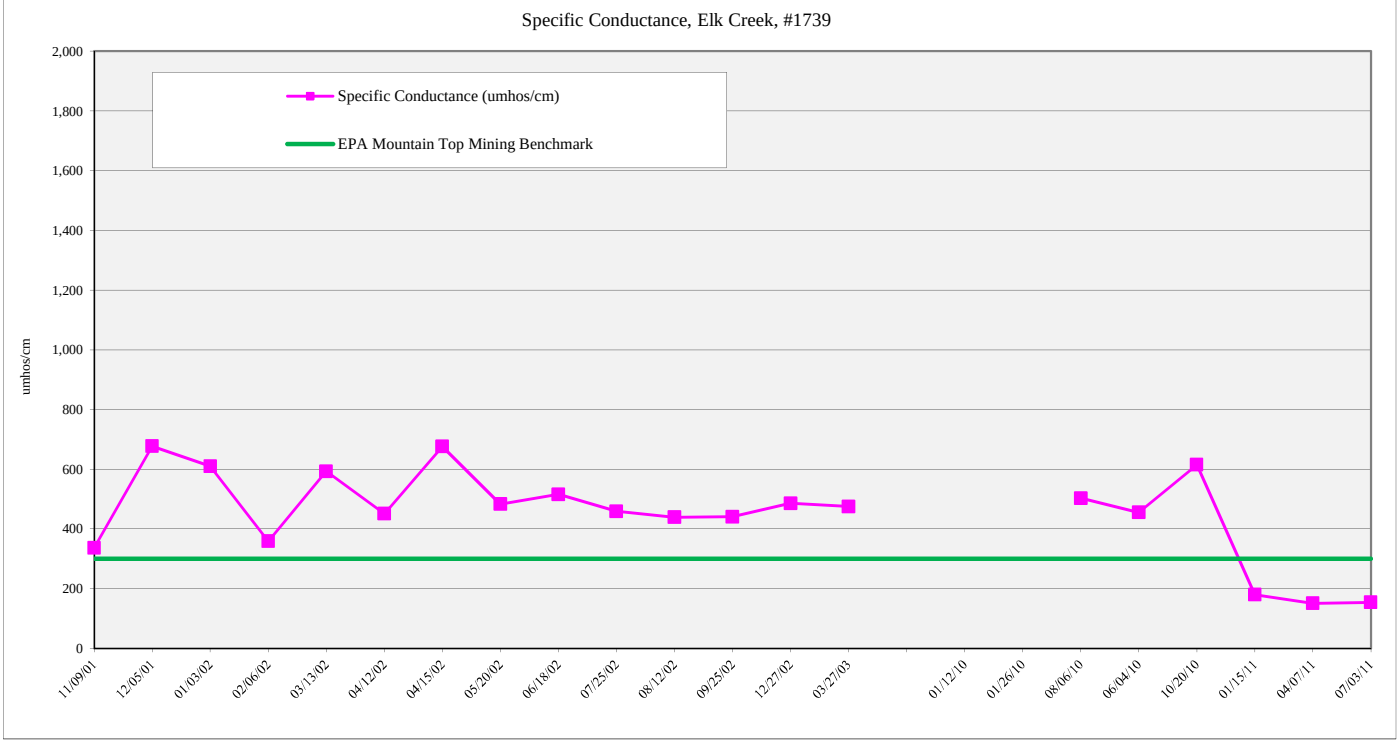
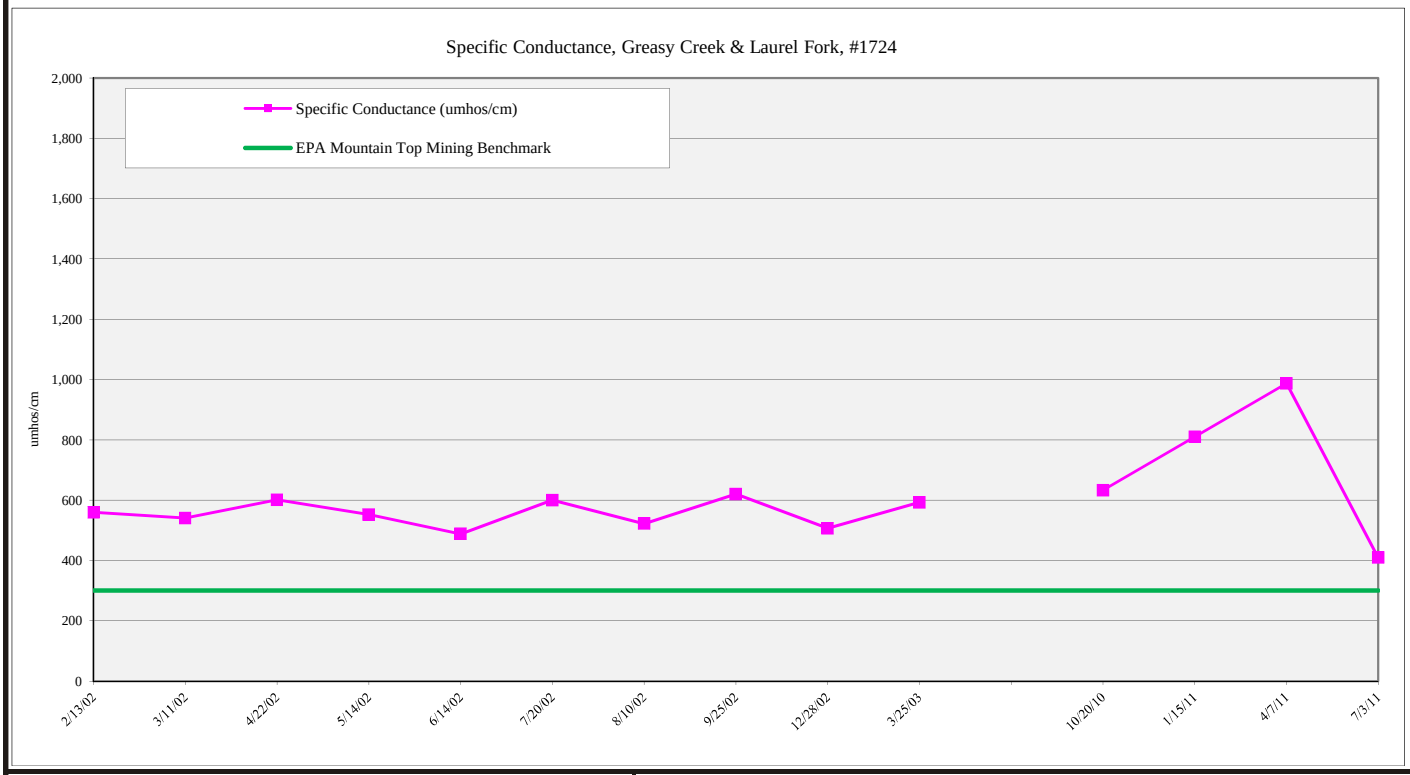


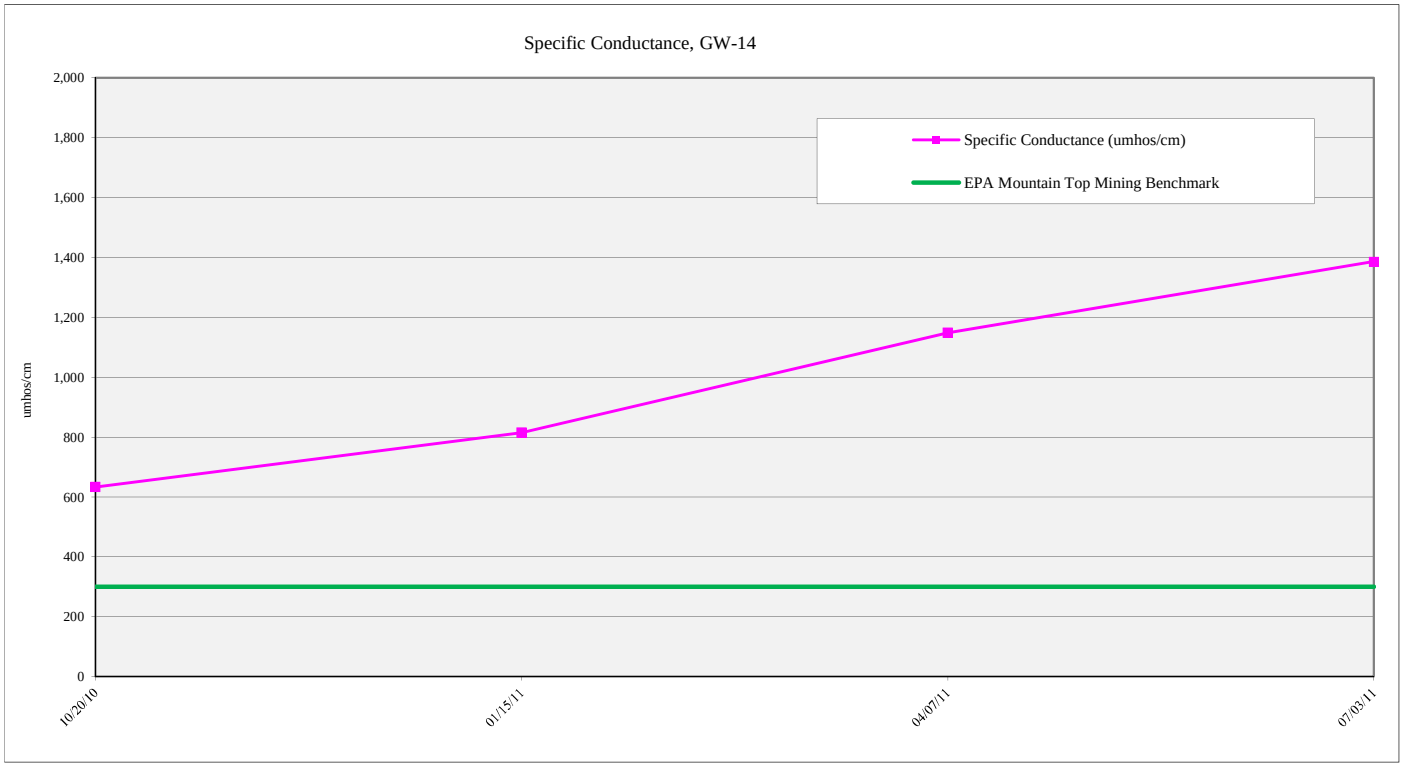


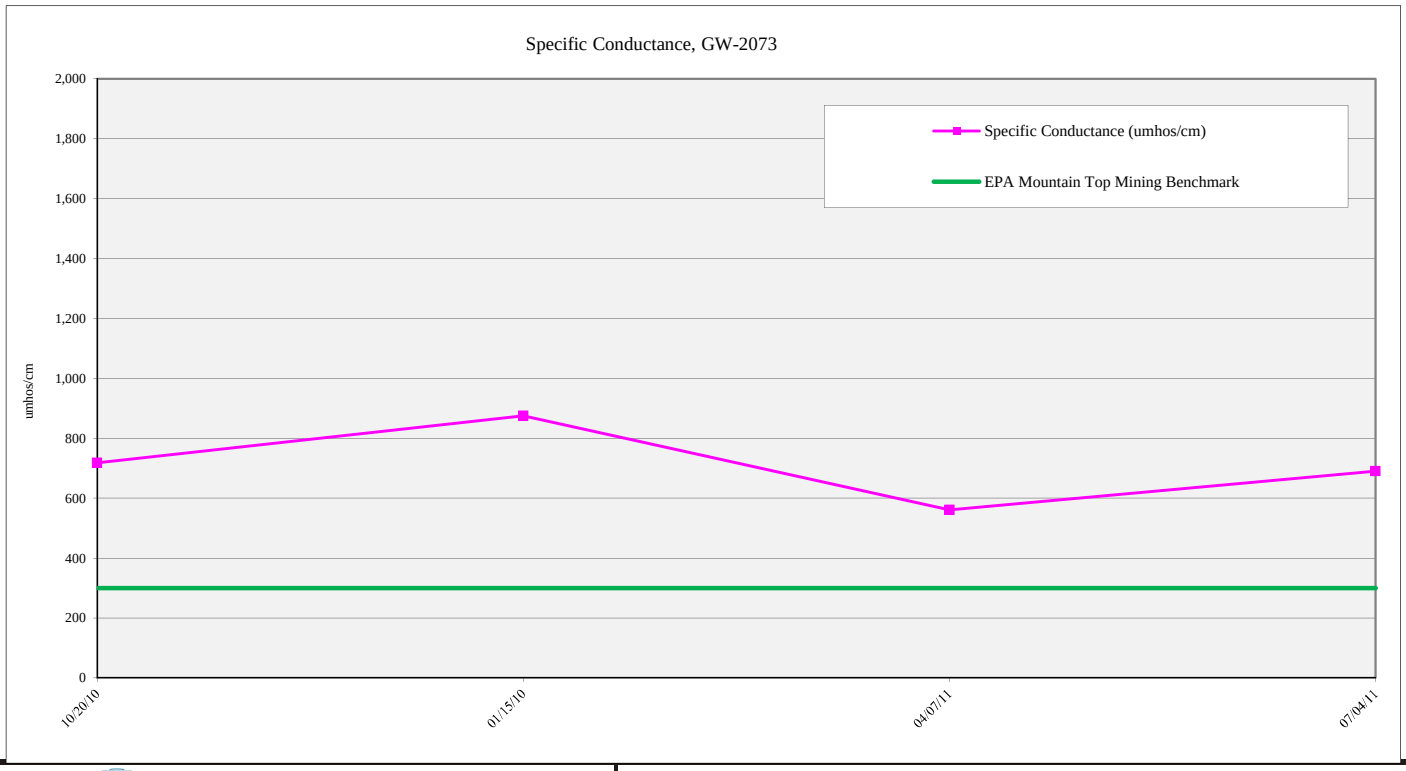
Golder Associates — Denver, Colorado

TITLE
Groundwater Monitoring
Specific Conductance
Elk Creek, Greasy Creek & Laurel Fork

CLIENT/PROJECT
Bledsoe Coal Corporation
Bledsoe EA (KYES5-3865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786
CHECKED EJP	SCALE NTS	DWG NO./REV. NO.
REVIEWED MWB	FILE NO. 10381786 RPT-FNL BledsoeCoalEA APP-F.xlsx	FIGURE NO. App F-2.14





Golder Associates
Denver, Colorado

TITLE
Groundwater Monitoring
Specific Conductance
GW-14 and GW-2073

CLIENT/PROJECT
Bledsoe Coal Corporation
Bledsoe EA (KYES5-3865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE NTS	DWG NO./REV. NO.	
REVIEWED MWB	FILE NO. 10381786 RPT-FNL BledsoeCoalEA APP-F.xlsx	FIGURE NO. App F-2.15	

APPENDIX G-1
AVAILABLE SURFACE WATER DATA

Appendix G-1
Details of Surface Water Monitoring Results

SW Fern Branch, 1754

Parameter	1/24/2002	2/1/2002	2/15/2002	3/1/2002	3/1/2002	4/1/2002	4/26/2002	5/13/2002	5/28/2002	6/13/2002	6/28/2002	7/15/2002	7/30/2002	8/14/2002	8/29/2002	9/13/2002	9/27/2002	10/9/2002	10/21/2002	12/10/2002	12/26/2002	1/10/2003	1/24/2003	2/6/2003	2/21/2003
Flow m^3/day (Cfs)	2.24	0.59	0.91	0.96	0.63	0.54	0.55	0.58	0.56	0.52	0.50	0.38	0	0	0	0	0	0.34	0.32	0.38	0.41	0.32	0.33	3.42	3.37
Total Iron	0.33	0.24	0.26	0.40	0.22	0.13	0.15	0.29	0.25	0.20	0.25	0.28						0.32	0.36	0.34	0.46	0.16	0.39	0.21	0.27
Dissolved Iron	0.17	0.10	0.11	0.31	0.15	0.08	0.10	0.15	0.13	0.08	0.10	0.16						0.10	0.28	0.12	0.31	0.04	0.26	0.07	0.10
Total Manganese[3]	0.41	0.12	0.43	0.14	0.69	0.10	0.09	0.07	0.14	0.29	0.23	0.12						0.08	0.14	0.20	0.14	0.22	0.28	0.45	0.29
Dissolved Manganese	0.26	0.02	0.26	0.05	0.56	0.01	0.03	0.04	0.06	0.15	0.15	0.02						0.05	0.09	0.08	0.09	0.09	0.17	0.30	0.14
Sulfates	62	54	29	70	73	77	79	71	79	81	72	65						60	55	51	66	42	52	40	46
pH (standard units)	8.3	7.6	7.4	8.2	8.4	8.2	8.0	8.3	8.3	8.0	8.0	7.9						7.4	7.9	8.2	8.2	8.0	8.0	8.0	8.0
Total Alkalinity to pH 4.5 (mg/L)	120.8	115.0	100.3	120.8	130.1	121.8	120.1	120.8	121.2	120.7	120.7	120.0						108.1	112.6	118.8	120.1	109.4	120.5	80.4	80.1
Acidity to pH 8.3 (mg/L)	0	0	0	0	0	0	0	0	0	0	0	0						0	0	0	0	0	0	0	0
Total Suspended Solids	31	16	16	16	31	10	14	12	18	16	12	8						11	14	14	15	6	16	9	8
Total Dissolved Solids (mg/L)	371	290	300	296	298	246	287	307	355	378	341	348						329	306	355	380	170	180	170	160
TDS measured or calculated (mg/L)	371	290	300	296	298	246	287	307	355	378	341	348						329	306	355	380	170	180	170	160
Specific Conductance (umhos/CM)	630	491	508	502	506	417	486	520	602	640	578	590						557	519	602	644	230	250	220	210

SW Mare Branch, 1753

Parameter	1/24/2002	2/1/2002	2/15/2002	3/1/2002	3/15/2002	4/1/2002	4/26/2002	5/13/2002	5/28/2002	6/13/2002	6/28/2002	7/15/2002	7/30/2002	8/14/2002	8/29/2002	9/13/2002	9/27/2002	10/9/2002	10/21/2002	12/10/2002	12/26/2002	1/10/2003	1/24/2003	2/6/2003	2/21/2003
Flow m^3/day (Cfs)	2.18	1.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.081	0.89	0.089	0.08
Total Iron	0.44	0.18																				0.22	0.25	0.43	0.39
Dissolved Iron	0.21	0.04																				0.14	0.18	0.31	0.2
Total Manganese[3]	0.56	0.16																				0.13	0.06	0.01	0.01
Dissolved Manganese	0.42	0.07																				0.11	0.01	0.01	0.01
Sulfates	75	59																				27	26	26	34
pH (standard units)	8.3	7.5																				8.3	8.3	8.4	8.5
Total Alkalinity to pH 4.5 (mg/L)	124.8	106.1																				115.1	112.23	56.1	56.89
Acidity to pH 8.3 (mg/L)	0	0																				0	0	0	0
Total Suspended Solids	35	24																				8	5	5	6
Total Dissolved Solids (mg/L)	420	326																				300	310	290	280
TDS measured or calculated (mg/L)	420	326																				300	310	290	280
Specific Conductance (umhos/CM)	712	552																				400	405	400	400
Temp	49	44																				38.8	38.6	43.7	47.3

SW Simms Branch, 1752

Parameter	1/24/2002	2/1/2002	2/15/2002	3/1/2002	3/15/2002	4/1/2002	4/26/2002	5/13/2002	5/28/2002	6/13/2002	6/28/2002	7/15/2002	7/30/2002	8/14/2002	8/29/2002	9/13/2002	9/27/2002	10/9/2002	10/21/2002	12/10/2002	12/26/2002	1/10/2003	1/24/2003	2/6/2003	2/21/2003
Flow m^3/day (Cfs)	5.37	1.03	Jan-00	0.17	1.10	1.03	0.92	0.71	0.66	0.97	0.92	0.83	0	0	0	0	0	0.67	1.73	0.73	0.77	1.89	1.96	1.98	2.9
Total Iron	0.38	0.12		0.41	0.07	0.10	0.15	0.18	0.29	0.24	0.28	0.30						0.35	0.25	0.41	0.35	0.48	0.46	0.22	0.18
Dissolved Iron	0.18	0.02		0.26	0.04	0.04	0.08	0.10	0.14	0.10	0.12	0.16						0.1	0.19	0.3	0.28	0.32	0.31	0.18	0.07
Total Manganese[3]	0.50	0.15		0.63	0.28	0.22	0.20	0.29	0.15	0.19	0.20	0.17						0.1	0.2	0.6	0.49	0.05	0.06	0.1	0.09
Dissolved Manganese	0.41	0.04		0.50	0.16	0.16	0.10	0.18	0.07	0.12	0.14	0.08						0.04	0.11	0.41	0.32	0.01	0.01	0.04	0.02
Sulfates	71	58		62	52	66	60	63	61	58	62	70						66	64	64	80	26	41	2	13
pH (standard units)	8.3	7.9		8.5	8.5	8.3	8.3	8.1	8.2	8.4	8.4	8.2						8	7.9	8.3	8.3	8.3	8.4	8.2	8.3
Total Alkalinity to pH 4.5 (mg/L)	124.5	117.5		130.5	130.1	123.1	123.1	123.8	122.1	121.7	121.8	120.3						121.14	118.06	120.9	121.12	40.11	41.9	50.1	50.78
Acidity to pH 8.3 (mg/L)	0	0		0	0	0	0	0	0	0	0	0						0	0	0	0	0	0	0	0
Total Suspended Solids	39	18		32	15	25	20	24	21	24	22	20						11	16	20	16	16	7	6	9
Total Dissolved Solids (mg/L)	407	320		445	236	304	319	326	355	378	395	327						308	399	399	450	400	400	40	50
TDS measured or calculated (mg/L)	407	320		445	236	304	319	326	355	378	395	327						308	399	399	450	400	400	40	50
Specific Conductance (umhos/CM)	690	542		754	400	515	540	552	602	640	669	654						522	676	676	762	600	600	70	70
Temp	48	41		54	53	54	55	56	59	62	63	67						54	55	37.2	37.1	37.1	36.8	43.1	47.6

Simms Branch - monitored semi-monthly, beginning in January 2002; 2/15/02 - Not Flowing; 7/30/02 through 9/27/02 - Not Flowing

SW Apple Orchard Branch, 1751

Parameter	1/24/2002	2/1/2002	2/15/2002	3/1/2002	3/15/2002	4/1/2002	4/26/2002	5/13/2002	5/28/2002	6/13/2002	6/28/2002	7/15/2002	7/30/2002	8/14/2002	8/29/2002	9/13/2002	9/27/2002	10/9/2002	10/23/2002	12/10/2002	12/26/2002	1/10/2003	1/24/2003	2/6/2003	2/21/2003
Flow m^3/day (Cfs)	2.29	0.78	1.46	1.48	1.44	0.97	0.95	0.90	0	0	0	0	0	0	0	0	0	0	0	0	0	0.178	0.186	1.87	1.8
Total Iron	0.25	0.30	0.23	0.29	0.32	0.25	0.14	0.15														0.57	0.48	0.05	0.08
Dissolved Iron	0.14	0.08	0.14	0.18	0.18	0.09	0.05	0.07														0.41	0.29	0.01	0.02
Total Manganese[3]	0.30	0.27	0.29	0.54	0.41	0.13	0.12	0.14														0.18	0.12	0.06	0.11
Dissolved Manganese	0.17	0.11	0.11	0.26	0.20	0.07	0.08	0.06														0.12	0.05	0.01	0.05
Sulfates	80	62	71	52	81	75	70	78														26	32	30	32
pH (standard units)	8.1	7.7	7.8	8.1	8.2	8.1	8.2	8.0														8.2	8.4	8.1	8.1
Total Alkalinity to pH 4.5 (mg/L)	122.6	110.5	116.1	115.5	120.5	120.8	120.2	119.2														101.15	100.33	70.16	70.5
Acidity to pH 8.3 (mg/L)	0	0	0	0	0	0	0	0														0	0	0	0
Total Suspended Solids	28	21	16	18	20	19	14	11														10	8	6	3
Total Dissolved Solids (mg/L)	345	287	355	100	266	382	390	395														300	380	300	300
TDS measured or calculated (mg/L)	345	287	355	100	266	382	390	395														300	380	300	300
Specific Conductance (umhos/CM)	585	487	601	590	451	647	661	661														410	410	400	400
Temp	49	43	43	53	53	54	55	57														37.6	36.1	42.9	46.9

Apple Orchard Branch - monitored semi-monthly, beginning in January 2002; 5/28/02 through 12/26/02 - Not Flowing

SW Laurel Branch, 1750

Parameter	1/24/2002	2/1/2002	2/15/2002	3/1/2002	3/15/2002	4/1/2002	4/26/2002	5/13/2002	5/28/2002	6/13/2002	6/28/2002	7/15/2002	7/30/2002	8/14/2002	8/29/2002	9/13/2002	9/27/2002	10/9/2002	10/23/2002	12/10/2002	12/26/2002	1/10/2003	1/24/2003	2/6/2003	2/21/2003
Flow m^3/day (Cfs)	1.79	1.41	1.10	0.97	0.93	0.78	0.79	0.81	0.79	0.72	0.70	0.68	0	0	0	0	0	0.28	0.31	0.34	0.36	2.88	2.94	2.95	2.9
Total Iron	0.10	0.12	0.41	0.60	0.33	0.36	0.32	0.28	0.24	0.33	0.39	0.30						0.36	0.49	0.35	0.52	0.36	0.56	0.35	0.39
Dissolved Iron	0.04	0.05	0.36	0.47	0.16	0.24	0.20	0.14	0.08	0.16	0.20	0.18						0.14	0.22	0.24	0.39	0.21	0.41	0.17	0.19
Total Manganese[3]	0.36	0.18	0.02	0.33	0.47	0.18	0.14	0.22	0.16	0.10	0.15	0.25						0.28	0.16	0.46	0.2	0.22	0.25	0.2	0.17
Dissolved Manganese	0.20	0.10	0.01	0.21	0.25	0.10	0.09	0.13	0.07	0.04	0.06	0.11						0.16	0.1	0.28	0.11	0.14	0.18	0.11	0.1
Sulfates	73	63	81	75	49	64	69	72	74	78	80	77						78	64	70	64	35	39	31	28
pH (standard units)	8.2	7.8	7.9	8.4	8.5	8.5	8.3	8.4	8.5	8.6	8.5	8.5						8.3	8.1	8.3	8.3	8.1	8.2	8	8
Total Alkalinity to pH 4.5 (mg/L)	125.1	109.0	121.5	122.2	130.5	130.1	129.1	129.7	130.2	128.2	130.2	130.7						125.1	120.16	121.1	124.75	108.5	102.45	60.3	64.1
Acidity to pH 8.3 (mg/L)	0	0	0	0	0	0	0	0	0	0	0	0						0	0	0	0	0	0	0	0
Total Suspended Solids	25	24	22	29	25	22	26	20	22	19	21	20						18	14	19	9	6	10	4	6
Total Dissolved Solids (mg/L)	307	325	355	401	311	299	350	369	399	384	412	357						350	310	415	390	200	290	180	180
TDS measured or calculated (mg/L)	307	325	355	401	311	299	350	369	399	384	412	357						350	310	415	390	200	290	180	180
Specific Conductance (umhos/CM)	520	550	601	679	527	507	593	625	676	650	698	605						593	525	703	661	310	400	200	200
Temp	48	42	43	54	53	54	55	57	59	64	67	67						55	54	37.5	36.6	38.1	36.6	43.6	47.7

Appendix G-1
Details of Surface Water Monitoring Results

SW Fern Branch, 1754

Parameter	3/6/2003	3/20/2003	4/4/2003	4/21/2003				1/12/2010	1/26/2010	2/11/2010	2/24/2010	3/11/2010	3/26/2010	4/4/2010	4/25/2010	5/11/2010	5/27/2010	6/8/2010	6/28/2010	7/12/2010	7/25/2010	8/6/2010	8/25/2010	9/12/2010	9/25/2010
Flow m^3/day (Cfs)	3.42	3.44	3.47	3.55				3.58	1.88	2.05	2.88	1.88	2.95	5.20	6.33	6.95	2.75	3.02	1.05	4.10	2.13	0.36	0.50	1.15	0.96
Total Iron	0.25	0.23	0.16	0.21				0.68	0.57	0.47	0.15	0.29	0.26	0.13	0.28	0.18	0.05	0.10	0.18	0.18	0.37	0.55	0.12	0.54	0.45
Dissolved Iron	0.13	0.12	0.05	0.09																					
Total Manganese[3]	0.40	0.49	0.14	0.16				0.47	0.42	0.12	0.09	0.21	0.12	0.02	0.05	0.06	0.12	0.11	0.02	0.05	0.11	0.12	0.05	0.08	0.06
Dissolved Manganese	0.29	0.31	0.01	0.08																					
Sulfates	42	41	30	36										55	47	59	52	46	53	43	69	68	67	75	67
pH (standard units)	8.0	8.2	8.1	8.2				8.4	7.8	8.1	7.7	8.2	8.2	7.3	7.4	7.7	7.3	7.7	7.9	7.2		7.8	7.5	7.7	8.0
Total Alkalinity to pH 4.5 (mg/L)	80.5	80.5	109.2	118.1				120.2	120.2	114.1	121.7	110.5	120.7	106.9	101.3	104.4	100.3	108.9	121.1	101.2	100.5	100.5	101.6	100.2	106.2
Acidity to pH 8.3 (mg/L)	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Suspended Solids	11	9	15	14				12	18	10	10	10	10	12	8	12	11	13	14	7	11	12	9	13	8
Total Dissolved Solids (mg/L)	160	150	160	140																					
TDS measured or calculated (mg/L)	160	150	160	140				240	259	133	136	138	131	195	120	82	128	131	182	266	65	128	176	196	144
Specific Conductance (umhos/CM)	220	220	271	200				375	405	208	213	215	205	305	188	128	200	204	284	415	101	200	275	306	225

SW Mare Branch, 1753

Parameter	3/6/2003	3/20/2003	4/4/2003	4/21/2003				1/12/2010	1/26/2010	2/11/2010	2/24/2010	3/11/2010	3/26/2010	4/4/2010	5/11/2010	4/25/2010	5/25/2010	6/8/2010	6/28/2010	7/12/2010	7/25/2010	8/6/2010	8/25/2010	9/12/2010	9/25/2010
Flow m^3/day (Cfs)	0.081	0.082	0.084	0.086				1.96	1.25	1.55	2.88	2.85	1.99	2.19	1.25	4.05	2.05	1.07	1.03	1.15	0.55	0	0	0	0
Total Iron	0.29	0.35	0.3	0.14				0.49	0.72	0.25	0.26	0.27	0.24	0.28	0.05	0.42	0.09	0.19	0.12	0.36	0.11				
Dissolved Iron	0.18	0.29	0.16	0.09																					
Total Manganese[3]	0.01	0.01	0.08	0.22				0.15	0.45	0.15	0.12	0.14	0.07	0.36	0.11	0.19	0.12	0.08	0.09	0.12	0.17				
Dissolved Manganese	0.01	0.01	0.02	0.1																					
Sulfates	21	10	11	12										73	42	33	52	44	59	86	69				
pH (standard units)	8.4	8.5	8.3	8.3				7.9	7.8	7.6	7.7	8.1	8.2	7.9	7.7	7.4	8.1	7.9	8.1	8.3	7.7				
Total Alkalinity to pH 4.5 (mg/L)	57.1	56.11	120.45	110.2				120.1	115.1	114.12	120.08	121.18	120.15	108.12	115.25	108.11	110.12	121.15	117.5	110.15	108.99				
Acidity to pH 8.3 (mg/L)	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Total Suspended Solids	6	5	11	17				16	12	10	14	12	12	15	12	10	7	9	9	15	13				
Total Dissolved Solids (mg/L)	300	40	30	30																					
TDS measured or calculated (mg/L)	300	40	30	30				323.2	299.52	163.84	198.4	140.8	144	194.56	175.36	143.36	99.84	120.32	188.8	204.16	237.44				
Specific Conductance (umhos/CM)	500	60	50	40				505	468	256	310	220	225	304	274	224	156	188	295	319	371				
Temp	51.9	53	58.3	58.6																					

SW Simms Branch, 1752

Parameter	3/6/2003	3/20/2003	4/4/2003	4/21/2003				1/12/2010	1/26/2010	2/11/2010	2/24/2010	3/11/2010	3/26/2010	4/4/2010	4/25/2010	5/11/2010	5/27/2010	6/8/2010	6/28/2010	7/12/2010	7/25/2010	8/6/2010	8/25/2010	9/12/2010	9/25/2010
Flow m^3/day (Cfs)	1.96	1.99	1.99	1.99				3.55	3.88	3.88	2.95	3.08	2.88	2.1	2.19	3.06	3.05	1.75	2.55	1.35	0.67	0.36	0.95	0.55	0.65
Total Iron	0.21	0.14	0.29	0.2				0.36	0.34	0.36	0.21	0.27	0.27	0.5	0.37	0.21	0.21	0.55	0.28	0.28	0.41	0.42	0.36	0.55	0.24
Dissolved Iron	0.13	0.13	0.1	0.08																					
Total Manganese[3]	0.14	0.16	0.14	0.15				0.17	0.47	0.12	0.1	0.14	0.05	0.02	0.15	0.08	0.08	0.27	0.19	0.06	0.08	0.08	0.12	0.12	0.11
Dissolved Manganese	0.06	0.05	0.06	0.04																					
Sulfates	12	19	22	16										45	67	50	83	80	45	67	52	75	47	74	86
pH (standard units)	8.2	8.2	8.1	8.2				8.4	8.1	8.1	8.2	8.2	7.9	7.3	7.4	7.5	7.8	8	7.9	7.7	7.7	7.5	7.5	7.9	8
Total Alkalinity to pH 4.5 (mg/L)	50.6	50.12	106.55	120.1				120.9	122.91	121.25	114.05	114.55	120.11	105.18	101.29	105.18	106.88	117.5	115.72	110.55	100.57	100.72	100.18	101.55	121.5
Acidity to pH 8.3 (mg/L)	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Suspended Solids	11	8	11	11				14	12	10	12	12	8	11	17	11	11	10	12	10	10	8	7	8	10
Total Dissolved Solids (mg/L)	49	50	40	30																					
TDS measured or calculated (mg/L)	49	50	40	30				233.6	374.4	130.56	137.6	161.28	140.16	106.24	192.64	191.36	136.96	186.88	197.76	131.2	256	201.6	202.24	195.84	196.48
Specific Conductance (umhos/CM)	70	70	60	50				365	585	204	215	252	219	166	301	299	214	292	309	205	400	315	316	306	307
Temp	54.9	56.2	56.8	58.2																					

Simms Branch - monitored semi-monthly, beginning in January 2002; 2/15/02 - Not Flowing; 7/30/02 through 9/27/02 - Not Flowing

SW Apple Orchard Branch, 1751

Parameter	3/6/2003	3/20/2003	4/4/2003	4/21/2003				1/12/2010	1/26/2010	2/11/2010	2/24/2010	3/11/2010	3/26/2010	4/4/2010	4/25/2010	5/11/2010	5/27/2010	6/8/2010	6/28/2010	7/12/2010	7/25/2010	8/6/2010	8/25/2010	9/12/2010	9/25/2010
Flow m^3/day (Cfs)	1.87	1.84	1.97	1.97				1.05	1.55	2.55	3.23	1.47	2.55	2.88	2.04	3.65	2.55	1.55	0.95	3.05	2.88	1.88	0	0	0
Total Iron	0.12	0.14	0.11	0.1				0.69	0.29	0.12	0.25	0.28	0.28	0.17	0.27	0.04	0.03	0.14	0.09	0.36	0.2	0.15			
Dissolved Iron	0.07	0.05	0.05	0.04																					
Total Manganese[3]	0.19	0.16	0.03	0.03				0.32	0.15	0.08	0.07	0.14	0.37	0.08	0.07	0.12	0.12	0.02	0.02	0.09	0.12	0.06			
Dissolved Manganese	0.07	0.09	0.01	0.01																					
Sulfates	38	31	17	12										50	54	60	42	69	82	66	61	64			
pH (standard units)	8.1	8.1	8	8.2				8.2	7.7	7.9	8.2	8.1	7.8	7.9	7.7	7.6	7.7	7.7	7.4	8	7.7	7.7			
Total Alkalinity to pH 4.5 (mg/L)	70.55	70.23	114.1	118.05				114.15	114.1	121.66	117.28	120.5	117.1	110.6	105.87	106.9	110.12	106.38	100.36	120.15	114.1	101.16			
Acidity to pH 8.3 (mg/L)	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
Total Suspended Solids	8	5	9	9				10	16	14	10	16	12	14	9	11	15	10	11	12	12	6			
Total Dissolved Solids (mg/L)	300	30	30	30																					
TDS measured or calculated (mg/L)	300	30	30	30				261.12	272	138.24	136.96	184.96	153.6	140.16	137.6	184.32	196.48	128	192	256.64	195.84	185.6			
Specific Conductance (umhos/CM)	400	40	40	40				408	425	216	214	289	240	219	215	288	307	200	300	401	306	290			
Temp	55.7	57.2	57.4	57.9																					

Apple Orchard Branch - monitored semi-monthly, beginning in January 2002; 5/28/02 through 12/26/02 - Not Flowing

SW Laurel Branch, 1750

Parameter	3/6/2003	3/20/2003	4/4/2003	4/21/2003				1/12/2010	1/26/2010	2/11/2010	2/24/2010	3/11/2010	3/26/2010	4/4/2010	4/25/2010	5/11/2010	5/27/2010	6/8/2010	6/28/2010	7/12/2010	7/25/2010	8/6/2010	8/25/2010	9/12/2010	9/25/2010
Flow m^3/day (Cfs)	2.93	2.94	2.49	2.97				1.8	1.55	2.55	2.88	1.88	0.88	0.88	3.02	3.57	3.14	1.25	3.85	0.55	1.15	0.95	0.55	0.45	0.25
Total Iron	0.29	0.3	0.16	0.11				0.35	0.35	0.24	0.21	0.28	0.28	0.2	0.4	0.18	0.12	0.12	0.65	0.46	0.29	0.12	0.05	0.05	0.33
Dissolved Iron	0.2	0.12	0.09	0.05				0.27																	
Total Manganese[3]	0.16	0.1	0.05	0.04					0.08	0.1	0.14	0.1	0.14	0.03	0.11	0.05	0.06	0.05	0.2	0.11	0.11	0.05	0.11	0.18	0.15
Dissolved Manganese	0.12	0.08	0.01	0.01																					
Sulfates	38	34	5	6										62	57	73	62	33	70	74	65	46	43	38	70
pH (standard units)	8	7.9	8	8.2				8.4	8.1	8	8	8	8.2	7.4	7.1	7.5	7.2	7.5	7.7	7.7	7.2	7.5	7.2	7.8	7.8
Total Alkalinity to pH 4.5 (mg/L)	61.34	64.55	100.45	105.9				110.72	115.9	114.69	114.96	117.1	117.1	110.8	104.88	108.29	100.15	110.12	110.56	105.75	100.54	101.18	101.56	114.75	112.1
Acidity to pH 8.3 (mg/L)	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Suspended Solids	6	4	13	9				12	10	12	10	14	12	13	7	11	8	10	12	10	12	10	12	10	8
Total Dissolved Solids (mg/L)	190	180	18	18																					
TDS measured or calculated (mg/L)	190	180	18	18				256	120.32	133.12	166.4	238.08	163.2	103.04	120.96	131.2	140.8	131.84	185.6	131.84	140.16	141.44	163.84	192.64	192.64
Specific Conductance (umhos/CM)	200	200	20	20				400	188	208	260	372	255	161	189	205	220	206	290	206	219	221	256	301	301
Temp	55	58.9	57.9	57.9																					

Appendix G-1
Details of Surface Water Monitoring Results

SW Fern Branch, 1754																								
Parameter	**10/12/2010**	**10/20/2010**	**11/9/2010**	**11/23/2010**	**12/10/2010**	**12/20/2010**	**1/10/2011**	**1/25/2011**	**2/8/2011**	**2/21/2011**	**3/11/2011**	**3/28/2011**	**4/7/2011**	**4/21/2011**	**5/11/2011**	**5/26/2011**	**6/9/2011**	**6/22/2011**	**7/4/2011**	**7/14/2011**	**8/6/2011**	**8/14/2011**	**8/13/2011**	**9/27/2011**
Flow m^3/day (Cfs)	5.00	3.00	1.25	1.50	2.25	1.15	10.00	5.00	3.50	5.00	15.00	10.00	0.30	0.10	0.50	1.50	0.25	2.00	5.00	2.50	1.00	3.00	3.50	2.50
Total Iron	0.26	0.47	0.63	0.26	0.61	0.31	0.39	0.68	0.42	0.44	0.26	0.51	0.59	0.51	0.64	0.80	0.53	0.79	2.68	0.77	0.77	0.46	0.48	1.10
Dissolved Iron																								
Total Manganese[3]	0.16	0.26	0.33	0.18	0.33	0.19	0.22	0.41	0.23	0.29	0.18	0.33	0.37	0.26	0.36	0.56	0.34	0.52	0.09	0.58	0.23	0.23	0.42	0.69
Dissolved Manganese																								
Sulfates	58	51	44	73	67	73	40	70	50	60	45	60	66	44	77	79	63	78	105	57	81	63	80	90
pH (standard units)	7.5	7.4	7.5	7.8	7.2	8.1	7.8	7.6	7.7	8.0	7.4	7.7	6.9	7.4	7.4	8.3	7.7	7.5	7.0	7.8	7.1	8.6	7.4	7.8
Total Alkalinity to pH 4.5 (mg/L)	106.5	103.1	103.4	107.2	103.4	105.1	112.3	108.5	109.5	113.0	110.3	115.6	83.3	113.5	115.5	119.0	117.2	104.3	78.6	117.3	110.2	113.5	112.3	114.3
Acidity to pH 8.3 (mg/L)	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total Suspended Solids	9	13	10	11	12	12	13	15	14	15	9	14	9	8	9	21	16	11	4	15	13	12	10	15
Total Dissolved Solids (mg/L)																								
TDS measured or calculated (mg/L)	328	96	191	202	241	199	446	208	266	347	333	329	136	404	147	503	458	205	243	264	266	545	328	266
Specific Conductance (umhos/CM)	512	150	298	315	377	311	697	325	415	542	520	514	212	631	230	786	715	321	380	412	415	852	512	415

SW Mare Branch, 1753																								
Parameter	**10/12/2010**	**10/20/2010**	**11/9/2010**	**11/23/2010**	**12/10/2010**	**12/21/2010**	**1/10/2011**	**1/25/2011**	**2/8/2011**	**2/21/2011**	**3/22/2011**	**3/28/2011**	**4/7/2011**	**4/21/2011**	**5/11/2011**	**5/26/2011**	**6/9/2011**	**6/22/2011**	**7/4/2011**	**7/14/2022**	**8/6/2011**	**8/14/2011**	**9/13/2011**	**9/27/2011**
Flow m^3/day (Cfs)	2	1.5	0	0	0	0	5	3	0	0	0	0	0.2	0.1	5	2.5	1.25	3.5	3	2.5	2.5	3.5	3	5
Total Iron	0.47	0.22					0.61	0.42					1.91	0.67	0.45	0.77	0.65	0.46	1.53	0.88	0.6	0.8	0.8	0.74
Dissolved Iron																								
Total Manganese[3]	0.29	0.36					0.44	0.23					0.01	0.32	0.21	0.51	0.42	0.21	0.05	0.65	0.45	0.46	0.55	0.24
Dissolved Manganese																								
Sulfates	70	53					80	70					72.6	51.3	124.3	86.3	45.3	63.9	120.3	69.3	90.3	79.3	63.5	48.3
pH (standard units)	7.7	7.4					8	7.8					7.6	8.2	7.7	8	7.3	7.6	7.1	9.6	8	7.7	7.6	7.1
Total Alkalinity to pH 4.5 (mg/L)	107.48	106.15					112.3	112.67					32.16	121.45	103.65	132.15	125.14	123.4	63.59	112.14	116.14	112.33	118.36	102.14
Acidity to pH 8.3 (mg/L)	<5	<5					<5	<5					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total Suspended Solids	13	12					15	15					1	10	16	12	12	15	2	16	13	16	15	12
Total Dissolved Solids (mg/L)																								
TDS measured or calculated (mg/L)	263.04	272					403.84	431.36					603.52	623.36	333.44	205.44	416.64	349.44	192	559.36	474.24	312.96	590.08	263.68
Specific Conductance (umhos/CM)	411	425					631	674					943	974	521	321	651	546	300	874	741	489	922	412
Temp																								

SW Simms Branch, 1752																								
Parameter	**10/12/2010**	**10/20/2010**	**11/9/2010**	**11/23/2010**	**12/10/2010**	**12/21/2010**	**1/10/2011**	**1/25/2011**	**2/8/2011**	**2/21/2011**	**3/11/2011**	**3/28/2011**	**4/7/2011**	**4/21/2011**	**5/11/2011**	**5/26/2011**	**6/9/2011**	**6/22/2011**	**7/4/2011**	**7/14/2011**	**8/6/2011**	**8/14/2011**	**9/13/2011**	**9/27/2011**
Flow m^3/day (Cfs)	3	1.5	2	1.25	1.5	1.25	8	3	5	10	3.5	3	0.05	0.1	0.15	0.25	0.2	0.5	3	0.5	0.25	0.5	0.5	0.15
Total Iron	0.46	0.54	0.31	0.48	0.32	0.39	0.58	0.69	0.44	0.63	0.48	0.63	0.65	0.42	0.65	0.42	0.26	0.42	1.88	0.5	0.42	0.89	0.48	0.6
Dissolved Iron																								
Total Manganese[3]	0.31	0.21	0.24	0.31	0.24	0.22	0.42	0.33	0.63	0.49	0.31	0.42	0.51	0.23	0.42	0.21	0.18	0.21	0.03	0.42	0.18	0.63	0.22	0.46
Dissolved Manganese																								
Sulfates	74	62	57	55	48	70	60	80	65	70	60	55	74.3	35.6	45.2	55.1	45.2	35.9	78.6	48.6	26.3	101.2	65.8	63.5
pH (standard units)	7.3	7.4	7.1	7.2	8	7.7	7.5	7.8	7.3	7.4	7.8	8	7.8	7.5	7.6	7.7	7.2	7.6	8.5	7.9	7.2	8	7.6	8
Total Alkalinity to pH 4.5 (mg/L)	107.15	103.14	102.18	101.46	106.15	113.45	112.34	110.36	110.37	108.64	112.34	120.64	117.65	102.36	116.47	116.14	118.94	112.36	59.24	113.15	102.33	130.65	100.13	116.45
Acidity to pH 8.3 (mg/L)	>5	>5	>5	>5	>5	>5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total Suspended Solids	8	11	12	10	11	12	10	15		15	13	15	13	11	10	12	10	10	1	9	8	23	16	14
Total Dissolved Solids (mg/L)																								
TDS measured or calculated (mg/L)	124.8	199.68	175.36	135.04	209.92	220.16	199.68	382.72	263.68	403.84	265.6	441.6	390.4	204.8	441.6	526.72	147.2	526.72	167.68	336	512	631.68	265.6	611.84
Specific Conductance (umhos/CM)	195	312	274	211	328	344	312	598	412	631	415	690	610	320	690	823	230	823	262	525	800	987	415	956
Temp																								

Simms Branch - monitored semi-monthly, beginning in January 2002; 2/15/02 - Not Flowing; 7/30/02 through 9/27/02 - Not Flowing

SW Apple Orchard Branch, 1751																								
Parameter	**10/12/2010**	**10/20/2010**	**11/9/2010**	**11/23/2010**	**12/10/2010**	**12/21/2010**	**1/10/2011**	**1/25/2011**	**2/8/2011**	**2/21/2011**	**3/11/2011**	**3/28/2011**	**4/7/2011**	**4/21/2011**	**5/11/2011**	**5/26/2011**	**6/9/2011**	**6/22/2011**	**7/4/2011**	**7/14/2011**	**8/6/2011**	**8/14/2011**	**9/13/2011**	**9/27/2011**
Flow m^3/day (Cfs)	5	4.5	2	0	0	0	10	8	5	0	0	0	0.56	0.2	0.15	4.2	5	2.5	3	0.75	0.3	5.5	2.5	1.5
Total Iron	0.45	0.34	0.51				0.59	0.63	0.72				0.71	0.42	0.51	0.61	0.65	0.54	0.43	0.8	0.77	0.78	0.36	0.59
Dissolved Iron																								
Total Manganese[3]	0.22	0.19	0.32				0.41	0.44	0.59				0.59	0.28	0.32	0.23	0.41	0.16	0.01	0.64	0.52	0.56	0.21	0.23
Dissolved Manganese																								
Sulfates	79	44	44				65	55	60				36.4	78.9	78.6	33.6	165.6	65.4	167.4	80.6	56.3	88.6	45.6	41.3
pH (standard units)	7.6	8	7.3				7.8	7.8	7.5				7.5	8.1	7.8	7.2	7.5	7.1	8.6	7.2	8.2	7.6	7.8	7.5
Total Alkalinity to pH 4.5 (mg/L)	113.48	110.64	105.26				116.97	106.33	110.31				13.57	115.31	115.69	61.45	46.4	32.14	61.2	112.31	110.14	100.14	74.65	49.65
Acidity to pH 8.3 (mg/L)	>5	>5	>5				<5	<5	<5				<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total Suspended Solids	16	9	9				12	11	13				3	16	11	8	15	10	1	13	16	15	12	14
Total Dissolved Solids (mg/L)																								
TDS measured or calculated (mg/L)	297.6	263.68	151.04				403.84	457.6	291.2				510.08	588.8	540.8	98.56	87.04	208.64	168.96	412.8	272	234.24	289.28	391.68
Specific Conductance (umhos/CM)	465	412	236				631	715	455				797	920	845	154	136	326	264	645	425	366	452	612
Temp																								

Apple Orchard Branch - monitored semi-monthly, beginning in January 2002; 5/28/02 through 12/26/02 - Not Flowing

SW Laurel Branch, 1750																								
Parameter	**10/12/2010**	**10/20/2010**	**11/9/2010**	**11/23/2010**	**12/10/2010**	**12/21/2010**	**1/10/2011**	**2/8/2011**	**2/21/2011**	**3/11/2011**	**3/28/2011**	**4/7/2011**	**4/21/2011**	**5/11/2011**	**5/26/2011**	**6/9/2011**	**6/9/2011**	**7/4/2011**	**7/14/2011**	**8/6/2011**	**8/14/2011**	**9/13/2011**	**9/27/2011**	
Flow m^3/day (Cfs)	2	1.2	2.25	1.15	1.2	1.5	3	2.5	3	2	3.5	1.78	3	5	10	5	15	5	2	3	25	2	10	
Total Iron	0.56	0.55	0.36	0.31	0.18	0.26	0.68	0.51	0.28	0.41	0.32	2.22	0.59	0.72	0.59	0.69	0.55	1.08	0.46	0.45	0.14	0.25	0.48	
Dissolved Iron																								
Total Manganese[3]	0.37	0.29	0.24	0.18	0.26	0.23	0.44	0.26	0.18	0.33	0.21	0.02	0.33	0.53	0.32	0.46	0.36	0.15	0.65	0.58	0.65	0.12	0.12	
Dissolved Manganese																								
Sulfates	81	63	52	55	58	46	80	70	70	60	60	34.1	32.5	45.3	88.3	32.5	31.2	108.9	54.6	15.2	26.4	59.6	54.6	
pH (standard units)	8	7.2	7	7.8	7.4	7.5	7.4	7.6	7.6	7.3	7.4	7.1	7.5	8	7.9	7.6	7.8	8.4	7.8	7.4	8.2	7.9	8	
Total Alkalinity to pH 4.5 (mg/L)	106.14	103.44	101.18	106.48	104.45	110.14	115.64	110.31	108.67	105.37	103.22	11.96	112.35	115.68	117.39	114.31	109.64	67.81	56.31	154.54	165.45	110.14	132.55	
Acidity to pH 8.3 (mg/L)	>5	>5	>5	>5	>5	>5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	
Total Suspended Solids	12	12	8	13	15	8	15	15	11	11	15	10	14	11	18	17	11	2	12	15	12	12	12	
Total Dissolved Solids (mg/L)																								
TDS measured or calculated (mg/L)	231.68	125.44	111.36	199.68	199.68	156.16	226.56	339.2	265.6	289.28	147.84	242.56	265.6	391.68	136.32	502.4	265.6	191.36	364.16	98.56	265.6	630.4	199.68	
Specific Conductance (umhos/CM)	362	196	174	312	312	244	354	530	415	452	231	379	415	612	213	785	415	299	569	154	415	985	312	
Temp																								

Laurel Branch - monitored semi-monthly, beginning in January 2002; 7/30/02 through 9/27/02 - Not Flowing

SW Right Fork of Peters Branch, 1766																									
Parameter	**1/24/2002**	**2/1/2002**	**2/15/2002**	**3/1/2002**	**3/15/2002**	**4/1/2002**	**4/26/2002**	**5/13/2002**	**5/28/2002**	**6/13/2002**	**6/28/2002**	**7/15/2002**	**7/30/2002**	**8/14/2002**	**8/29/2002**	**9/13/2002**	**9/27/2002**	**10/9/2002**	**10/21/2002**	**12/10/2002**	**12/26/2002**	**1/10/2003**	**1/24/2003**	**2/6/2003**	**2/21/2003**
Flow m^3/day (Cfs)	3.47	1.33	1.08	1.03	0.98	0.96	0.81	0	0	0	0	0	0	0	0	0	0	0	0	0.44	0.48	1.23	1.36	1.34	1.27
Total Iron	0.10	0.28	0.25	0.32	0.13	0.10	0.15													0.2	0.33	0.1	0.17	0.12	0.07
Dissolved Iron	0.06	0.13	0.10	0.12	0.05	0.02	0.04													0.14	0.26	0.04	0.06	0.09	0.01
Total Manganese[3]	0.12	0.36	0.33	0.11	0.26	0.47	0.40													0.38	0.15	0.12	0.08	0.04	0.04
Dissolved Manganese	0.05	0.12	0.18	0.04	0.19	0.31	0.22													0.15	0.07	0.07	0.02	0.01	0.01
Sulfates	76	40	64	51	78	69	65													80	79	13	20	11	19
pH (standard units)	7.8	8.0	7.6	7.9	8.1	8.0	8.1													7.9	7.8	8.1	7.9	8.2	8.3
Total Alkalinity to pH 4.5 (mg/L)	120.7	121.4	108.6	110.7	119.9	120.3	120.6													115.06	110.14	102.19	106.05	40.55	40.21
Acidity to pH 8.3 (mg/L)	0	0	0	0	0	0	0													0	0	0	0	0	0
Total Suspended Solids	38	29	20	15	21	17	18													12	8	8	9	3	5
Total Dissolved Solids (mg/L)	348	288	296	206	303	247	290													477	410	50	50	60	50
TDS measured or calculated (mg/L)	348	288	296	206	303	247	290													477	410	50	50	60	50
Specific Conductance (umhos/CM)	589	488	503	349	514	418	492													808	695	70	70	70	60
Temp	49	42	43	53	53	54	56													38.1	36.6	36.9	36.2	43.9	47.1

Right Fork of Peters Branch - monitored semi-monthly, beginning in January 2002; 5/13/02 through 10/21/02 - Not Flowing

SW Left Fork of Peters Branch, 1746																									
Parameter	**1/24/2002**	**2/1/2002**	**2/15/2002**	**3/1/2002**	**3/15/2002**	**4/1/2002**	**4/26/2002**	**5/13/2002**	**5/28/2002**	**6/13/2002**	**6/28/2002**	**7/15/2002**	**7/30/2002**	**8/14/2002**	**8/29/2002**	**9/13/2002**	**9/27/2002**	**10/9/2002**	**10/21/2002**	**12/10/2002**	**12/26/2002**	**1/10/2003**	**1/24/2003**	**2/6/2003**	**2/21/2003**
Flow m^3/day (Cfs)	4.79	1.33	1.36	2.18	1.96	1.81	1.88	1.86	1.89	1.52	1.50	0.94						0.49	1.73	0.55	0.59	3.3	3.49	3.51	3.49
Total Iron	0.14	0.31	0.28	0.67	0.15	0.15	0.12	0.08	0.05	0.11	0.20	0.17						0.12	0.14	0.28	0.28	0.13	0.2	0.54	0.65
Dissolved Iron	0.08	0.19	0.12	0.55	0.08	0.07	0.05	0.01	0.01	0.07	0.14	0.08						0.07	0.11	0.1	0.2	0.05	0.14	0.38	0.4
Total Manganese[3]	0.20	0.30	0.10	0.30	0.19	0.18	0.13	0.25	0.13	0.28	0.29	0.24						0.22	0.26	0.14	0.31	0.07	0.08	0.32	0.19
Dissolved Manganese	0.11	0.11	0.06	0.16	0.06	0.10	0.10	0.17	0.10	0.17	0.17	0.15						0.14	0.1	0.06	0.19	0.02	0.01	0.21	0.11
Sulfates	88	46	62	45	61	36	41	58	41	48	51	49						54	59	75	52	33	24	15	22
pH (standard units)	7.9	8.0	7.8	7.7	7.8	7.9	7.7	7.6	7.8	7.8	8.0	7.8						7.1	7.7	7.5	7.9	8	7.9	8.1	8.2
Total Alkalinity to pH 4.5 (mg/L)	120.2	121.6	112.0	106.2	107.1	121.0	121.8	120.2	119.0	119.8	121.8	120.1						100.56	105.19	101.99	114.06	105.1	106.1	76.5	70.31
Acidity to pH 8.3 (mg/L)	0	0	0	0	0	0	0	0	0	0	0	0						0	0	0	0	0	0	0	0
Total Suspended Solids	29	30	15	20	14	20	29	24	18	20	23	18						10	13	10	10	6	7	6	9
Total Dissolved Solids (mg/L)	354	286	290	211	394	306	311	325	320	327	316	299						288	250	290	245	60	60	70	70
TDS measured or calculated (mg/L)	354	286	290	211	394	306	311	325	320	327	316	299						288	250	290	245	60	60	70	70
Specific Conductance (umhos/CM)	600	486	491	358	667	518	527	550	542	555	536	506						488	424	492	415	80	80	110	110
Temp	49	41	43	54	53	54	56	57	59	60	63	68						52	53	37.2	36.6	37	36.5	44.1	46.9

Left Fork of Peters Branch - monitored semi-monthly, beginning in January 2002; 7/30/02 through 9/27/02 - Not Flowing

SW Dug Fork, 1747																									
Parameter	**1/24/2002**	**2/1/2002**	**2/15/2002**	**3/1/2002**	**3/15/2002**	**4/1/2002**	**4/26/2002**	**5/13/2002**	**5/28/2002**	**6/13/2002**	**6/28/2002**	**7/15/2002**	**7/30/2002**	**8/14/2002**	**8/29/2002**	**9/13/2002**	**9/27/2002**	**10/9/2002**	**10/23/2002**	**12/10/2002**	**12/26/2002**	**1/10/2003**	**1/24/2003**	**2/6/2003**	**2/21/2003**
Flow m^3/day (Cfs)	4.32	1.04	0.73	0.61	0.54	0.50	0.48	0.42	0.40	0.47	0	0	0	0	0	0	0	0.2	0.32		0.31	2.25	2.76	2.39	2.27
Total Iron	0.26	0.39	0.35	0.21	0.56	0.25	0.28	0.33	0.30	0.14								0.29	0.14		0.25	0.36	0.17	0.43	0.4
Dissolved Iron	0.15	0.20	0.18	0.17	0.41	0.13	0.10	0.15	0.12	0.05								0.14	0.06		0.1	0.24	0.05	0.3	0.28
Total Manganese[3]	0.08	0.24	0.30	0.10	0.19	0.22	0.14	0.20	0.08	0.11								0.36	0.19		0.08	0.07	0.04	0.07	0.05
Dissolved Manganese	0.02	0.09	0.22	0.04	0.11	0.15	0.08	0.12	0.04	0.06								0.2	0.08		0.02	0.02	0.01	0.02	0.02
Sulfates	74	55	56	84	69	42	44	39	36	41								46	52		64	10	11	9	9
pH (standard units)	7.8	8.0	7.8	7.6	7.6	7.6	7.7	7.7	7.5	7.7								7.8	7.5		7.7	8.1	8	8.1	8
Total Alkalinity to pH 4.5 (mg/L)	116.3	121.8	120.5	105.1	105.1	112.1	120.1	120.8	118.8	118.2								115.33	110.23		112.7	112.1	112.59	55.12	55.78
Acidity to pH 8.3 (mg/L)	0	0	0	0	0	0	0	0	0	0								0	0		0	0	0	0	0
Total Suspended Solids	27	31	18	17	22	12	13	9	8	11								10	15		17	8	9	5	4
Total Dissolved Solids (mg/L)	315	315	236	305	310	295	288	254	221	230								207	245		285	30	30	50	40
TDS measured or calculated (mg/L)	315	315	236	305	310	295	288	254	221	230								207	245		285	30	30	50	40
Specific Conductance (umhos/CM)	534	534	400	516	525	500	488	430	374	390								351	415		483	60	60	60	50
Temp	50	43	43	54	53	54	55	55	57	58								55	53		36.4	37.2	36.9	42.6	47

Dug Fork - monitored semi-monthly, beginning in January 2002; 6/28/02 through 9/27/02 - Not Flowing

SW Main Branch Peters Branch, 1748																									
Parameter	**1/24/2002**	**2/1/2002**	**2/15/2002**	**3/1/2002**	**3/15/2002**	**4/1/2002**	**4/26/2002**	**5/13/2002**	**5/28/2002**	**6/13/2002**	**6/28/2002**	**7/15/2002**	**7/30/2002**	**8/14/2002**	**8/29/2002**	**9/13/2002**	**9/27/2002**	**10/9/2002**	**10/23/2002**	**12/10/2002**	**12/26/2002**	**1/10/2003**	**1/24/2003**	**2/6/2003**	**2/21/2003**
Flow m^3/day (Cfs)	5.16	3.78	1.83	1.49	1.44	1.39	1.22	1.51	1.66	1.53	1.48	1.41	0	0	0	0	0	0.51	1.73	0.67	0.69	6.65	6.81	6.93	6.93
Total Iron	0.47	0.41	0.10	0.18	0.80	0.50	0.55	0.50	0.48	0.40	0.33	0.24						0.55	0.59	0.69	0.58	0.6	0.56	0.28	0.42
Dissolved Iron	0.33	0.24	0.04	0.10	0.74	0.41	0.48	0.42	0.31	0.28	0.15	0.10						0.38	0.41	0.55	0.49	0.44	0.4	0.19	0.3
Total Manganese[3]	0.28	0.27	0.14	0.33	0.68	0.10	0.12	0.10	0.15	0.16	0.21	0.16						0.6	0.33	0.43	0.26	0.18	0.29	0.1	0.17
Dissolved Manganese	0.16	0.15	0.06	0.18	0.55	0.08	0.06	0.03	0.07	0.10	0.18	0.09						0.52	0.26	0.3	0.15	0.07	0.14	0.03	0.05
Sulfates	60	51	41	69	78	45	43	49	44	50	18	29						60	69	58	68	22	12	33	30
pH (standard units)	7.8	7.9	7.6	7.4	7.5	7.3	7.5	7.2	7.0	7.3	7.1	7.4						7	7.4	7.6	7.6	8	7.9	8	7.9
Total Alkalinity to pH 4.5 (mg/L)	119.0	122.0	114.5	102.7	101.8	100.5	101.2	103.0	96.6	101.1	100.6	100.7						99.1	102.56	107.15	109.88	110.18	110.4	88.75	81.09
Acidity to pH 8.3 (mg/L)	0	0	0	0	0	0	0	0	0	0	0	0						0	0	0	0	0	0	0	0
Total Suspended Solids	30	29	11	25	31	16	14	10	18	19	14	8						20	12	16	10	11	12	7	2
Total Dissolved Solids (mg/L)	325	334	285	325	363	264	288	295	306	326	318	312						330	352	360	329	70	70	70	70
TDS measured or calculated (mg/L)	325	334	285	325	363	264	288	295	306	326	318	312						330	352	360	329	70	70	70	70
Specific Conductance (umhos/CM)	550	566	483	550	615	447	487	500	519	552	539	530						559	597	610	558	90	90	80	80
Temp	49	42	42	53	53	54	56	56	59	63	65	65						55	54	38.2	37.3	38.8	37.2	43.8	47.9

Appendix G-1
Details of Surface Water Monitoring Results

Laurel Branch - monitored semi-monthly, beginning in January 2002; 7/30/02 through 9/27/02 - Not Flowing

SW Right Fork of Peters Branch, 1766

Parameter	3/6/2003	3/20/2003	4/4/2003	4/21/2003				1/12/2010	1/26/2010	2/11/2010	2/24/2010	4/4/2010	4/25/2010	5/11/2010	5/27/2010	6/8/2010	6/28/2010	7/12/2010	7/25/2010	8/5/2010	8/21/2010	9/6/2010	9/25/2010	10/12/2010	10/20/2010
Flow m^3/day (Cfs)	1.31	1.33	1.4	1.4				1.56	1.65	2.05	2.05	4.55	2.66	3.65	1.95	1.45	2.61	2.05	1.05	0	0	0	0	0	5
Total Iron	0.15	0.11	0.31	0.3				0.47	0.48	0.24	0.28	0.21	0.44	0.37	0.38	0.27	0.28	0.05	0.51						0.35
Dissolved Iron	0.11	0.05	0.17	0.16																					
Total Manganese[3]	0.02	0.29	0.2	0.21				0.1	0.24	0.08	0.04	0.14	0.25	0.19	0.2	0.05	0.19	0.07	0.7						0.26
Dissolved Manganese	0.01	0.09	0.11	0.14																					
Sulfates	12	22	36	31								57	62	70	45	50	47	69	73						60
pH (standard units)	8.4	8.5	8.6	8.4				8	8.4	8	7.4	7.7	7.6	7.7	7.7	7.9	7.7	7.9	8.2						7
Total Alkalinity to pH 4.5 (mg/L)	40.12	40.78	124.99	122.1				121.16	121.1	120.18	110.26	115.75	107.28	111.5	110.5	112.56	110.28	112.9	110.55						120.41
Acidity to pH 8.3 (mg/L)	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0						>5
Total Suspended Solids	3	6	10	11				8	12	14	10	11	8	12	12	12	13	15	11						13
Total Dissolved Solids (mg/L)	70	70	70	60																					
TDS measured or calculated (mg/L)	70	70	70	60				128	160	140.8	140.16	224.64	164.48	220.8	128	131.2	162.56	260.48	256.64						263.68
Specific Conductance (umhos/CM)	110	100	118	80				200	250	220	219	351	257	345	200	205	254	407	401						412
Temp	55.2	56.9	57.1	57.7																					

Right Fork of Peters Branch - monitored semi-monthly, beginning in January 2002; 5/13/02 through 10/21/02 - Not Flowing

SW Left Fork of Peters Branch, 1746

Parameter	3/6/2003	3/20/2003	4/4/2003	4/21/2003				1/12/2010	1/26/2010	2/11/2010	2/24/2010	3/11/2010	3/26/2010	4/4/2010	4/25/2010	5/11/2010	5/27/2010	6/8/2010	6/28/2010	7/12/2010	7/25/2010	8/5/2010	8/21/2010	9/6/2010	9/25/2010
Flow m^3/day (Cfs)	3.58	3.59	3.63	3.64				2.87	2.05	2.05	3.55	2.85	1.88	3.69	2.99	1.56	1.04	1.05	2.05	3.55	3.65	1.25	0.95	1.65	2.31
Total Iron	0.5	0.6	0.35	0.26				0.27	0.23	0.25	0.48	0.34	0.28	0.36	0.08	0.11	0.18	0.15	0.12	0.47	0.17	0.29	0.72	0.9	0.15
Dissolved Iron	0.28	0.39	0.24	0.18																					
Total Manganese[3]	0.19	0.12	0.18	0.14				0.1	0.12	0.16	0.05	0.28	0.11	0.21	0.15	0.02	0.21	0.02	0.08	0.2	0.05	0.18	0.35	0.17	0.83
Dissolved Manganese	0.07	0.07	0.07	0.05																					
Sulfates	19	20	22	15										25	44	58	56	60	51	60	60	65	69	72	69
pH (standard units)	8.3	8.3	8.4	8.3				7.2	8.4	8	8.2	7.8	8.1	7.9	7.8	8.1	7.8	7.2	7.8	8.1	7.9	8	8	8	8.2
Total Alkalinity to pH 4.5 (mg/L)	72.1	70.24	122.1	121.59				110.86	120.95	112.9	117.1	115.1	114.1	120.55	115.4	121.05	122.05	110.2	120.68	119.05	118.95	118.95	121.75	117.4	110.9
Acidity to pH 8.3 (mg/L)	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Suspended Solids	8	7	15	9				14	12	12	12	10	10	10	8	11	5	11	12	11	11	10	11	12	15
Total Dissolved Solids (mg/L)	60	60	30	30																					
TDS measured or calculated (mg/L)	60	60	30	30				160	157.44	133.12	189.44	163.84	156.16	188.16	143.36	192	196.48	131.2	192	196.48	389.12	198.4	262.4	250.88	234.24
Specific Conductance (umhos/CM)	110	110	50	50				250	246	208	296	256	244	294	224	300	307	205	300	307	608	310	410	392	366
Temp	56.1	56.4	56.5	57.8																					

Left Fork of Peters Branch - monitored semi-monthly, beginning in January 2002; 7/30/02 through 9/27/02 - Not Flowing

SW Dug Fork, 1747

Parameter	3/6/2003	3/20/2003	4/4/2003	4/21/2003				1/12/2010	1/26/2010	2/11/2010	2/24/2010	3/11/2010	3/26/2010	4/4/2010	4/25/2010	5/11/2010	5/27/2010	6/8/2010	6/28/2010	7/12/2010	7/25/2010	8/5/2010	8/21/2010	9/6/2010	9/25/2010
Flow m^3/day (Cfs)	2.28	2.29	2.32	2.34				1.86	1.25	1.05	3.88	3.55	2.88	2.95	2.88	1.05	1.69	3.1	2.05	2.88	2.05	0	0	0	0
Total Iron	0.41	0.45	0.06	0.05				0.07	0.24	0.12	0.17	0.37	0.24	0.19	0.33	0.29	0.19	0.27	0.5	0.56	0.96				
Dissolved Iron	0.22	0.3	0.02	0.01																					
Total Manganese[3]	0.06	0.05	0.01	0.01				0.19	0.17	0.27	0.24	0.25	0.12	0.18	0.2	0.14	0.04	0.05	0.17	0.29	0.18				
Dissolved Manganese	0.01	0.02	0.01	0.01																					
Sulfates	9	9	10	9										80	68	65	75	57	80	100	112				
pH (standard units)	7.9	7.8	7.9	8.5				8.4	7.8	8	8.2	8	8.1	7.6	7.6	7.4	7.9	7.5	7.7	7.9	8.1				
Total Alkalinity to pH 4.5 (mg/L)	53.02	52.18	101.15	120.9				121.35	121.96	121.28	120.86	114.1	120.72	108.12	118.05	108.99	121.55	106.75	114.7	110.25	120.05				
Acidity to pH 8.3 (mg/L)	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Total Suspended Solids	10	4	6	8				12	11	14	10	12	10	8	11	7	11	10	9	12	15				
Total Dissolved Solids (mg/L)	40	40	30	30																					
TDS measured or calculated (mg/L)	40	40	30	30				163.2	177.28	197.12	136.96	133.12	112	99.84	67.2	120.96	135.68	140.8	185.6	122.88	140.8				
Specific Conductance (umhos/CM)	60	90	40	40				255	277	308	214	208	175	156	105	189	212	220	290	192	220				
Temp	57.2	58.1	58.3	58.6																					

Dug Fork - monitored semi-monthly, beginning in January 2002; 6/28/02 through 9/27/02 - Not Flowing

SW Main Branch Peters Branch, 1748

Parameter	3/6/2003	3/20/2003	4/4/2003	4/21/2003				1/12/2010	1/26/2010	2/11/2010	2/24/2010	3/11/2010	3/26/2010	4/4/2010	4/25/2010	5/11/2010	5/27/2010	6/8/2010	6/28/2010	7/12/2010	7/25/2010	8/5/2010	8/21/2010	9/6/2010	9/25/2010
Flow m^3/day (Cfs)	6.88	6.89	6.91	6.92				1.24	4.89	4.55	3.55	5.05	6.88	2.5	3.69	2.15	1.45	2.1	2.1	1.66	2.05	2.05	1.1	2.65	1.55
Total Iron	0.23	0.47	0.14	0.24				0.24	0.28	0.24	0.38	0.24	0.38	0.27	0.27	0.21	0.31	0.15	0.1	0.25	0.14	0.73	0.45	0.77	0.29
Dissolved Iron	0.14	0.39	0.06	0.16																					
Total Manganese[3]	0.15	0.1	0.05	0.08				0.07	0.14	0.15	0.21	0.12	0.12	0.18	0.05	0.12	0.1	0.11	0.21	0.3	0.9	0.1	0.03	0.05	0.55
Dissolved Manganese	0.07	0.05	0.01	0.02																					
Sulfates	31	30	25	33										80	72	65	60	50	58	55	89	85	86	89	67
pH (standard units)	7.8	7.8	7.9	7.9				8.1	7.8	7.8	8.1	8.2	8.1	7.6	8	7.7	7.5	8	7.5	7.8	8.1	7.8	7.7	8.2	7.7
Total Alkalinity to pH 4.5 (mg/L)	89.1	80.22	108.9	121.55				120.08	117.1	117.29	121.45	120.19	120.59	104.36	121.45	116.05	110.55	114.75	111.05	101.2	110.75	110.25	112.91	115.95	101.9
Acidity to pH 8.3 (mg/L)	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Suspended Solids	4	3	9	11				15	10	12	10	10	14	8	15	10	10	9	15	15	10	11	12	12	10
Total Dissolved Solids (mg/L)	80	90	90	90																					
TDS measured or calculated (mg/L)	80	90	90	90				160	170.24	119.04	131.84	230.4	153.6	124.8	256.64	224	230.4	192.64	167.04	131.84	320	192	192	224	165.76
Specific Conductance (umhos/CM)	90	100	110	100				250	266	186	206	360	240	195	401	350	360	301	261	206	500	300	300	350	259
Temp	56.5	57.1	57.4	57.7																					

Laurel Branch - monitored semi-monthly, beginning in January 2002; 7/30/02 through 9/27/02 - Not Flowing

SW Right Fork of Peters Branch, 1766																						
Parameter	**11/9/2010**	**11/23/2010**	**12/10/2010**	**12/21/2010**	**1/10/2011**	**1/25/2011**	**2/8/2011**	**2/21/2011**	**3/11/2011**	**3/28/2011**	**4/7/2011**	**4/21/2011**	**5/11/2011**	**5/26/2011**	**6/9/2011**	**6/22/2011**	**7/4/2011**	**7/14/2011**	**8/6/2011**	**8/14/2011**	**9/13/2011**	**9/27/2011**
Flow m^3/day (Cfs)	3	0	0	0	3.5	5	0	0	0	0	6.25	2.5	3	1.5	2.5	5	5	5	1	2.5	3.5	2.3
Total Iron	0.62				0.61	0.42					0.8	0.63	0.45	0.54	0.48	0.63	0.13	0.45	0.21	0.23	0.45	0.9
Dissolved Iron																						
Total Manganese[3]	0.44				0.35	0.26					0.59	0.32	0.29	0.24	0.12	0.42	0.03	0.21	0.18	0.18	0.63	0.63
Dissolved Manganese																						
Sulfates	80				45	60					68.3	42.3	64.3	154.3	164.5	54.3	29.4	48.9	42.3	48.9	48.9	89.6
pH (standard units)	7.8				8.1	8					7.7	7.7	7.2	7.8	7.7	7.8	7.4	8	7	7.5	8	7.3
Total Alkalinity to pH 4.5 (mg/L)	110.45				113.25	116.33					118.04	112.3	118.47	123.51	108.48	116.48	12.14	116.32	102.32	113.64	114.36	102.98
Acidity to pH 8.3 (mg/L)	>5				<5						<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total Suspended Solids	12				10	14					15	10	14	8	15	14	1	15	10	12	26	22
Total Dissolved Solids (mg/L)																						
TDS measured or calculated (mg/L)	220.8				391.68	265.6					546.56	403.84	84.48	231.04	291.84	205.44	375.04	265.6	236.16	312.96	572.16	312.96
Specific Conductance (umhos/CM)	345				612	415					854	631	132	361	456	321	586	415	369	489	894	489
Temp																						

Right Fork of Peters Branch - monitored semi-monthly, beginning in January 2002; 5/13/02 through 10/21/02 - Not Flowing

SW Left Fork of Peters Branch, 1746																									
Parameter	**10/12/2010**	**10/20/2010**	**11/9/2010**	**11/23/2010**	**12/10/2010**	**12/23/2010**	**1/10/2011**	**1/15/2011**	**1/25/2011**	**2/8/2011**	**2/21/2011**	**3/11/2011**	**3/28/2011**	**4/7/2011**	**4/21/2011**	**5/11/2011**	**5/26/2011**	**6/9/2011**	**6/22/1011**	**7/4/2011**	**7/14/2011**	**8/6/2011**	**8/14/2011**	**9/13/2011**	**9/27/2011**
Flow m^3/day (Cfs)	5	5	3.5	2	2	2	2.5		5	1.5	5	3.5	2	3.91	2	3	4.5	5	3.5	5.5	3.5	1.5	5	2.5	5.5
Total Iron	0.19	0.29	0.23	0.26	0.63	0.26	0.41		0.44	0.45	0.42	0.48	0.28	1.69	0.63	0.63	0.41	0.63	0.59	2.1	0.8	0.8	0.59	0.44	0.48
Dissolved Iron																									
Total Manganese[3]	0.16	0.18	0.19	0.18	0.41	0.18	0.22		0.31	0.26	0.21	0.26	0.21	0.06	0.51	0.24	0.29	0.37	0.36	1.25	0.42	0.65	0.45	0.21	0.32
Dissolved Manganese																									
Sulfates	70	30	56	63	79	73	60		70	75	60	80	40	42.6	35.2	55.3	31.2	59.2	36.2	76.3	59.6	74.3	48.3	45.6	59.6
pH (standard units)	8	8.1	8	7.7	8	7.5	7.7		7.8	8	7.8	7.8	7.4	7.3	8.2	7.8	7.4	8.1	7.1	8.3	7.8	8	8	8.3	8.3
Total Alkalinity to pH 4.5 (mg/L)	118.23	113.45	120.45	113.14	114.45	113.45	116.33		112.39	117.84	110.31	118.64	112.3	11.1	102.36	112.36	95.63	110.45	106.35	123.62	115.15	119.65	102.36	115.63	115.63
Acidity to pH 8.3 (mg/L)	>5	>5	>5	>5	>5	>5	<5		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total Suspended Solids	16	13	12	13	10	14	15		15	16	15	11	10	10	9	13	6	15	12	16	12	18	15	121	19
Total Dissolved Solids (mg/L)																									
TDS measured or calculated (mg/L)	248.96	241.92	201.6	246.4	263.68	189.44	327.68		311.68	327.68	391.68	263.68	147.84	498.56	631.68	147.84	205.44	439.68	382.08	596.48	265.6	392.32	293.4	293.12	604.8
Specific Conductance (umhos/CM)	389	378	315	385	412	296	512		487	512	612	412	231	779	987	231	321	687	597	932	415	613	489	458	945
Temp																									

Left Fork of Peters Branch - monitored semi-monthly, beginning in January 2002; 7/30/02 through 9/27/02 - Not Flowing

SW Dug Fork, 1747																								
Parameter	**10/12/2010**	**10/20/2010**	**11/9/2010**	**11/23/2010**	**12/10/2010**	**12/21/2010**	**1/10/2011**	**1/25/2011**	**2/8/2011**	**2/21/2011**	**3/11/2011**	**3/28/2011**	**4/7/2011**	**4/21/2011**	**5/11/2011**	**5/26/2011**	**6/9/2011**	**6/22/2011**	**7/4/2011**	**7/14/2011**	**8/6/2011**	**8/14/2011**	**9/13/2011**	**9/27/2011**
Flow m^3/day (Cfs)	3.69	3.5	5	0	0	0	5	2.5	0	0	0	0	2.5	5	3	1.5	2.5	4	3.5	2.5	5	2.5	3	1.5
Total Iron	0.36	0.26	0.52				0.42	0.71					0.69	0.58	0.41	0.48	0.35	0.45	0.8	0.74	0.69	0.54	0.59	0.22
Dissolved Iron																								
Total Manganese[3]	0.21	0.22	0.31				0.33	0.45					0.44	0.32	0.37	0.23	0.14	0.31	0.58	0.53	0.51	0.22	0.26	0.18
Dissolved Manganese																								
Sulfates	25	65	73				50	60					67.3	48.6	56.4	36.4	65.9	146.5	88.6	84.6	80.2	75.6	85.6	123.6
pH (standard units)	7.9	7.4	7.2				7.1	7.5					7.4	7.2	7.5	7.3	7.7	7.8	7.8	8	7.8	7.8	8	7.2
Total Alkalinity to pH 4.5 (mg/L)	120.55	112.45	113.45				104.51	118.97					109.63	105.63	165.48	132.4	54.68	152.63	115.63	113.65	201.38	114.32	78.69	103.23
Acidity to pH 8.3 (mg/L)	0	>5	>5				<5	<5					<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total Suspended Solids	10	12	13				9	15					12	11	11	15	12	14	17	26	15	12	10	15
Total Dissolved Solids (mg/L)																								
TDS measured or calculated (mg/L)	188.16	76.8	138.24				181.76	267.52					265.6	160	65.92	98.56	363.52	208.64	574.72	382.72	220.8	233.6	476.8	267.52
Specific Conductance (umhos/CM)	294	120	216				284	418					415	250	103	154	568	326	898	598	345	365	745	418
Temp																								

Dug Fork - monitored semi-monthly, beginning in January 2002; 6/28/02 through 9/27/02 - Not Flowing

SW Main Branch Peters Branch, 1748																								
Parameter	**10/12/2010**	**10/20/2010**	**11/9/2010**	**11/23/2010**	**12/10/2010**	**12/21/2010**	**1/10/2011**	**1/25/2011**	**2/8/2011**	**2/21.2011**	**3/11/2011**	**3/28/2011**	**4/7/2011**	**4/21/2011**	**5/11/2011**	**5/26/2011**	**6/9/2011**	**6/22/2011**	**7/4/2011**	**7/14/2011**	**8/6/2011**	**8/14/2011**	**9/13/2011**	**9/27/2011**
Flow m^3/day (Cfs)	3	3	5	3	2	2.5	3.5	2	5	3.5	3.5	2	2	5.5	2.5	5	5	1.5	10	6.5	3	1.5	2.5	3
Total Iron	0.26	0.44	0.41	0.36	0.49	0.26	0.61	0.63	0.48	0.31	0.42	0.39	2.98	0.75	0.69	0.52	0.69	0.58	0.92	0.45	0.77	0.32	0.8	0.88
Dissolved Iron																								
Total Manganese[3]	0.18	0.31	0.22	0.22	0.26	0.18	0.48	0.44	0.31	0.21	0.21	0.23	0.12	0.43	0.41	0.36	0.41	0.36	0.16	0.25	0.63	0.18	0.45	0.67
Dissolved Manganese																								
Sulfates	58	69	63	70	51	43	80	75	60	40	60	65	20.1	88.6	44.3	35.6	75	42	60.3	46.5	75.3	48.9	113	65.5
pH (standard units)	7.8	7.2	7.8	7.4	7.7	7.5	7.5	8	7.2	8	7.8	7.5	7.9	8.2	7.5	7.7	8	7.2	7.7	7	7.1	7.5	7.7	8
Total Alkalinity to pH 4.5 (mg/L)	113.45	106.14	113.65	112.45	107.15	120.54	110.39	118.97	118.97	112.64	112.36	106.48	11.3	112.36	113.64	118.1	115.69	115.36	29.92	116.48	102.36	114.32	163.25	112.36
Acidity to pH 8.3 (mg/L)	>5	>5	>5	>5	>5	>5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5		
Total Suspended Solids	16	11	12	13	11	12	15	16	16	15	15	12	1	13	12	8	12	8	3	10	19	12	22	15
Total Dissolved Solids (mg/L)																								
TDS measured or calculated (mg/L)	214.4	151.04	305.28	265.6	263.68	247.68	263.68	403.84	403.84	403.2	265.6	265.6	565.76	540.8	519.68	538.88	501.76	129.92	97.28	629.76	474.88	289.28	604.8	265.6
Specific Conductance (umhos/CM)	335	236	477	415	412	387	412	631	631	630	415	415	884	845	812	842	784	203	152	984	742	452	945	415
Temp																								

Appendix G-1
Details of Surface Water Monitoring Results

Main Branch Peters Branch - monitored semi-monthly, beginning in January 2002; 7/30 through 9/27/02 - Not Flowing

SW Marion Branch, 1749

Parameter	1/24/2002	2/1/2002	2/15/2002	3/1/2002	3/15/2002	4/1/2002	4/26/2002	5/13/2002	5/28/2002	6/13/2002	6/28/2002	7/15/2002	7/30/2002	8/14/2002	8/29/2002	9/13/2002	9/27/2002	10/9/2002	10/23/2002	12/10/2002	12/26/2002	1/10/2003	1/24/2003	2/6/2003	2/21/2003
Flow m^3/day (Cfs)	3.48	2.27	0.77	2.04	1.93	1.89	1.87	1.88	1.75	1.67	1.60	1.34	0	0	0	0	0	0.21	1.73	0.35	0.36	5.66	5.73	5.76	5.7
Total Iron	0.39	0.36	0.19	0.47	0.10	0.30	0.38	0.49	0.39	0.41	0.45	0.40						0.47	0.46	0.6	0.55	0.64	0.56	0.77	0.69
Dissolved Iron	0.27	0.19	0.09	0.21	0.04	0.18	0.14	0.42	0.30	0.35	0.30	0.22						0.25	0.3	0.44	0.41	0.49	0.39	0.59	0.5
Total Manganese[3]	0.14	0.15	0.20	0.10	0.33	0.41	0.45	0.50	0.41	0.33	0.18	0.17						0.13	0.25	0.18	0.17	0.14	0.1	0.05	0.11
Dissolved Manganese	0.05	0.02	0.11	0.02	0.17	0.36	0.30	0.39	0.28	0.24	0.12	0.11						0.06	0.14	0.1	0.1	0.06	0.04	0.01	0.09
Sulfates	70	66	33	90	74	56	60	55	41	48	50	52						66	64	62	66	29	12	19	20
pH (standard units)	7.7	7.9	7.6	8.0	8.1	8.0	8.0	7.8	7.9	8.1	8.1	8.3						8.4	8	8.1	8	8	8.1	8.1	8.2
Total Alkalinity to pH 4.5 (mg/L)	115.7	118.6	108.2	120.0	125.1	120.2	119.1	120.1	120.8	120.2	121.1	120.3						122.05	119.1	121.55	119.15	117.1	115.05	30.15	30.67
Acidity to pH 8.3 (mg/L)	0	0	0	0	0	0	0	0	0	0	0	0						0	0	0	0	0	0	0	0
Total Suspended Solids	32	31	16	16	26	12	15	20	17	18	11	15						14	16	16	15	11	10	4	5
Total Dissolved Solids (mg/L)	348	275	243	404	355	301	400	407	385	355	269	289						360	399	351	382	50	50	50	50
TDS measured or calculated (mg/L)	348	275	243	404	355	301	400	407	385	355	269	289						360	399	351	382	50	50	50	50
Specific Conductance (umhos/CM)	590	466	412	684	602	510	678	690	653	601	456	490						610	676	595	647	60	60	80	80
Temp	55	42	43	54	53	54	54	56	57	59	63	65						56	54	38.1	37.6	38.1	37.5	44.1	48.1

Lower Double Branch - monitored semi-monthly, beginning in January 2002; No data for 4/01/02; 6/13/02 through 10/21/02 - Not Flowing

SW Blue Hollow, 1765

Parameter	1/24/2002	2/1/2002	2/15/2002	3/1/2002	3/15/2002	4/1/2002	4/26/2002	5/13/2002	5/28/2002	6/13/2002	6/28/2002	7/15/2002	7/30/2002	8/14/2002	8/29/2002	9/13/2002	9/27/2002	10/9/2002	10/21/2002	12/10/2002	12/26/2002	1/10/2003	1/24/2003	2/6/2003	2/21/2003
Flow m^3/day (Cfs)			1.21	1.21	1.13	1.16	1.05	0.96	0	0	0	0	0	0	0	0	0	0	0	0.49	0.48	1.13	1.21	1.23	1.19
Total Iron			0.11	0.26	0.15	0.31	0.36	0.39												0.13	0.28	0.2	0.3	0.29	0.21
Dissolved Iron			0.08	0.17	0.04	0.15	0.14	0.18												0.05	0.19	0.15	0.24	0.12	0.17
Total Manganese[3]			0.32	0.07	0.19	0.09	0.12	0.20												0.07	0.06	0.11	0.05	0.09	0.05
Dissolved Manganese			0.15	0.05	0.10	0.01	0.05	0.08												0.02	0.03	0.06	0.01	0.04	0.01
Sulfates			72	56	90	73	75	69												51	74	20	22	30	35
pH (standard units)			8.1	8.0	8.0	7.9	7.5	7.7												8.1	8.2	8.2	7.9	8.2	8.1
Total Alkalinity to pH 4.5 (mg/L)			108.5	120.1	120.1	115.6	111.0	110.4												115.5	115.2	110.89	106.36	26.17	26.05
Acidity to pH 8.3 (mg/L)			0	0	0	0	0	0												0	0	0	0	0	0
Total Suspended Solids			14	14	26	10	14	12												11	8	8	6	5	3
Total Dissolved Solids (mg/L)			329	300	422	355	310	330												305	310	74	60	80	80
TDS measured or calculated (mg/L)			329	300	422	355	310	330												305	310	74	60	80	80
Specific Conductance (umhos/CM)			558	508	715	601	525	560												517	525	100	100	100	100
Temp			43	53	53	54	55	57												37.2	36.9	37.2	36.1	43.7	47.9

SW Right Cawood, 1767

Parameter	10/9/2002	10/23/2002	12/10/2002	12/26/2002	1/10/2003	1/24/2003	2/6/2003	2/21/2003	3/6/2003	3/20/2003	4/4/2003	4/21/2003			1/12/2010	1/26/2010	2/11/2010	2/24/2010	4/4/2010	4/25/2010	5/11/2010	5/27/2010	6/8/2010	6/28/2010	1/26/2011
Flow m^3/day (Cfs)	1.04	1.72	1.16	1.18	1.31	1.36	1.39		1.42	1.44	1.51	1.59			1.25	1.25	1.5	4.88	2	1.57	1.55	2.24	2.25	1.65	5.95
Total Iron	0.29	0.25	0.37	0.59	0.49	0.52	0.5	0.49	0.52	0.4	0.16	0.33			0.24	0.37	0.28	0.38	0.2	0.22	0.18	0.36	0.08	0.11	0.33
Dissolved Iron	0.14	0.16	0.26	0.43	0.31	0.41	0.22	0.26	0.24	0.21	0.05	0.15													
Total Manganese[3]	0.65	0.47	0.69	0.32	0.02	0.18	0.12	0.08	0.16	0.16	0.11	0.14			0.07	0.15	0.14	0.211	0.11	0.3	0.02	0.01	0.27	0.29	0.11
Dissolved Manganese	0.41	0.32	0.57	0.15	0.01	0.05	0.09	0.03	0.11	0.09	0.03	0.07													
Sulfates	41	68	69	57	52	56	12	20	15	10	24	21							50	45	57	60	56	69	51.7
pH (standard units)	7.3	7.2	8	8.1	8.3	8.2	8.1	8.2	7.3	8.2	8.1	8.6			8.2	8.1	8	8.3	7.8	7.8	7.7	8	7.8	7.5	8.1
Total Alkalinity to pH 4.5 (mg/L)	101.15	99.1	118.4	120.1	30.1	33.12	39.41	26.88	26.31	28.1	121.5	122.1			117.25	121.55	121.75	114.1	105.6	119.2	116.1	120.22	107.55	107.05	140.7
Acidity to pH 8.3 (mg/L)	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0	0	0	5.801
Total Suspended Solids	10	15	18	17	14	15	7	8	9	5	20	12			12	10	10	10	12	8	10	14	8	12	9
Total Dissolved Solids (mg/L)	410	416	450	406	200	200	210	200	200	30	60	60													
TDS measured or calculated (mg/L)															198.4	165.76	174.08	184.32	295.04	124.8	133.12	137.6	121.6	145.92	144.64
Specific Conductance (umhos/CM)	695	705	762	688	338	339	200	300	400	50	102	102			310	259	272	288	461	195	208	215	190	228	226
Temp	54	53	37.9	36.4	35.1	36.2	45.1	43.6	55.6	56.8	57.1	58.2			0	0	0	0	0	0	0	0	0	0	

SW Left Cawood, 1770

Parameter	10/9/2002	10/23/2002	12/10/2002	12/26/2002	1/10/2003	1/24/2003	2/6/2003	2/21/2003	3/6/2003	3/20/2003	4/4/2003	4/21/2003			4/4/2010	4/25/2010	5/11/2011	5/27/2010	6/8/2010	6/28/2010	7/12/2010	7/25/2010	8/5/2010	8/21/2010	9/6/2010
Flow m^3/day (Cfs)	0.39	1.7	0.44	0.49	2.1	2.12	2.16	2.42	2.18	2.19	2.23	2.31			1.81	1.5	1.95	0.9	1.1	1.55	0.42	0.56	0.36	0.25	0.05
Total Iron	0.2	0.15	0.26	0.3	0.31	0.35	0.61	0.7	0.6	0.73	0.22	0.25			0.17	0.25	0.31	0.18	0.19	0.15	0.54	0.72	0.39	0.25	0.55
Dissolved Iron	0.13	0.09	0.1	0.19	0.15	0.24	0.34	0.55	0.37	0.5	0.1	0.15													
Total Manganese[3]	0.28	0.12	0.11	0.56	0.14	0.47	0.09	0.12	0.13	0.18	0.12	0.1			0.09	0.16	0.2	0.05	0.2	0.02	0.21	0.08	0.17	0.11	0.17
Dissolved Manganese	0.14	0.05	0.03	0.31	0.06	0.29	0.01	0.07	0.04	0.1	0.05	0.07													
Sulfates	55	62	56	65	61	56	23	25	29	22	28	33			80	43	60	54	72	67	36	56	77	67	90
pH (standard units)	7.2	7.4	8.1	8.1	8.2	8.1	8.2	8.2	8.2	8.1	8.1	8.1			7.4	7.4	7.7		7.4	7.7	7.8	7.7	7.2	7.7	7.5
Total Alkalinity to pH 4.5 (mg/L)	102.99	101.18	120.05	120.55	116.55	120.03	29.7	29.34	29.75	29.1	121.75	119.4			121.3	118.8	121.5	110.5	107.55	117.23	115.92	117.55	105.9	112.75	100.25
Acidity to pH 8.3 (mg/L)	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0	0	0	0	0	0	0	0
Total Suspended Solids	17	17	9	14	8	18	6	9	10	5	18	17			7	9	11	12	9	11	11	12	12	10	12
Total Dissolved Solids (mg/L)	410	450	400	418	200	205	190	190	200	180	190	190													
TDS measured or calculated (mg/L)	410	450	400	418	200	205	190	190	200	180	190	190			70.4	80	99.84	106.24	87.04	128	170.24	128	77.44	131.2	131.2
Specific Conductance (umhos/CM)	762	695	678	708	378	340	300	300	300	200	322	322			110	125	156	166	136	200	266	200	121	205	205
Temp	54	53	37.1	37.1	36.4	36.1	43.2	45.6	55.4	56.1	56.9	57.9													

Appendix G-1
Details of Surface Water Monitoring Results

Main Branch Peters Branch - monitored semi-monthly, beginning in January 2002; 7/30 through 9/27/02 - Not Flowing

SW Marion Branch, 1749																								
Parameter	3/6/2003	3/20/2003	4/4/2003	4/21/2003				1/12/2010	1/26/2010	2/11/2010	2/24/2010	3/11/2010	3/26/2010	4/4/2010	4/25/2010	5/11/2010	5/27/2010	6/8/2010	6/28/2010	7/12/2010	7/25/2010	8/5/2010	8/21/2010	9/6/2010	9/25/2010
Flow m^3/day (Cfs)	5.75	5.76	5.97	5.6				3.89	4.55	3.85	3.86	3.86	2.88	1.65	3.05	2.89	2.15	2.35	1.45	0.89	0.31	0.36	0.29	0.65	0.88
Total Iron	0.72	0.64	0.36	0.31				0.48	0.25	0.21	0.46	0.19	0.25	0.11	0.28	0.18	0.44	0.33	0.14	0.56	0.61	0.57	0.89	0.91	0.78
Dissolved Iron	0.5	0.52	0.15	0.24																					
Total Manganese[3]	0.12	0.26	0.11	0.19				0.12	0.17	0.1	0.21	0.08	0.1	0.02	0.25	0.14	0.2	0.12	0.2	0.18	0.7	0.62	0.22	0.55	0.25
Dissolved Manganese	0.05	0.1	0.06	0.07																					
Sulfates	14	23	25	12										47	55	62	74	73	63	101	85	72	75	89	100
pH (standard units)	8.3	8.2	8.3	7.9				8.2	8.4	8.1	8.2	8.1	7.7	7.5	8	8	8	7.7	8	8	8.2	8.9	8.4	8	8.1
Total Alkalinity to pH 4.5 (mg/L)	30.25	30.11	118.25	107.41				120.05	120.67	120.45	117.05	120.2	117.1	120.61	120.61	115.2	115.75	118.45	121.5	118.6	117.5	105.88	125.9	118.6	107.2
Acidity to pH 8.3 (mg/L)	0	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Suspended Solids	3	6	14	15				12	10	12	12	14	14	9	8	10	12	9	12	8	9	11	7	15	11
Total Dissolved Solids (mg/L)	60	70	60	30																					
TDS measured or calculated (mg/L)	60	70	60	30				192	188.8	139.52	185.6	156.8	138.88	382.08	165.12	195.84	192	192	256	281.6	320	312.96	371.84	447.36	387.2
Specific Conductance (umhos/CM)	80	80	110	50				300	295	218	290	245	217	597	258	306	300	300	400	440	500	489	581	699	605
Temp	55.3	56.6	57.1	57.9																					

Lower Double Branch - monitored semi-monthly, beginning in January 2002; No data for 4/01/02; 6/13/02 through 10/21/02 - Not Flowing

SW Blue Hollow, 1765																								
Parameter	3/6/2003	3/20/2003	4/4/2003	4/21/2003				1/12/2010	1/26/2010	2/11/2010	2/24/2010	3/11/2010	3/26/2010	4/4/2010	4/25/2010	5/11/2010	5/27/2010	6/8/2010	6/28/2010	7/12/2010	7/25/2010	8/5/2010	8/21/2010	9/6/2010	9/25/2010
Flow m^3/day (Cfs)	1.21	1.24	1.27	1.79				1.5	5.18	1.05	2.05			3.55	2.51	1.65	2.05	1.89	1.05	2.14	2.33	1.18	1.25	2.93	0.55
Total Iron	0.2	0.25	0.04	0.19				0.31	0.36	0.35	0.27			0.89	0.5	0.23	0.42	0.21	0.37	0.71	0.92	0.75	0.52	0.55	0.45
Dissolved Iron	0.09	0.1	0.02	0.06																					
Total Manganese[3]	0.14	0.11	0.09	0.05				0.15	0.1	0.28	0.04			0.26	0.22	0.08	0.09	0.14	0.1	0.33	0.31	0.11	0.19	0.09	0.18
Dissolved Manganese	0.07	0.06	0.05	0.02																					
Sulfates	32	30	36	32										39	40	46	69	57	53	45	66	69	73	63	60
pH (standard units)	8.2	8.1	8.1	8.1				8.1	8	8.2	8.2			7.2	7.8	7.8	7.7	7.6	7.8	7.7	7.9	8	8	8	8.2
Total Alkalinity to pH 4.5 (mg/L)	26.22	26.11	108.11	118.56				120.95	114.1	114.1	114.1			114.8	115.96	114.92	108.22	110.25	121.05	112.9	118.1	115.9	115.9	117.2	110.75
Acidity to pH 8.3 (mg/L)	0	0	0	0				0	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0
Total Suspended Solids	4	5	16	17				12	15	10	10			11	9	11	10	11	12	15	11	12	15	15	10
Total Dissolved Solids (mg/L)	70	80	90	80																					
TDS measured or calculated (mg/L)	70	80	90	80				128	184.96	134.4	183.04			332.16	163.84	193.28	191.36	205.44	176	438.4	249.6	304	294.4	441.6	191.36
Specific Conductance (umhos/CM)	90	100	110	100				200	289	210	286			519	256	302	299	321	275	685	390	475	460	690	299
Temp	55.9	56.7	56.9	58.2																					

SW Right Cawood, 1767																
Parameter	2/10/2011	2/25/2011	3/10/2011	3/22/2011	4/4/2011	4/25/2011	5/5/2011	5/27/2011	6/8/2011	6/28/2011	7/10/2011	7/25/2011	8/6/2011	8/25/2011	9/12/2011	9/25/2011
Flow m^3/day (Cfs)	5.95	5.55	6.55	6.1	5.1	5.55	4.05	5.12	6.55	6.27	4.1	2.1	3.1	3.05	4.05	1.05
Total Iron	0.37	0.55	0.72	0.72	0.58	0.47	0.62	0.55	0.5	0.64	0.61	0.42	0.59	0.45	0.6	0.59
Dissolved Iron																
Total Manganese[3]	0.12	0.07	0.59	0.55	0.35	0.29	0.4	0.26	0.66	0.51	0.37	0.31	0.26	0.1	0.12	0.4
Dissolved Manganese																
Sulfates	80.7	71.9	80.6	80.5	81.5	75.8	50.8	68.2	75.2	81.8	77.2	72.5	80.5	66.9	85.5	72.1
pH (standard units)	8	8.3	8	8	8	8.3	8	7.9	8	8.4	8	8.1	8	8.2	8	8.4
Total Alkalinity to pH 4.5 (mg/L)	136.2	120.8	120.5	129.7	139.7	151.2	141.2	130.2	121.2	150.8	137.8	141.5	150.2	121.8	144.7	148.1
Acidity to pH 8.3 (mg/L)	4.052	5.775	4.906	4.167	5.199	4.609	5.889	5.155	5.001	4.772	4.559	5.725	5.198	3.886	6.661	7.066
Total Suspended Solids	8	15	14	18	14	13	12	10	10	11	12	10	12	11	10	17
Total Dissolved Solids (mg/L)																
TDS measured or calculated (mg/L)	197.76	184.96	192	240	211.2	241.28	256.64	216.96	256	198.4	224	248.32	192	184.96	241.28	252.8
Specific Conductance (umhos/CM)	309	289	300	375	330	377	401	339	400	310	350	388	300	289	377	395
Temp																

SW Left Cawood, 1770																								
Parameter	9/25/2010	10/12/2010	10/20/2010	11/9/2010	11/23/2010	12/10/2010	12/21/2010	1/26/2011	2/10/2011	2/25/2011	3/10/2011	3/22/2011	4/4/2011	4/25/2011	5/5/2011	5/27/2011	6/8/2011	6/28/2011	7/10/2011	7/25/2011	8/6/2011	8/25/2011	9/12/2011	9/25/2011
Flow m^3/day (Cfs)	0.39	2.5	2	2	2	1.5	2	6.88	4.45	5.05	7.05	5.25	8.86	8.1	6.05	5.68	5.55	7.55	2.26	2.4	4.25	3.28	4.3	1.55
Total Iron	0.25	0.36	0.19	0.45	0.56	0.31	0.33	0.68	0.39	0.29	0.37	0.36	0.62	0.36	0.72	0.5	0.4	0.5	0.32	0.6	0.62	0.7	0.45	0.72
Dissolved Iron																								
Total Manganese[3]	0.19	0.19	0.16	0.26	0.48	0.22	0.22	0.12	0.51	0.34	0.45	0.15	0.05	0.48	0.24	0.36	0.28	0.29	0.1	0.37	0.47	0.55	0.2	0.33
Dissolved Manganese																								
Sulfates	64	75	63	59	80	70	50	67.1	61.3	72.1	67.8	56.8	71.4	66.9	60.9	70.8	70.6	77.8	56.6	70.2	62.9	60.9	77.9	90.6
pH (standard units)	7.2	7.9	7.2	7.1	7.9	7.5	7.6	8	7.9	7.8	8.4	8	8.2	7.8	7.7	8	8	8.1	8.2	8.2	8.2	8	8.2	8.8
Total Alkalinity to pH 4.5 (mg/L)	110.55	119.15	113.45	112.48	119.44	112.48	109.65	166.2	140.2	129.1	130.1	150.2	140.5	141.2	142.2	138.2	133.5	145.7	161.8	145.7	131.5	151.5	145.8	155.9
Acidity to pH 8.3 (mg/L)	0	<5	<5	<5	<5	<5	<5	5.559	3.011	2.705	4.559	3.314	4.089	5.745	5.699	6.175	4.712	6.701	4.945	6.188	4.778	5.608	5.771	7.05
Total Suspended Solids	7	13	10	19	13	14	11	11	14	10	15	10	12	12	10	10	15	12	11	15	10	17	17	10
Total Dissolved Solids (mg/L)																								
TDS measured or calculated (mg/L)	137.6	170.24	114.56	172.16	129.28	138.24	156.8	156.16	207.36	243.84	224	192	191.36	284.8	203.52	240	250.88	227.2	208.64	238.08	209.92	172.16	209.28	261.12
Specific Conductance (umhos/CM)	215	266	179	269	202	216	245	244	324	381	350	300	299	445	318	375	392	355	326	372	328	269	327	408
Temp																								

Appendix G-1
Details of Surface Water Monitoring Results

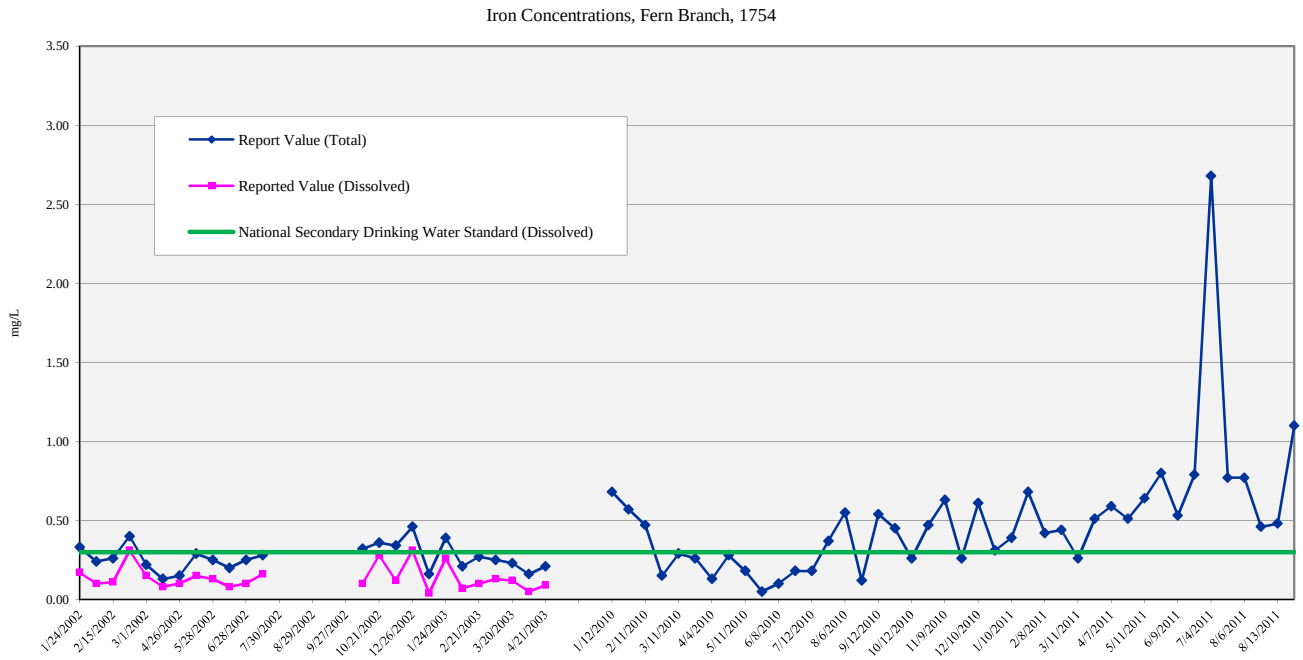
Main Branch Peters Branch - monitored semi-monthly, beginning in January 2002; 7/30 through 9/27/02 - Not Flowing

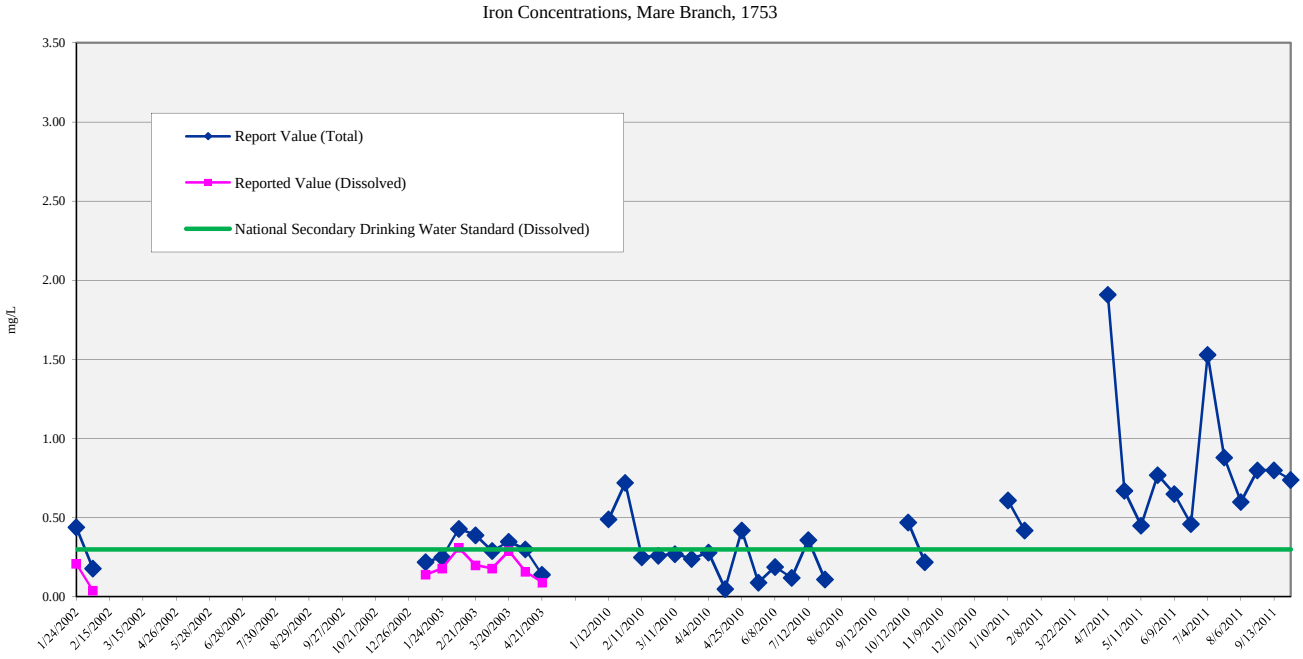
	SW Marion Branch, 1749																							
Parameter	**6/28/2010**	**10/12/2010**	**10/20/2010**	**11/9/2010**	**11/23/2010**	**12/10/2010**	**12/21/2010**	**1/10/2011**	**2/8/2011**	**2/21/2011**	**3/11/2011**	**3/28/2011**	**4/7/2011**	**4/21/2011**	**5/11/2011**	**5/26/2011**	**6/9/2011**	**6/22/2011**	**7/4/2011**	**7/14/2011**	**8/6/2011**	**8/14/2011**	**9/13/2011**	**9/27/2011**
Flow m^3/day (Cfs)	1.45	2	2.5	5	4	3	3	5	5	2.5	5	1.5	2	15	15	5	10	5	3.5	30	25	2.5	5	2.5
Total Iron	0.14	0.29	0.26	0.36	0.27	0.32	0.49	0.49	0.39	0.48	0.69	0.41	1.15	0.61	0.51	0.67	0.8	0.68	1.25	0.45	0.45	0.42	0.46	0.45
Dissolved Iron																								
Total Manganese[3]	0.2	0.16	0.18	0.22	0.21	0.17	0.26	0.29	0.26	0.23	0.46	0.26	0.02	0.45	0.33	0.42	0.61	0.31	0.56	0.12	0.13	0.3	0.21	0.23
Dissolved Manganese																								
Sulfates	63	71	59	49	70	61	80	70	60	75	60	50	42	51.8	78.6	60	77.4	35.6	35.3	74.3	56.3	56.3	96.3	56.3
pH (standard units)	8	7.9	7.2	7.7	7.6	7.6	7.4	7.5	7.8	7.8	7.6	7.5	7.3	7.5	8	8.1	7.9	7.8	8	7.9	7.7	7.6	8.3	8
Total Alkalinity to pH 4.5 (mg/L)	121.5	114.48	116.18	113.48	110.26	110.45	113.48	112.67	115.33	116.32	115.97	108.61	20.79	115.69	110.41	102.33	121.33	114.56	154.63	110.65	116.32	115.32	165.35	102.31
Acidity to pH 8.3 (mg/L)	0	>5	>5	>5	>5	>5	>5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total Suspended Solids	12	10	13	15	12	10	13	15	16	15	16	8	1	12	12	11	8	12	14	14	16	14	15	26
Total Dissolved Solids (mg/L)																								
TDS measured or calculated (mg/L)	256	297.6	405.12	199.68	247.68	272.64	241.28	268.8	275.84	398.72	321.28	198.4	537.6	291.84	446.08	548.48	455.68	362.88	291.84	441.6	462.72	291.84	350.72	502.4
Specific Conductance (umhos/CM)	400	465	633	312	387	426	377	420	431	623	502	310	840	456	697	857	712	567	456	690	723	456	548	785
Temp																								

Lower Double Branch - monitored semi-monthly, beginning in January 2002; No data for 4/01/02; 6/13/02 through 10/21/02 - Not Flowing

	SW Blue Hollow, 1765																							
Parameter	**10/12/2010**	**10/20/2010**	**11/9/2010**	**11/23/2010**	**12/10/2010**	**12/21/2010**	**1/10/2011**	**1/25/2011**	**2/8/2011**	**2/21/2011**	**3/11/2011**	**3/28/2011**	**4/7/2011**	**4/21/2011**	**5/11/2011**	**5/26/2011**	**6/9/2011**	**6/22/2011**	**7/4/2011**	**7/14/2011**	**8/6/2011**	**8/14/2011**	**9/13/2011**	**9/27/2011**
Flow m^3/day (Cfs)	1.5	5	3	2	2.5	2	3.5	1.5	3.5	3.5	5	3	6.5	3	5	2	2.5	5	0.25	1.5	4.25	3.5	5.5	3.75
Total Iron	0.56	0.63	0.72	0.44	0.63	0.44	0.72	0.42	0.61	0.42	0.63	0.32	0.53	0.74	0.8	0.69	0.78	0.59	0.18	0.8	0.46	0.42	0.86	0.23
Dissolved Iron																								
Total Manganese[3]	0.26	0.46	0.46	0.26	0.24	0.26	0.55	0.29	0.48	0.31	0.41	0.18	0.29	0.53	0.65	0.47	0.63	0.32	0.02	0.64	0.23	0.12	0.77	0.18
Dissolved Manganese																								
Sulfates	71	55	61	64	80	74	40	35	80	65	60	55	25.3	56.3	56.3	80	42.3	77.3	53.4	87.4	77.8	23.6	69.6	48.9
pH (standard units)	8	7.4	7.9	8	7.9	7.8	7.6	7.4	7.7	7.5	8	7.8	7.2	7.7	8	7.7	7.7	8	8.1	8	7.7	8	8	8.3
Total Alkalinity to pH 4.5 (mg/L)	116.45	116.48	117.15	116.48	110.45	112.41	113.1	112.36	112.39	115.61	118.97	112.39	115.59	118.94	116.97	112.3	105.69	118.97	20.04	134.56	112.64	105.63	112.36	123.65
Acidity to pH 8.3 (mg/L)	>5	>5	>5	>5	>5	>5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total Suspended Solids	14	14	12	13	12	13	16	10	15	14	16	12	12	13	11	13	11	15	2	18	15	11	15	13
Total Dissolved Solids (mg/L)																								
TDS measured or calculated (mg/L)	199.68	398.08	206.08	265.6	201.6	263.68	332.8	334.72	403.84	318.08	392.32	359.04	476.8	457.6	540.16	440.32	519.68	501.76	398.08	291.84	412.8	291.84	270.72	604.8
Specific Conductance (umhos/CM)	312	622	322	415	315	412	520	523	631	497	613	561	745	715	844	688	812	784	622	456	645	456	423	945
Temp																								

APPENDIX G-2
GRAPHS OF AVAILABLE SURFACE WATER DATA





Golder Associates

Denver, Colorado

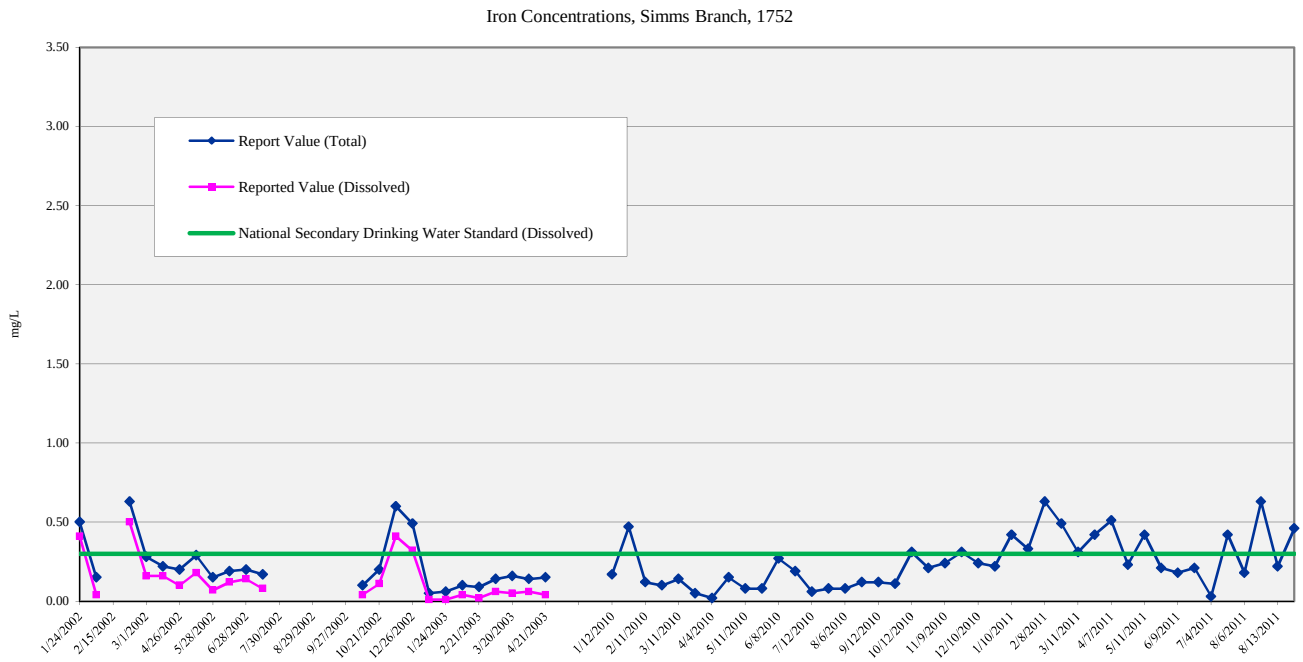
TITLE

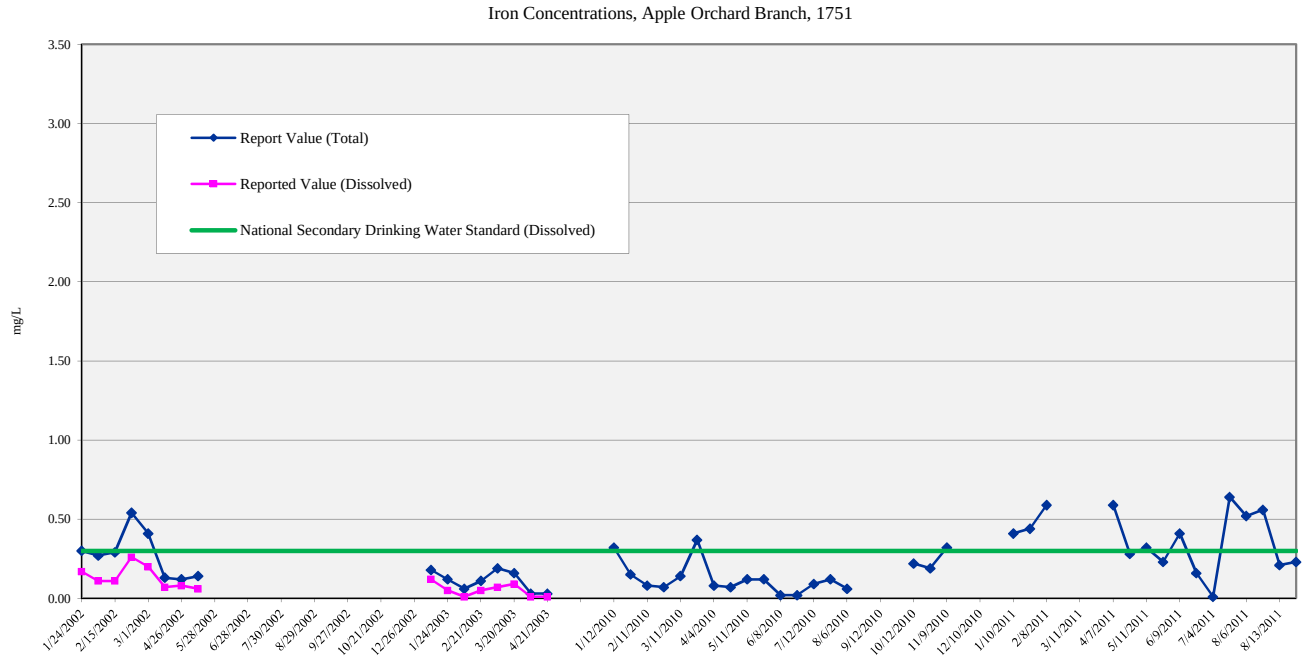
Surface Water Monitoring
Iron Concentrations

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**	
CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.	
REVIEWED **MWB**	FILE NO. 103-81786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. **App G-2.1**	





Golder Associates Denver, Colorado

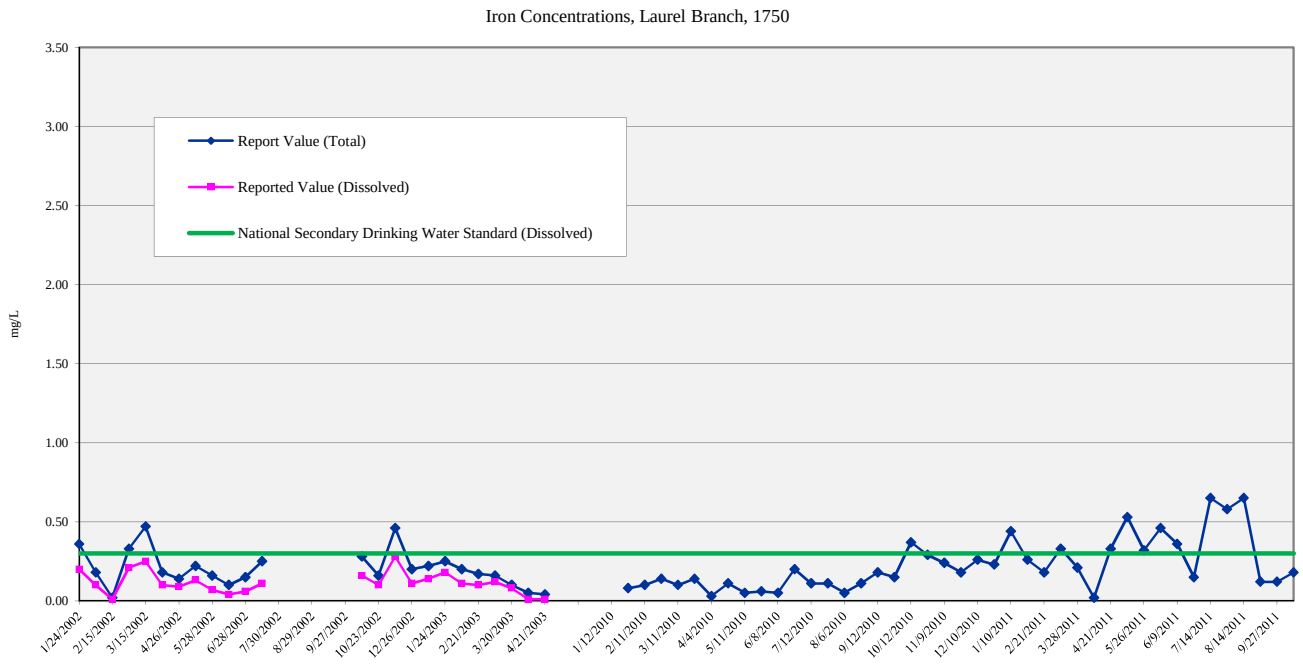
TITLE

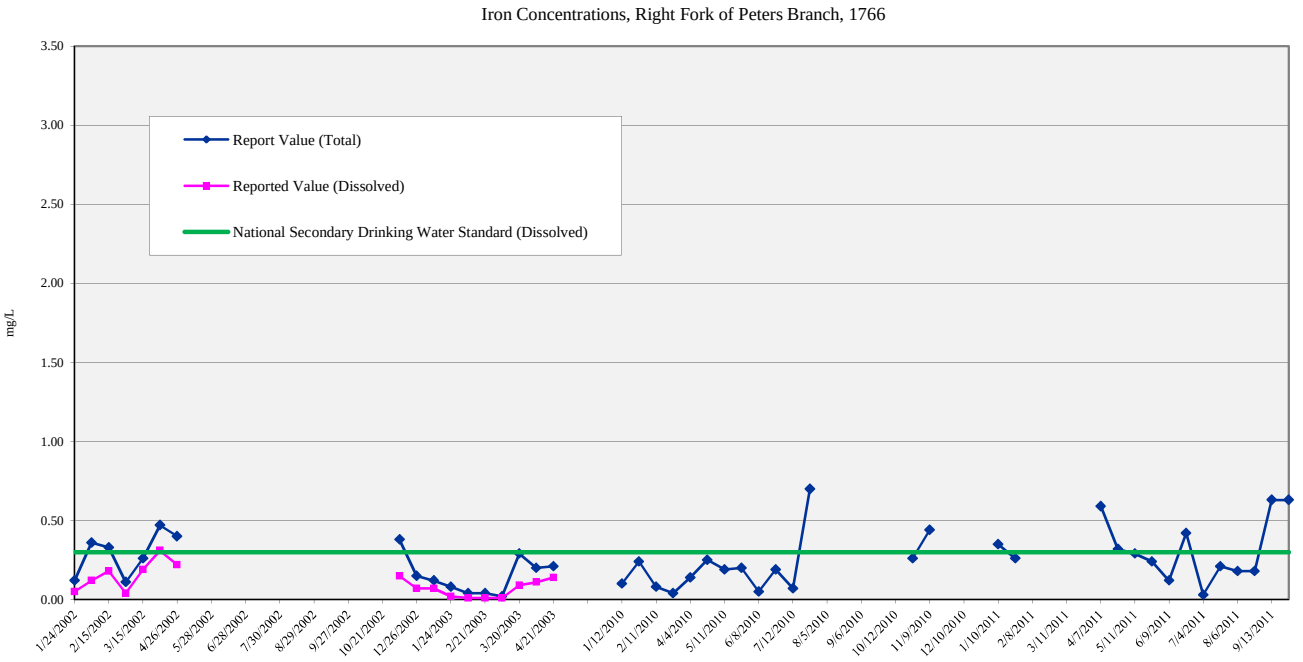
Surface Water Monitoring
Iron Concentrations

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**	
CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.	
REVIEWED **MWB**	FILE NO. 103817 86 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. **App G-2.2**	



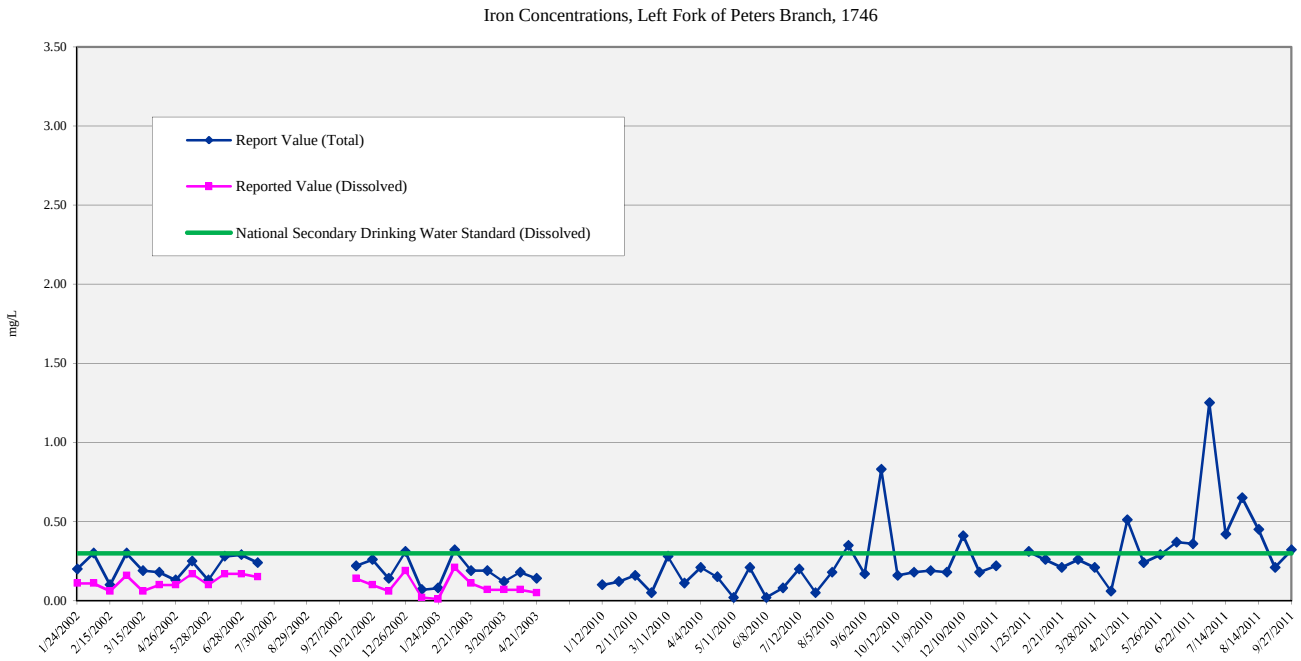


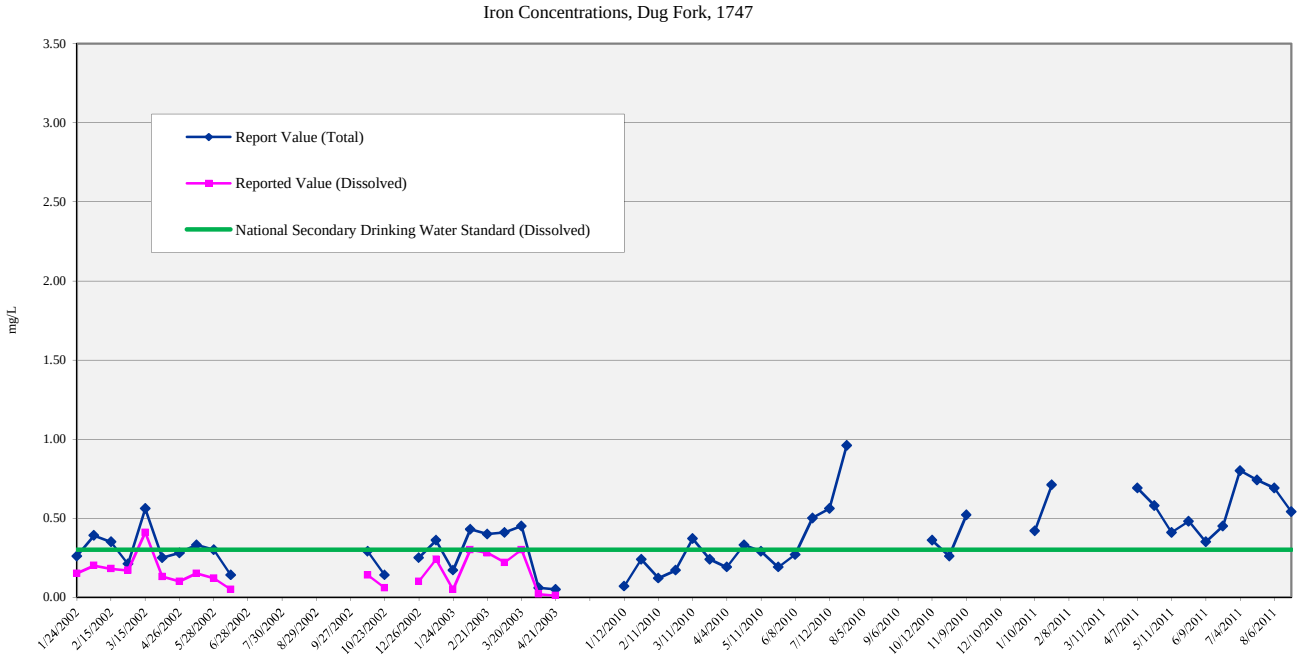
Golder Associates — Denver, Colorado

TITLE: **Surface Water Monitoring Iron Concentrations**

CLIENT/PROJECT: **Bledsoe Coal Corporation, Bledsoe EA (KYES-53865), Leslie County, KY**

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
REVIEWED MWB	FILE NO. 10381786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. App G-2.3	





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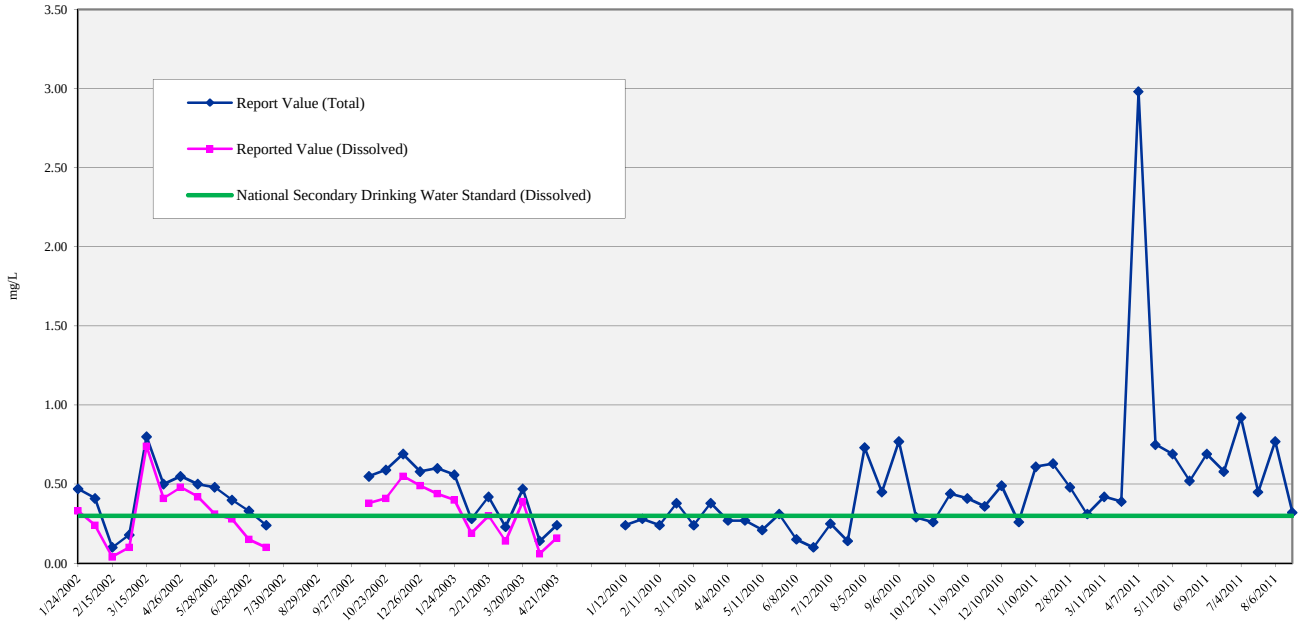
Surface Water Monitoring
Iron Concentrations

CLIENT/PROJECT

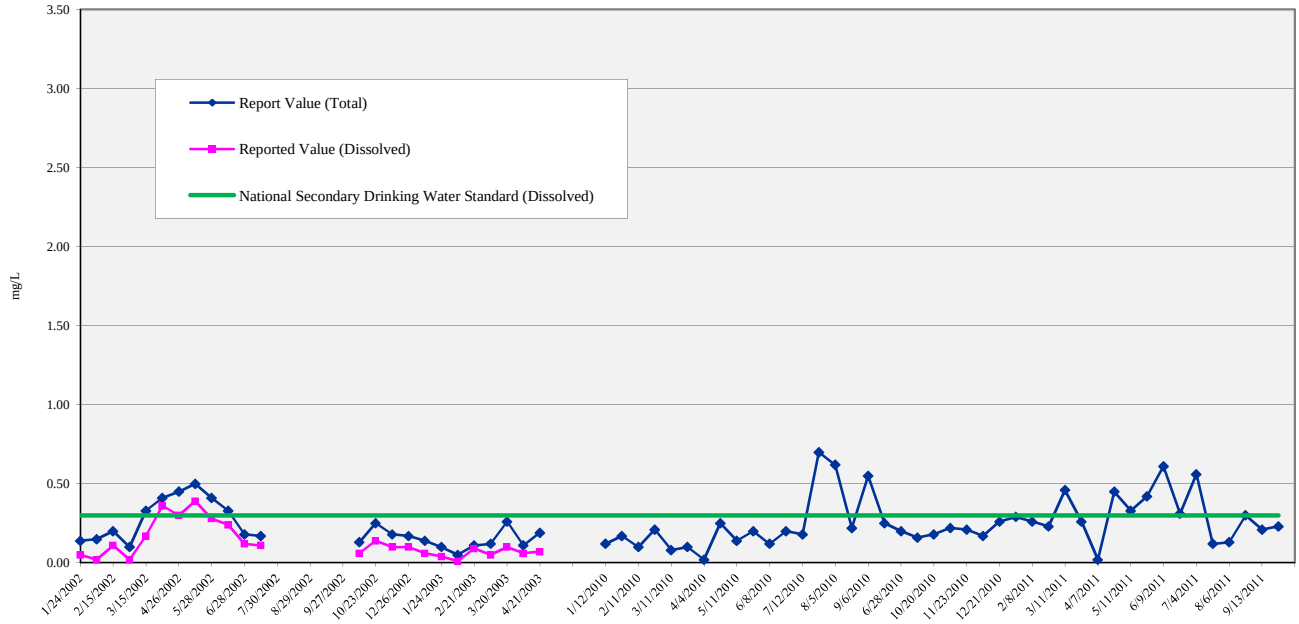
Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**
CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.
REVIEWED **MWB**	FILE NO. 103-81786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. **App G-2.4**

Iron Concentrations, Main Branch of Peters Branch, 1748



Iron Concentrations, Marion Branch, 1749

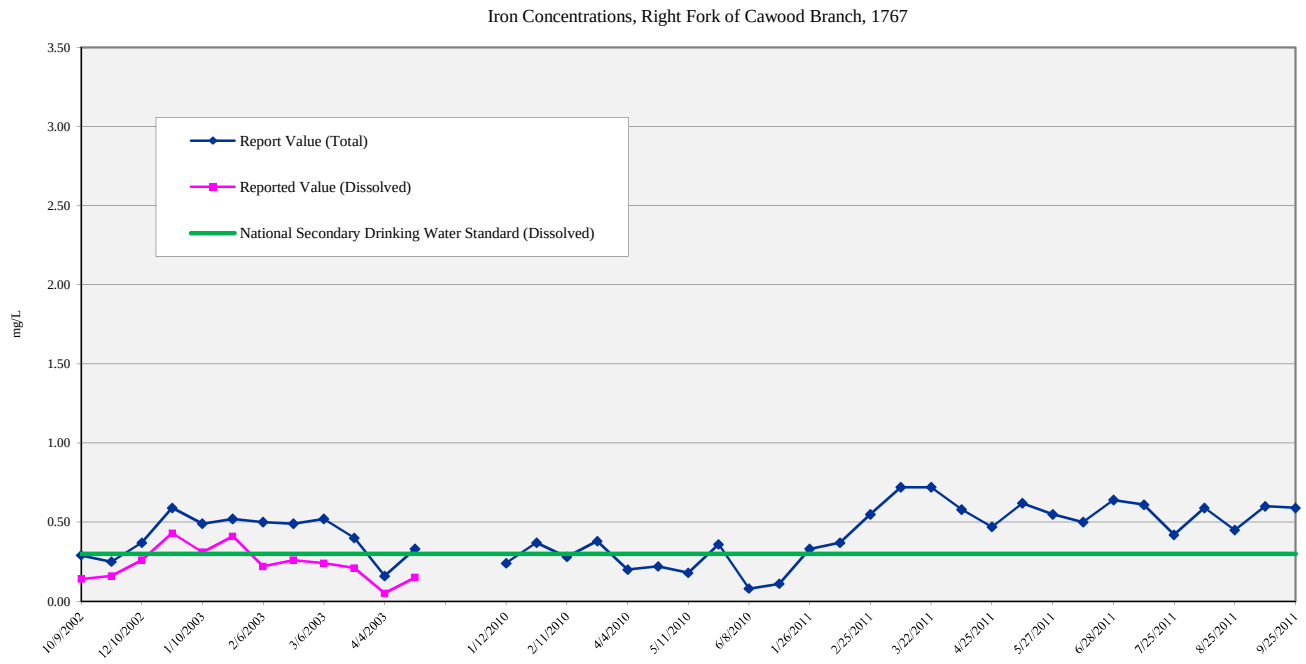


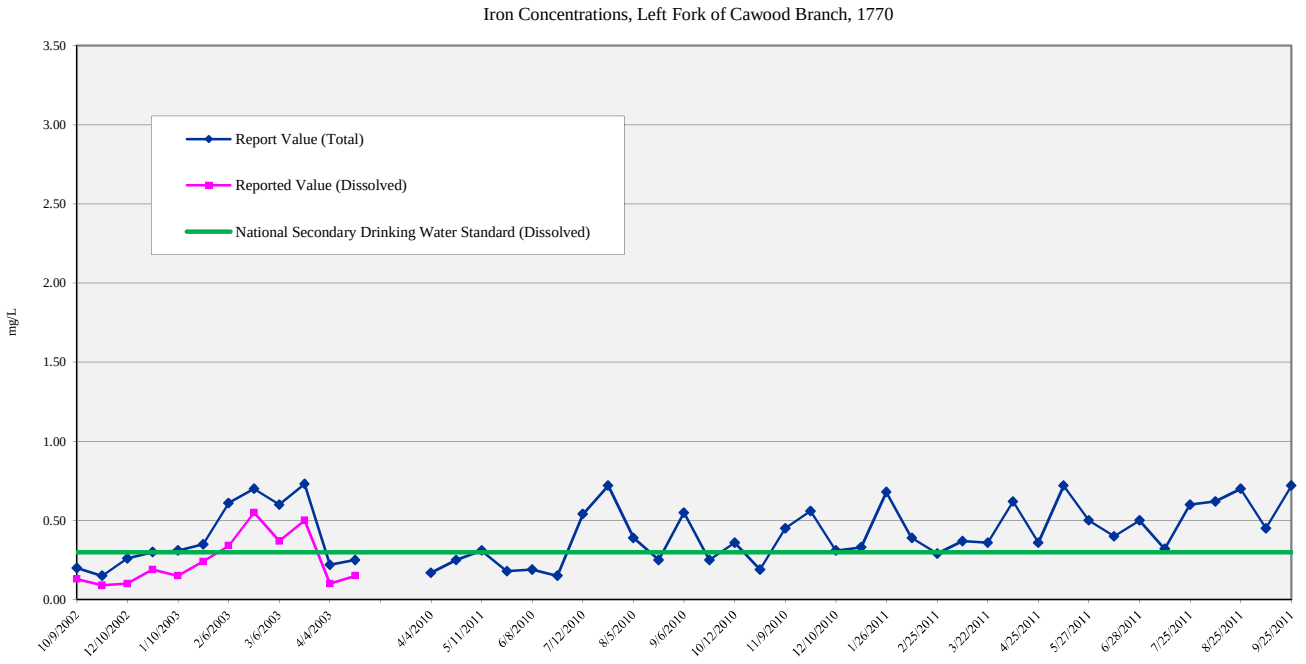
Golder Associates — Denver, Colorado

TITLE: **Surface Water Monitoring Iron Concentrations**

CLIENT/PROJECT: **Bledsoe Coal Corporation, Bledsoe EA (KYES-53865), Leslie County, KY**

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
REVIEWED MWB	FILE NO. 10381786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. App G-2.5	





Golder Associates Denver, Colorado

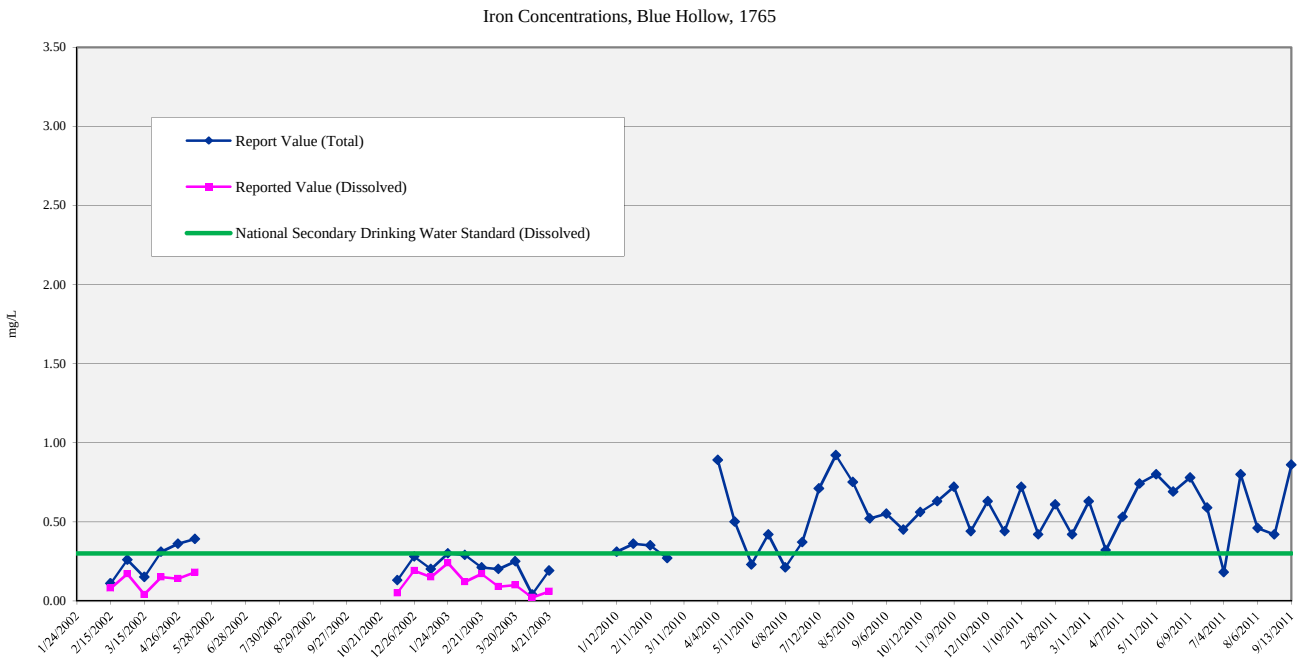
TITLE

Surface Water Monitoring
Iron Concentrations

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
REVIEWED MWB	FILE NO. 10381786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. App G-2.6	



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Denver, Colorado

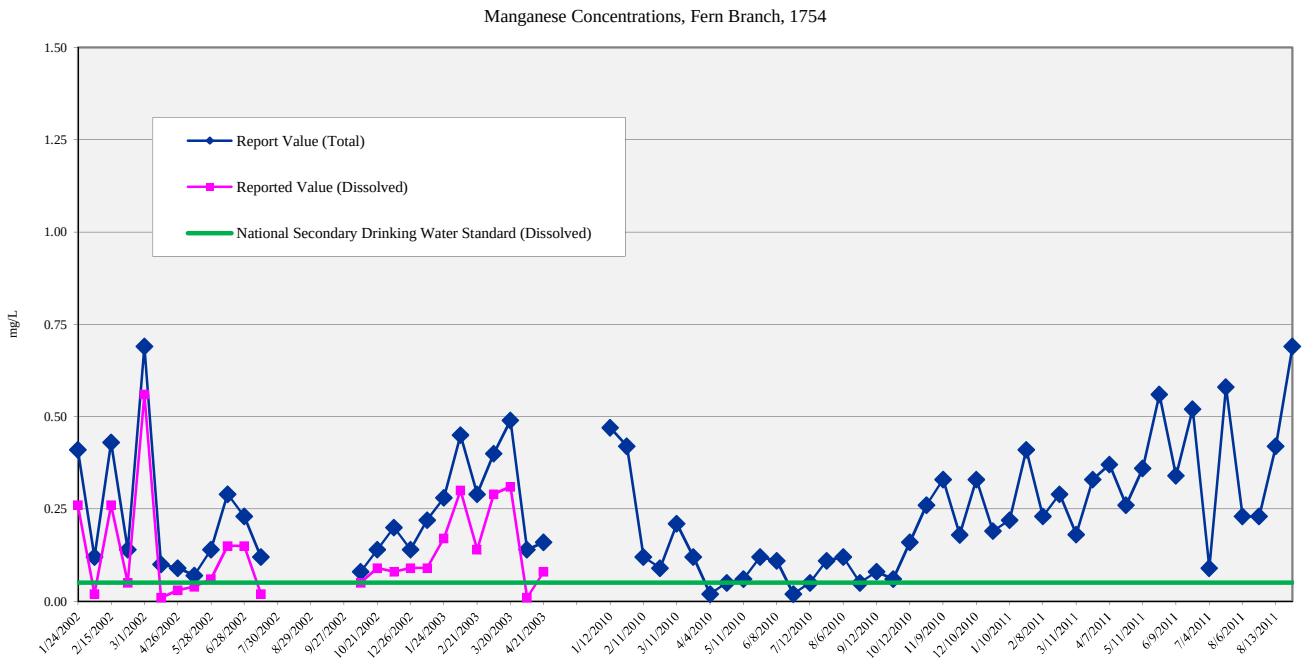
TITLE

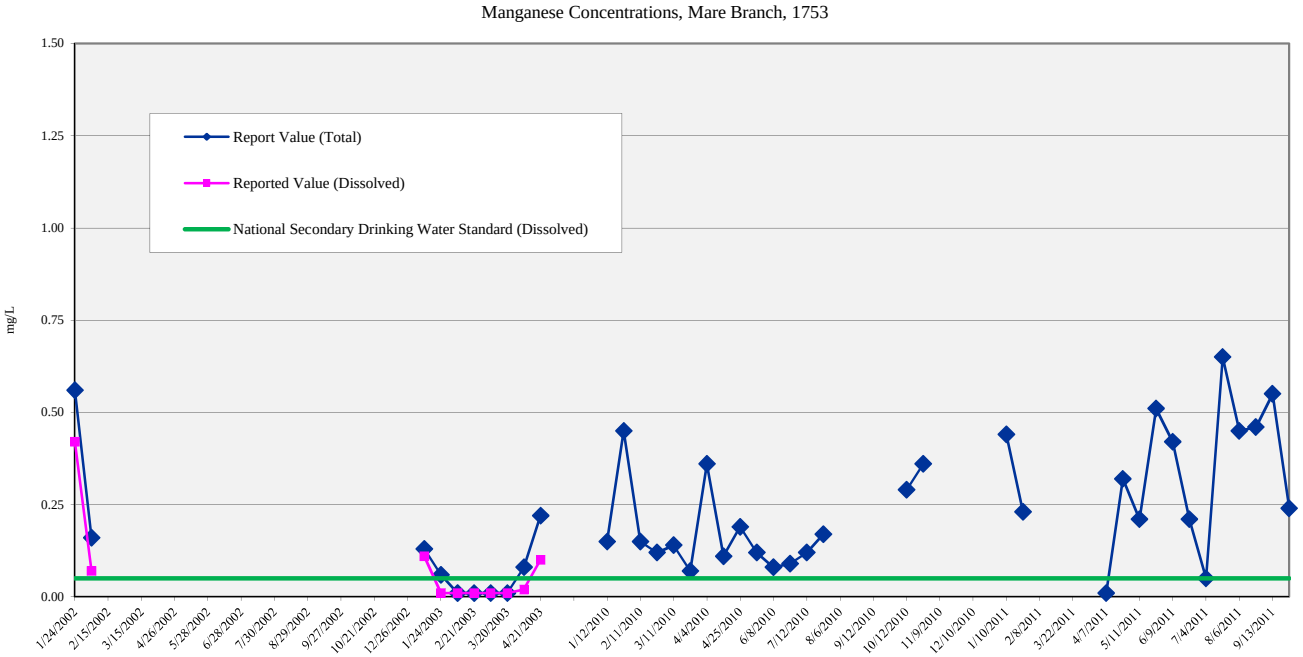
Surface Water Monitoring
Iron Concentrations

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN	SEM	DATE	Jun-12	JOB NO.	103-81786
CHECKED	EJP	SCALE	As Shown	DWG NO./REV. NO.	
REVIEWED	MWB	FILE NO.	10381786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO.	App G-2.7





Golder Associates

Denver, Colorado

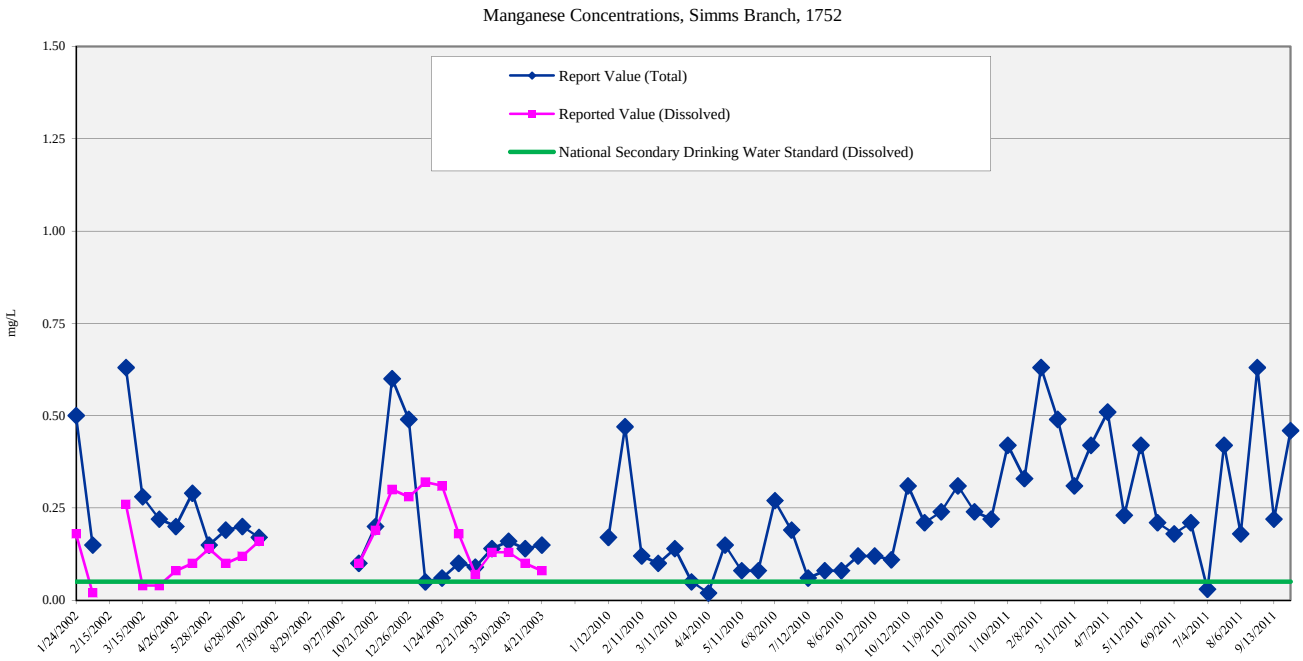
TITLE

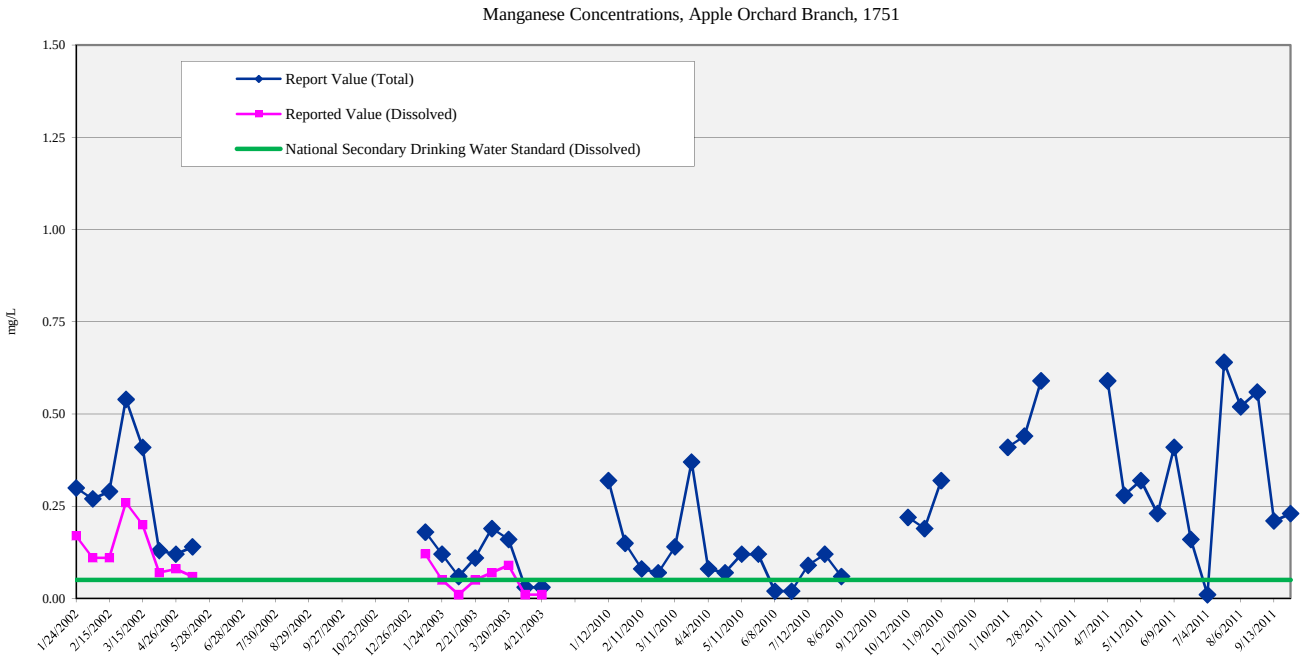
Surface Water Monitoring
Manganese Concentrations

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**	
CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.	
REVIEWED **MWB**	FILE NO. 103-81786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. **App G-2.8**	





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Denver, Colorado

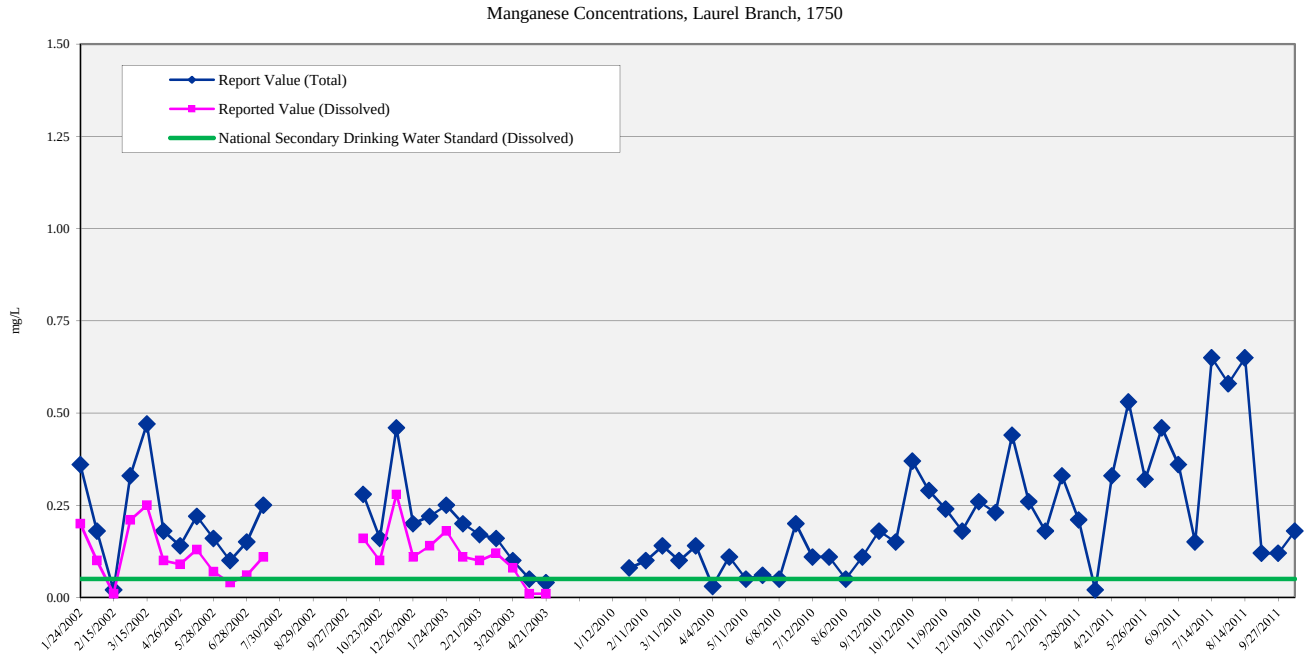
TITLE

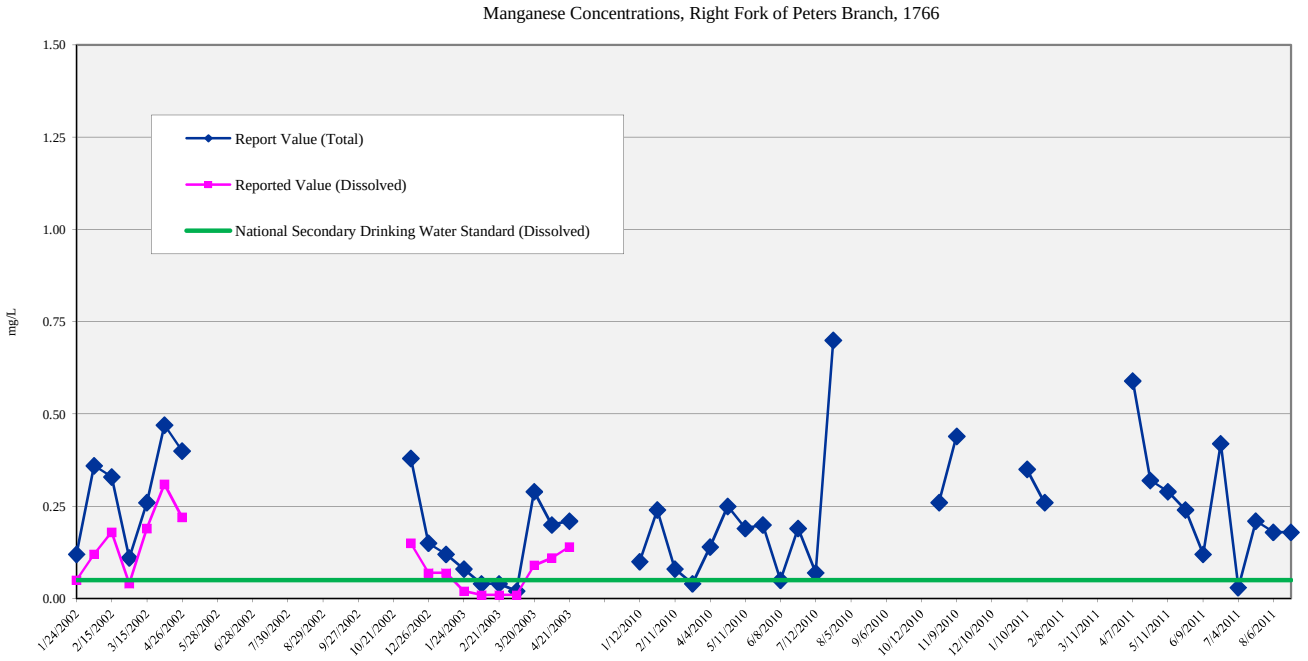
Surface Water Monitoring
Manganese Concentrations

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**	
CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.	
REVIEWED **MWB**	FILE NO. 103-81786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. **App G-2.9**	





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Denver, Colorado

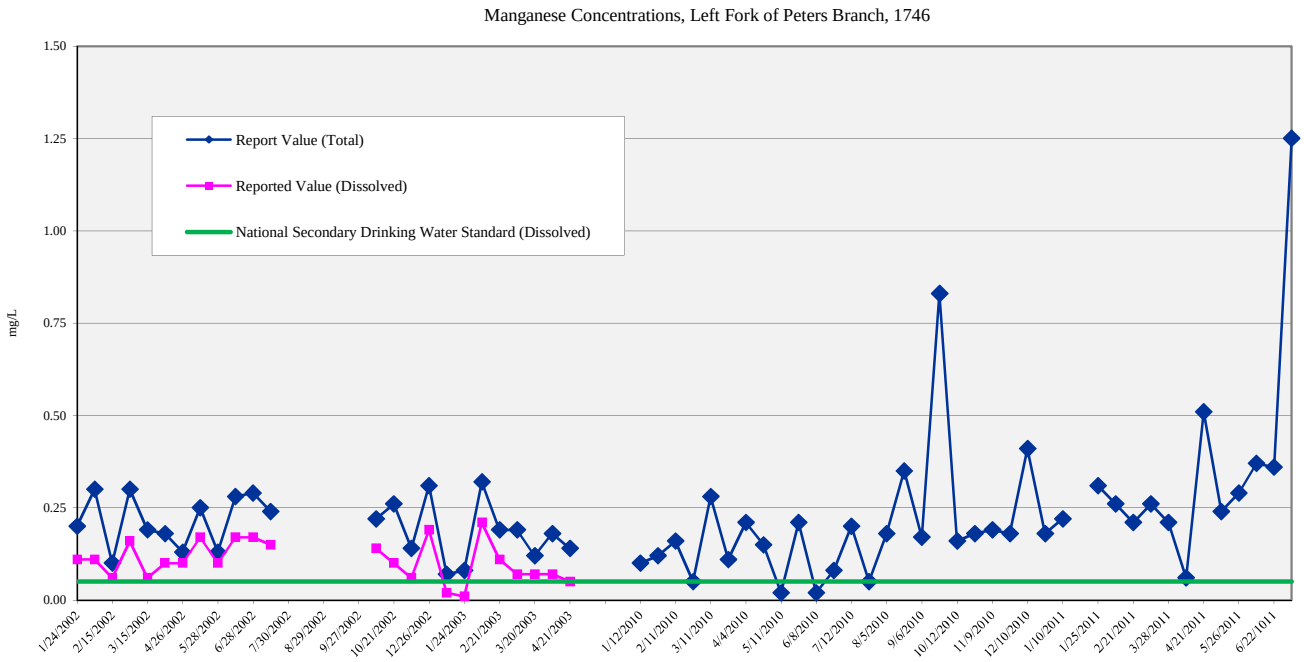
TITLE

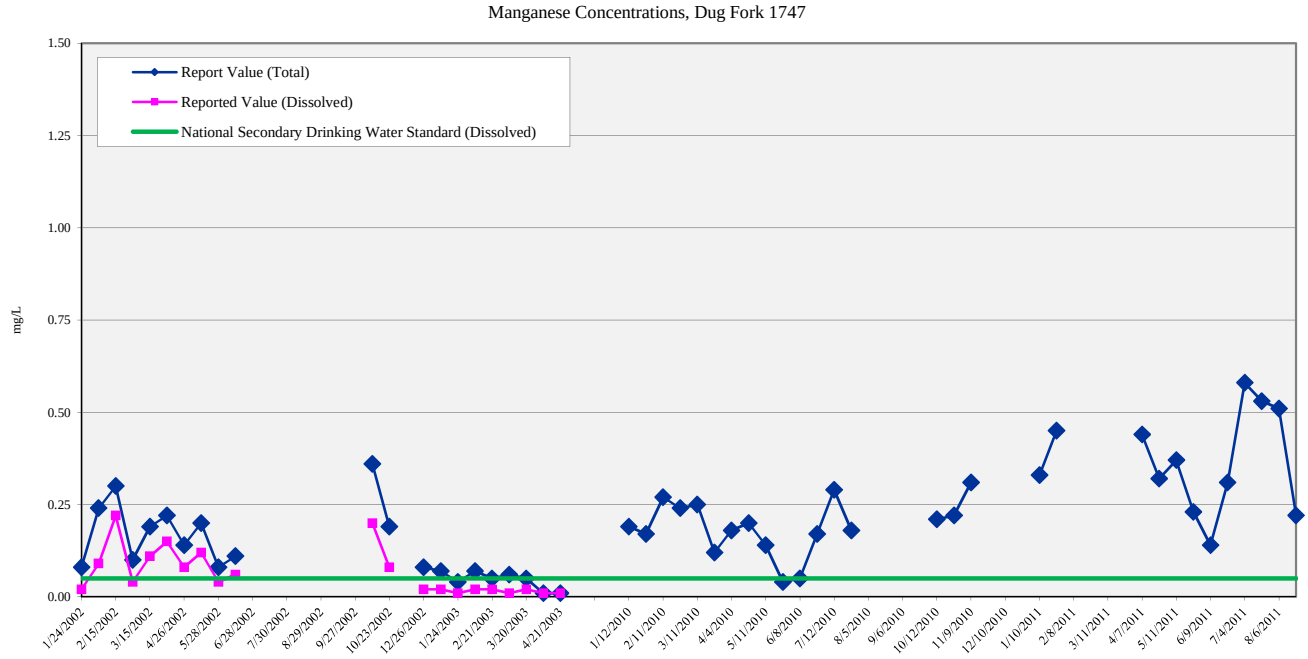
Surface Water Monitoring
Manganese Concentrations

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**
CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.
REVIEWED **MWB**	FILE NO. 103817786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. **App G-2.10**





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Denver, Colorado

TITLE

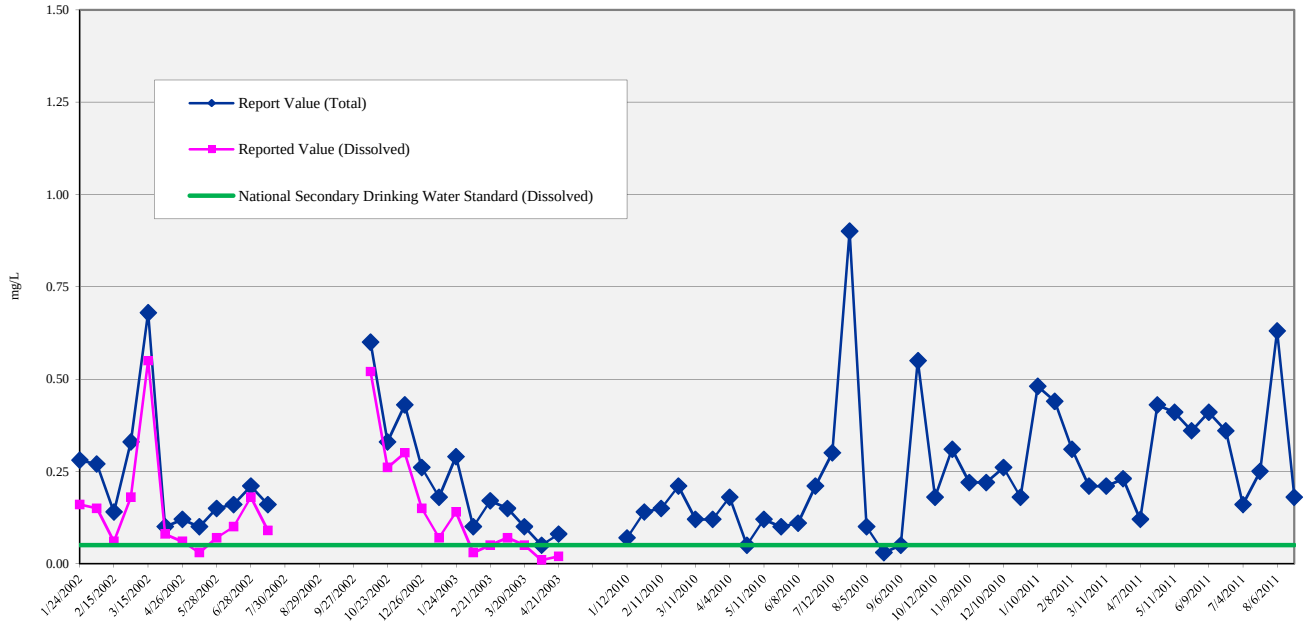
Surface Water Monitoring
Manganese Concentrations

CLIENT/PROJECT

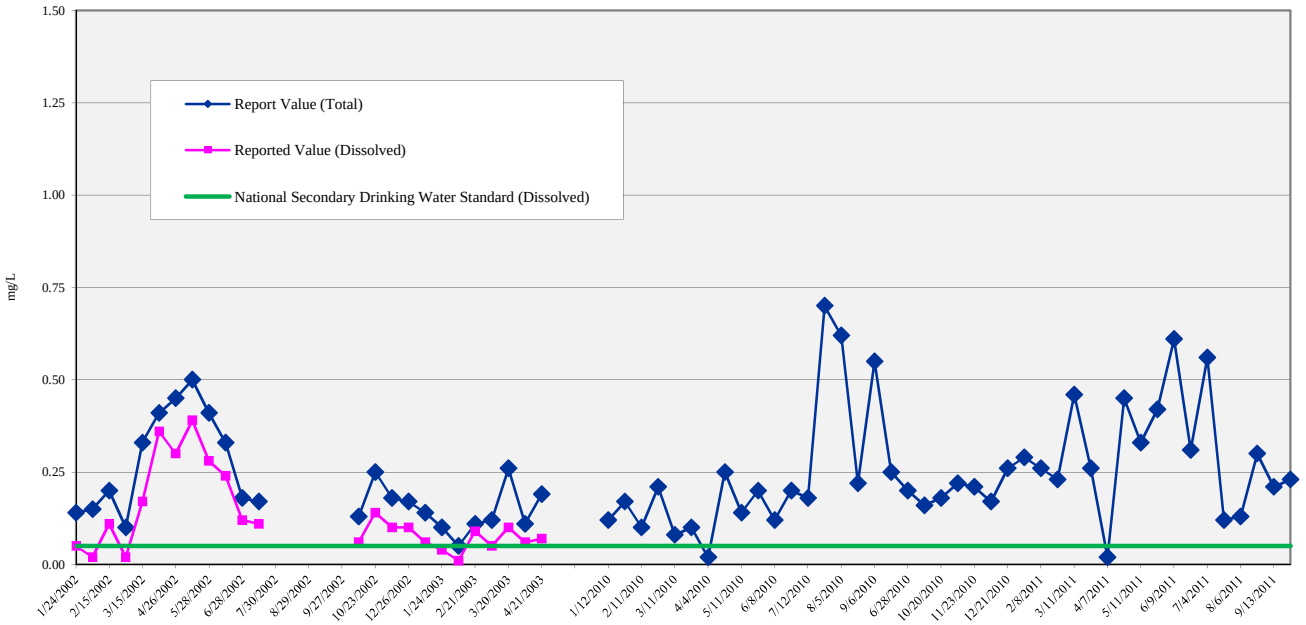
Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
REVIEWED MWB	FILE NO. 103-81786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. App G-2.11	

Manganese Concentrations, Main Branch of Peters Branch, 1748



Manganese Concentrations, Marion Branch, 1749



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Denver, Colorado

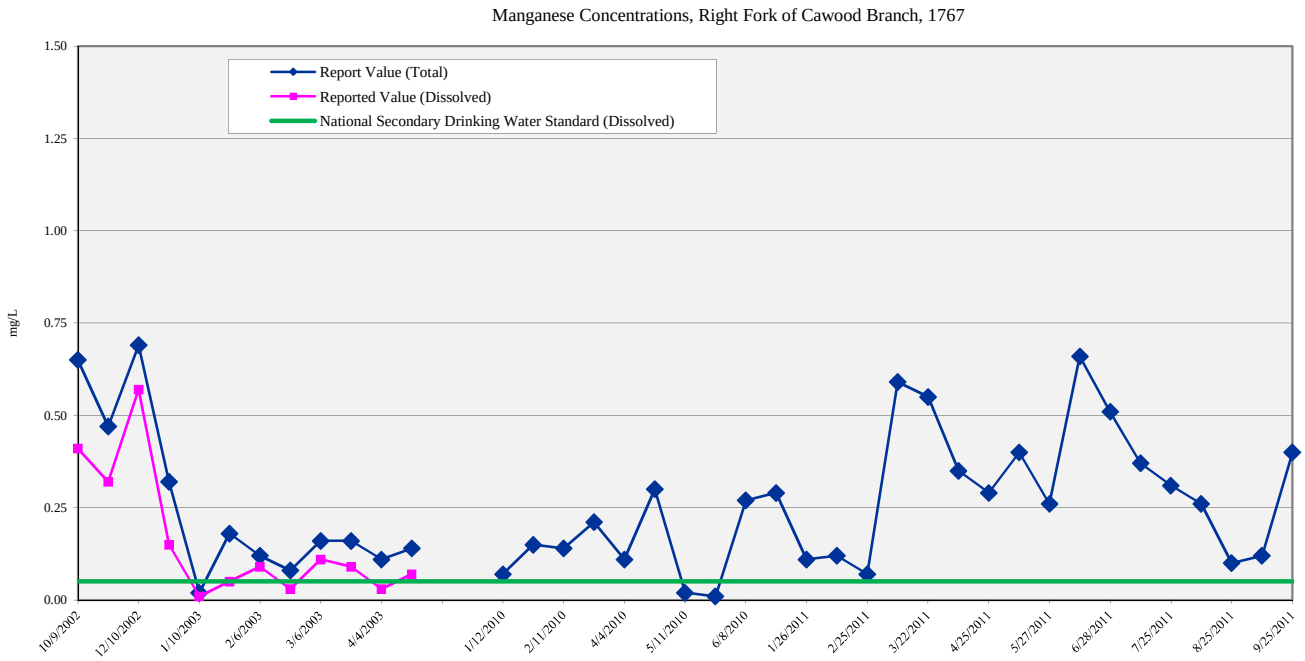
TITLE

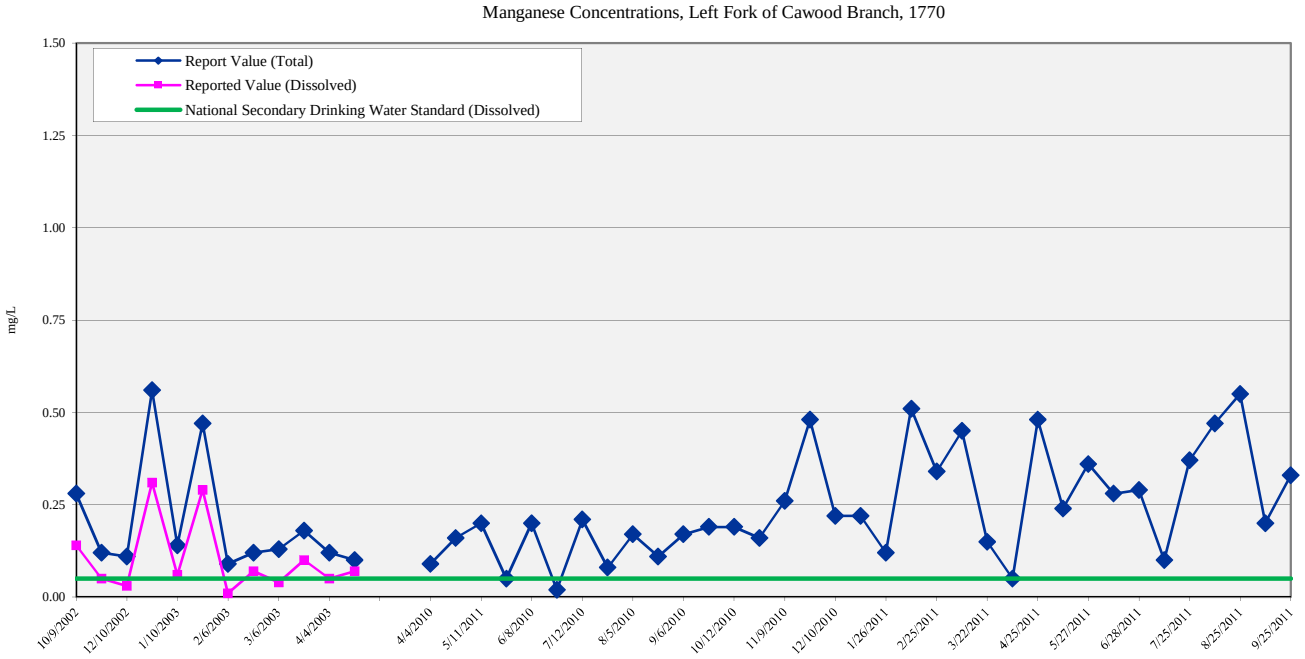
Surface Water Monitoring
Manganese Concentrations

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**	
CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.	
REVIEWED **MWB**	FILE NO. 103817786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. **App G-2.12**	





Golder Associates — Denver, Colorado

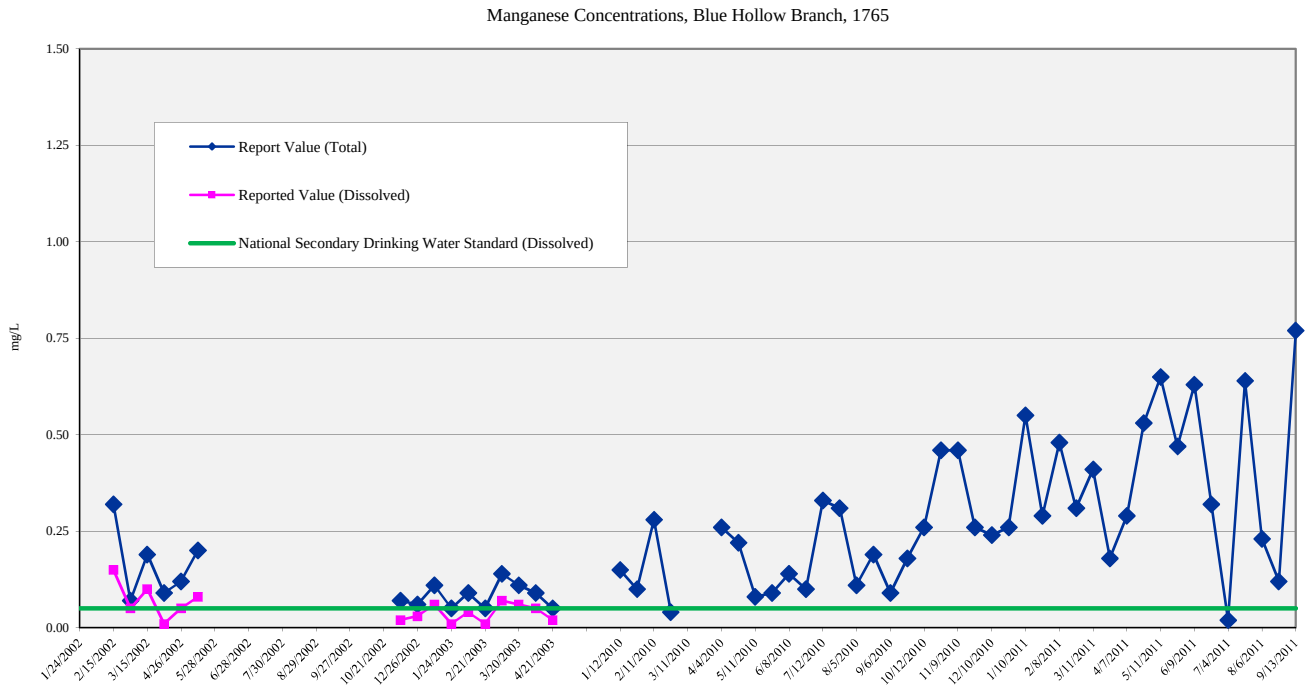
TITLE

Surface Water Monitoring
Manganese Concentrations

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
REVIEWED MWB	FILE NO. 10381786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. App G-2.13	



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Denver, Colorado

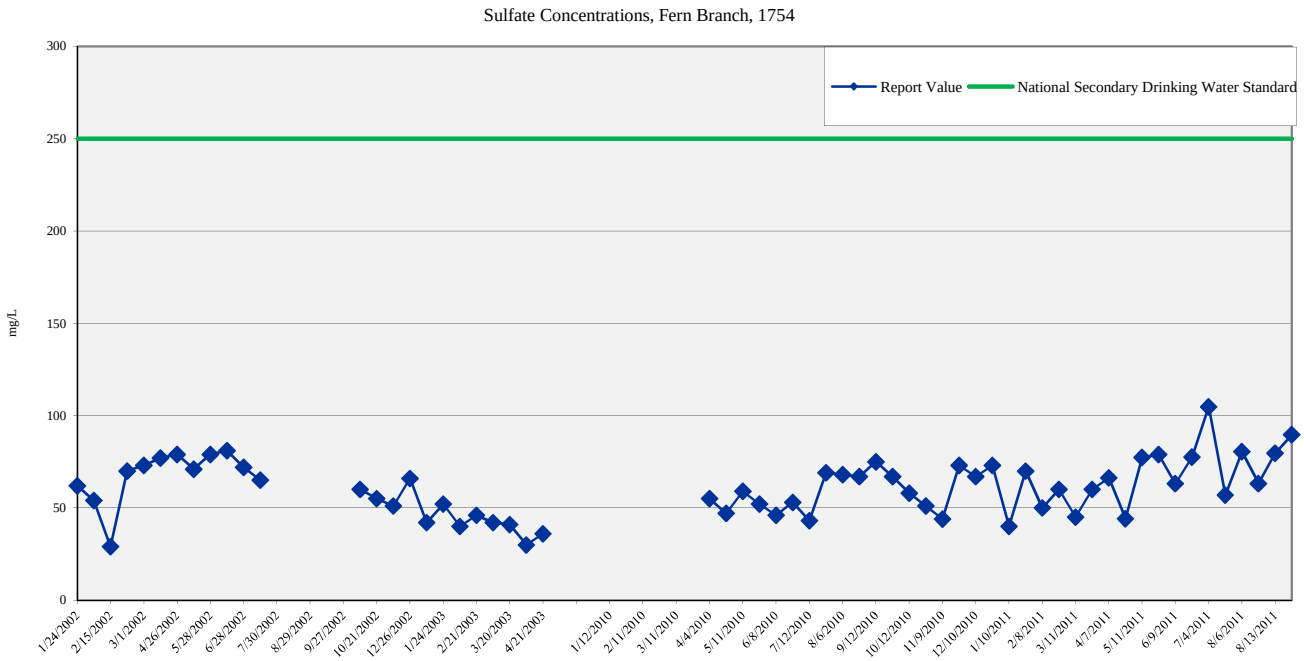
TITLE

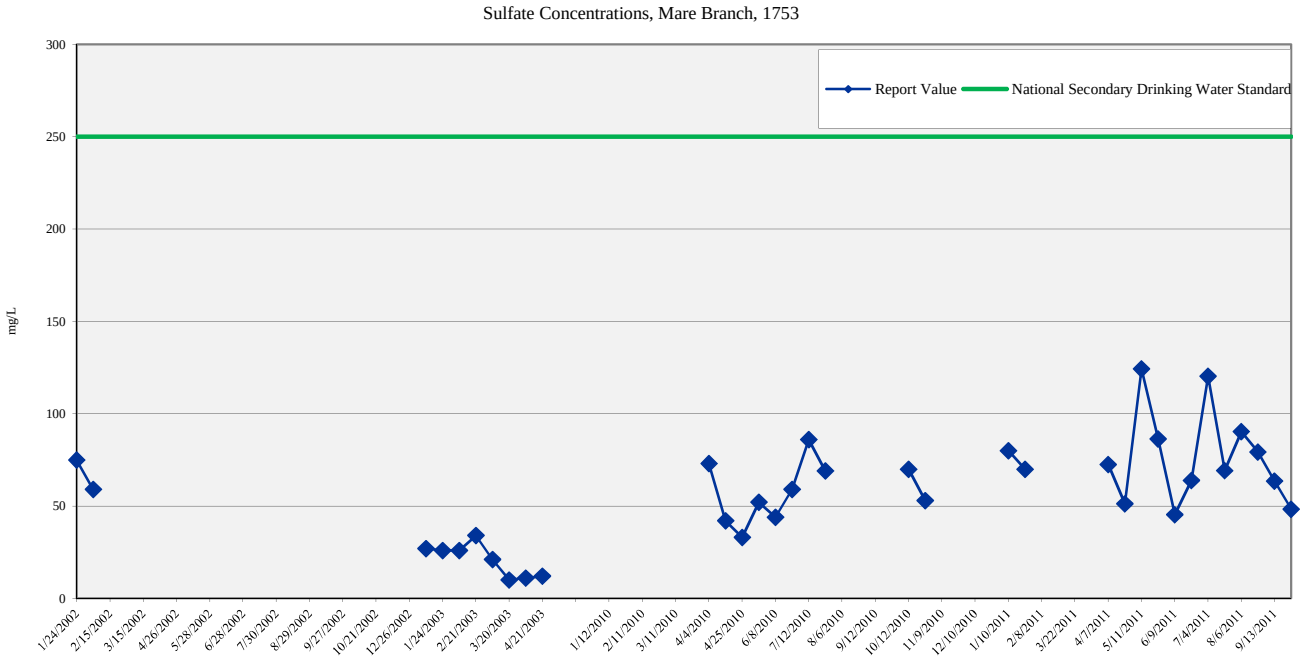
Surface Water Monitoring
Manganese Concentrations

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN	SEM	DATE	Jun-12	JOB NO.	103-18786
CHECKED	EJP	SCALE	As Shown	DWG NO./REV. NO.	
REVIEWED	MWB	FILE NO.	10381786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO.	App G-2.14





Golder Associates Denver, Colorado

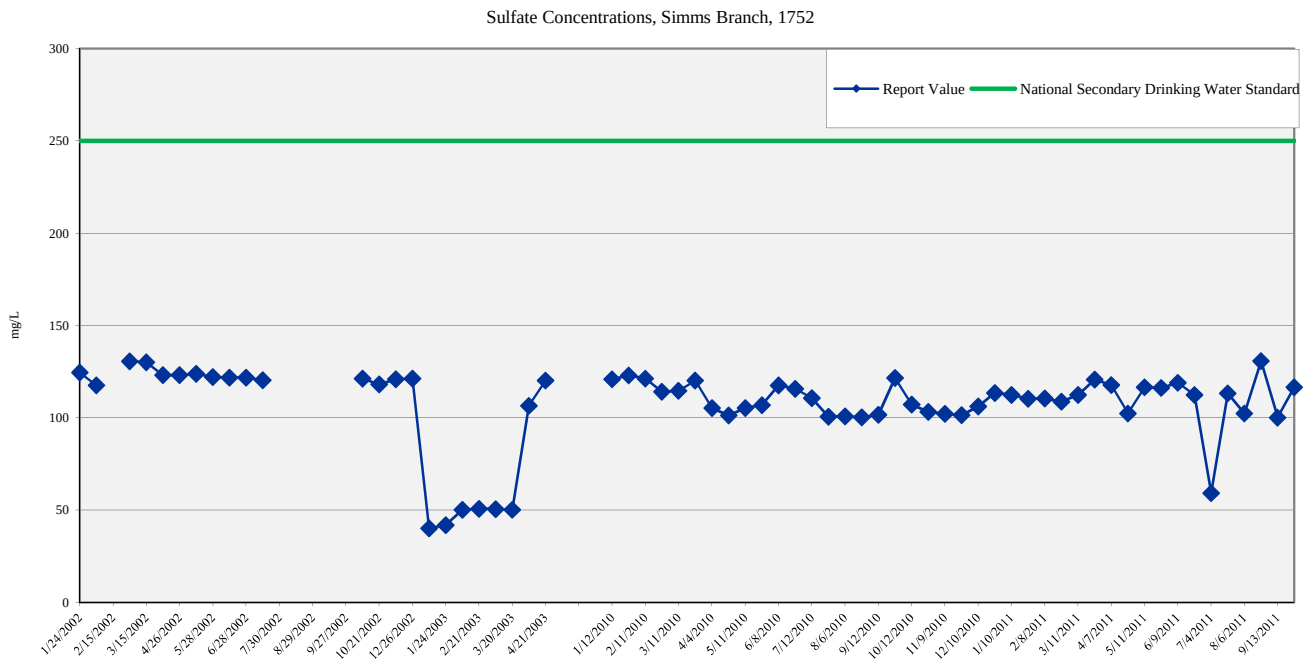
TITLE

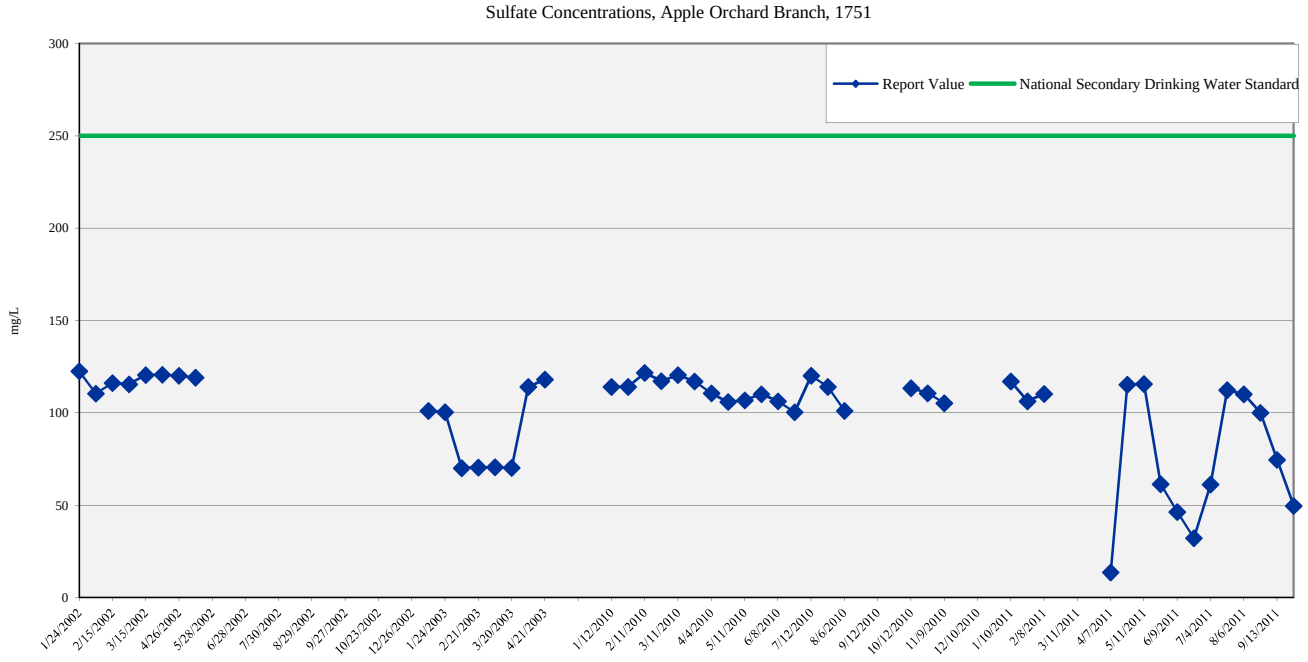
Surface Water Monitoring
Sulfate Concentrations

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
REVIEWED MWB	FILE NO. 103-81786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. App G-2.15	





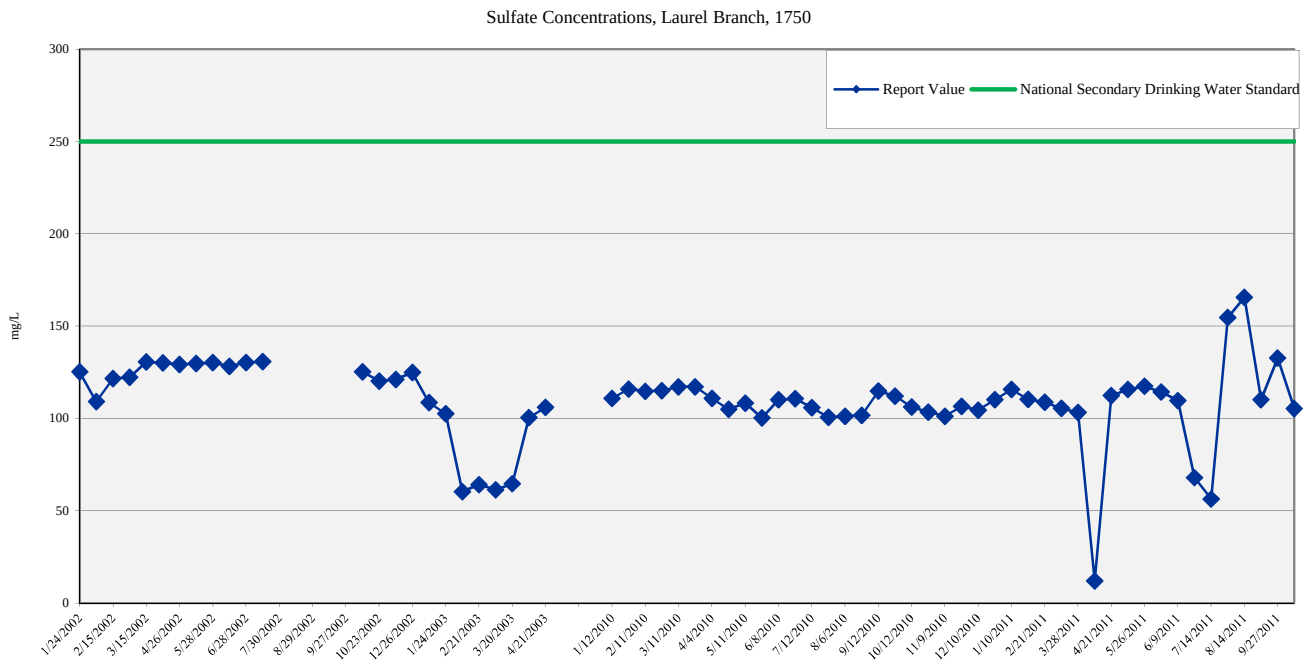
Golder Associates

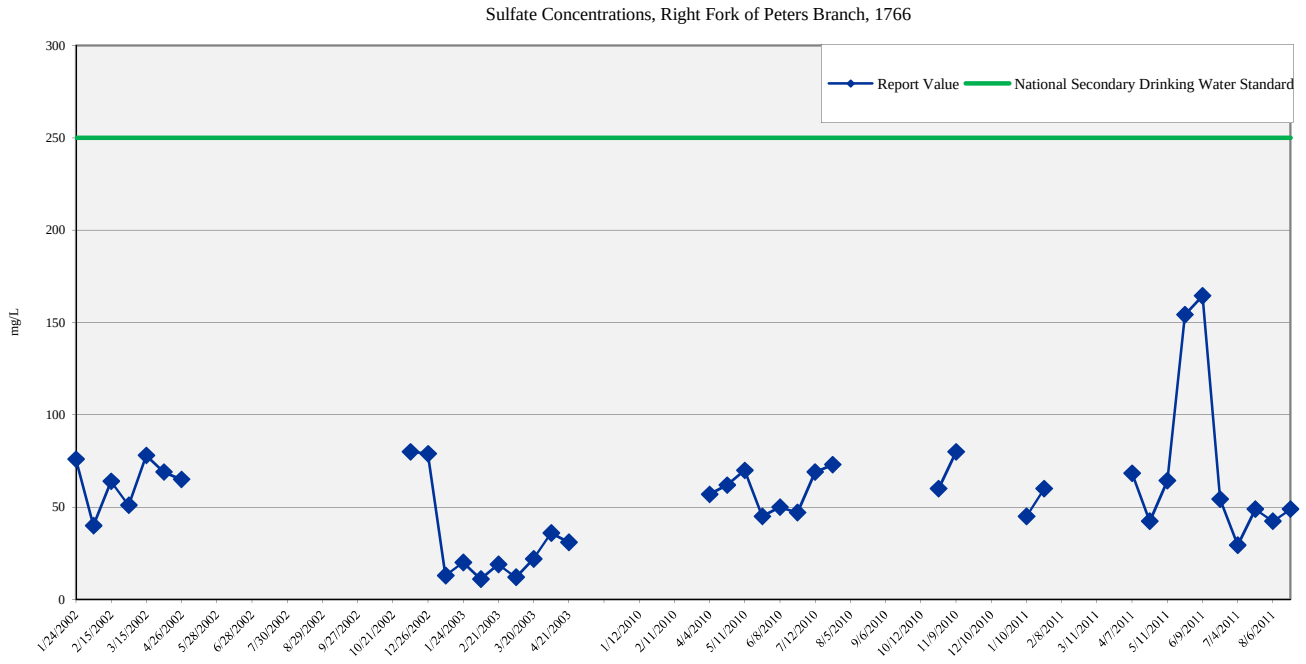
Denver, Colorado

TITLE

Surface Water Monitoring
Sulfate Concentrations

CLIENT/PROJECT			
Bledsoe Coal Corporation **Bledsoe EA (KYES-53865)** **Leslie County, KY**	DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**
	CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.
	REVIEWED **MWB**	FILE NO. 103-81786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. **App G-2.16**





Golder Associates

Denver, Colorado

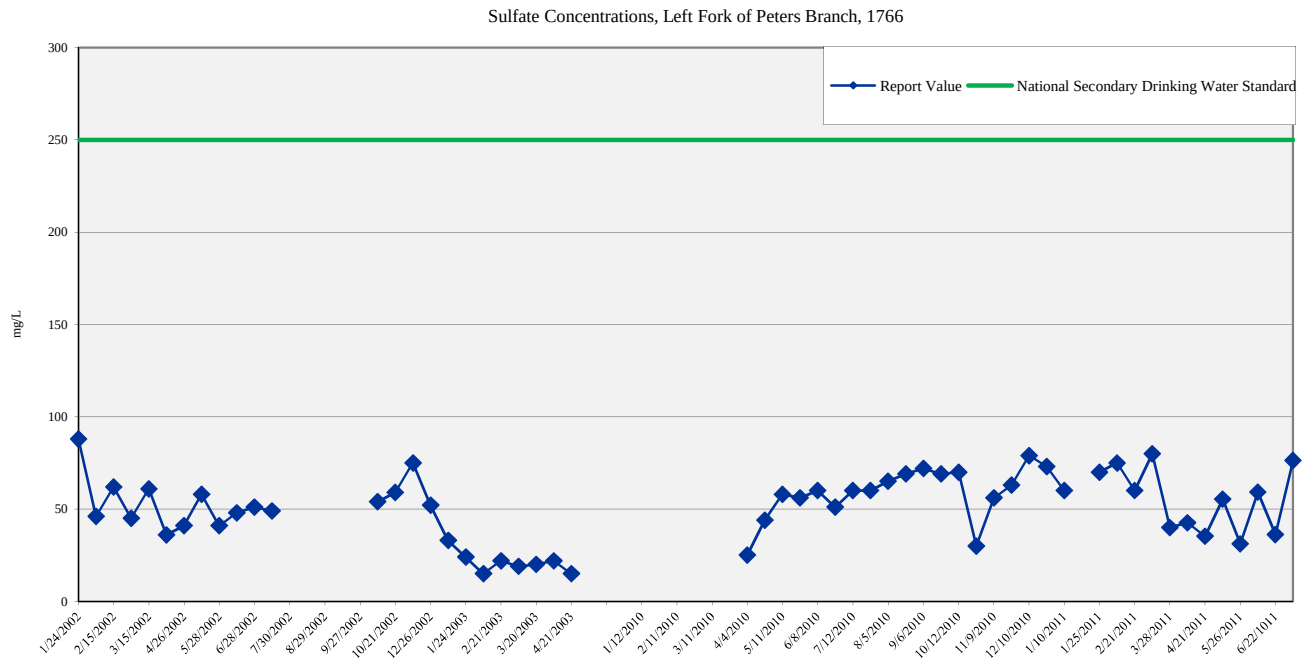
TITLE

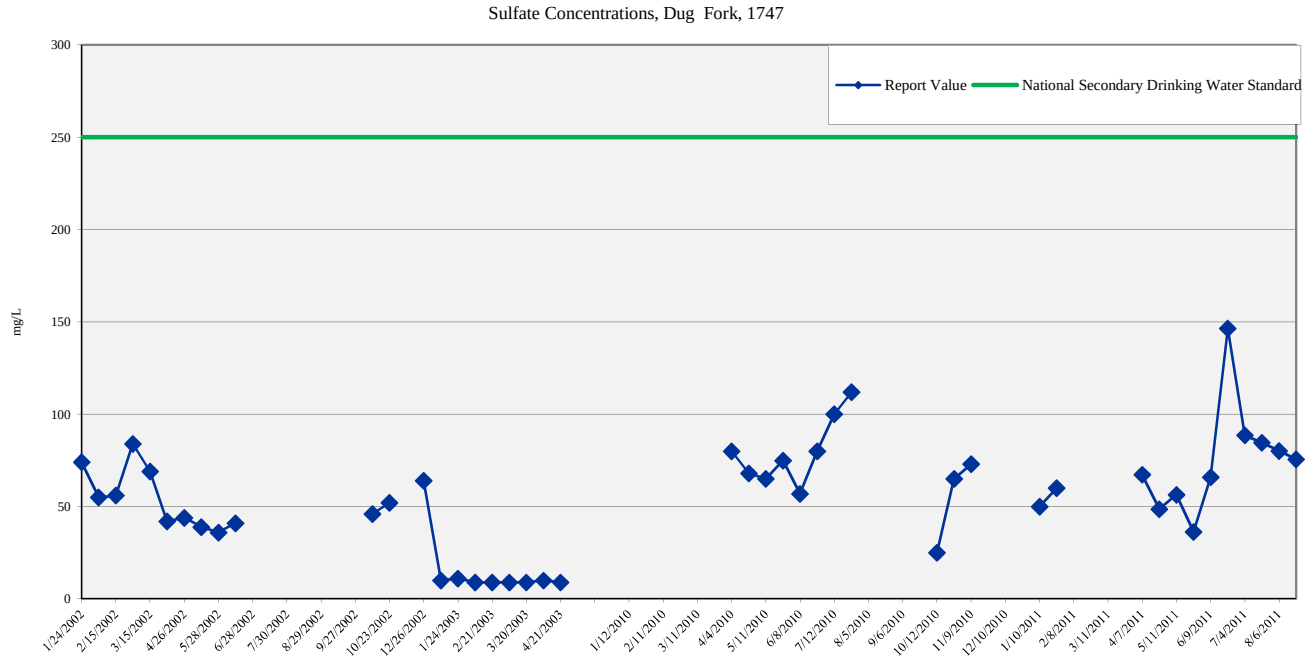
Surface Water Monitoring
Sulfate Concentrations

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**
CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.
REVIEWED **MWB**	FILE NO. 103-81786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. **App G-2.17**





Golder Associates Denver, Colorado

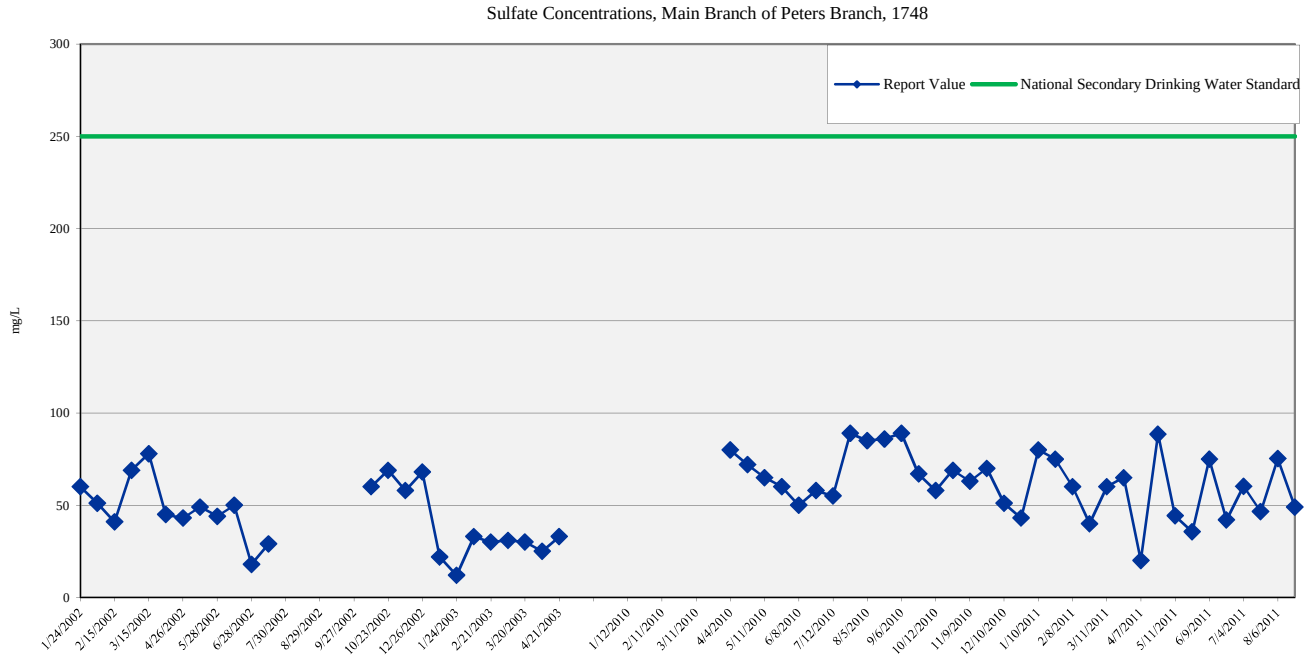
TITLE

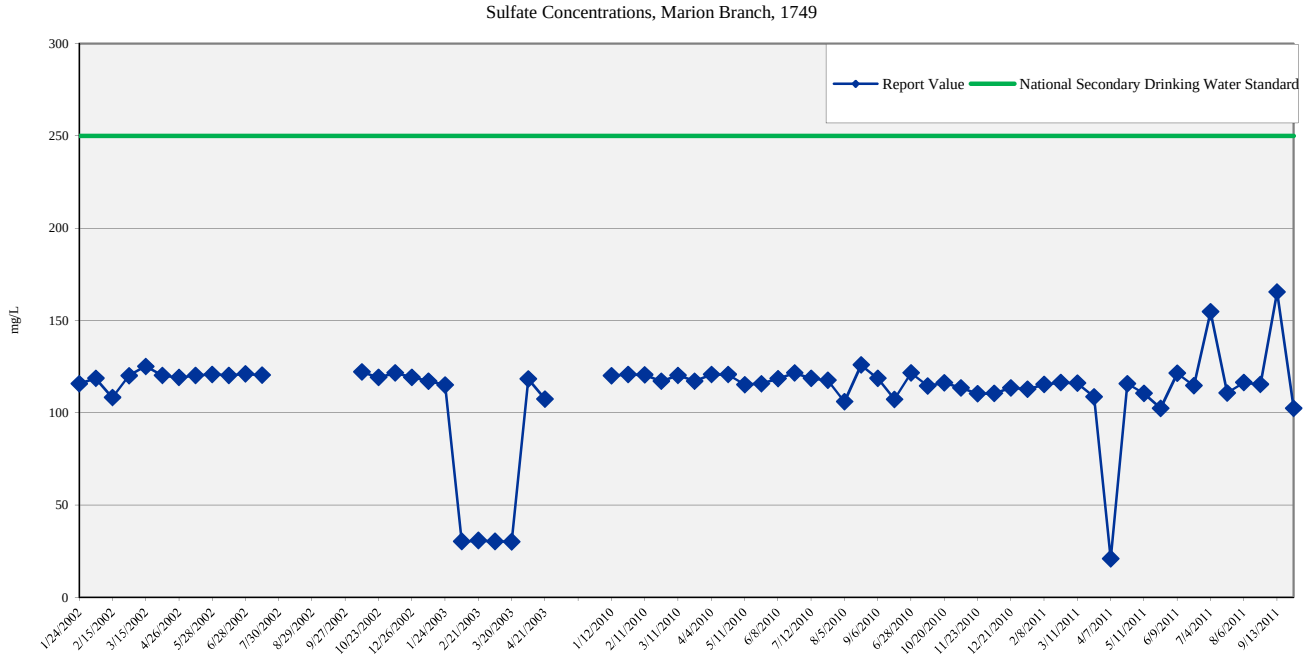
Surface Water Monitoring
Sulfate Concentrations

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
REVIEWED MWB	FILE NO. 103-81786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. App G-2.18	





Golder Associates

Denver, Colorado

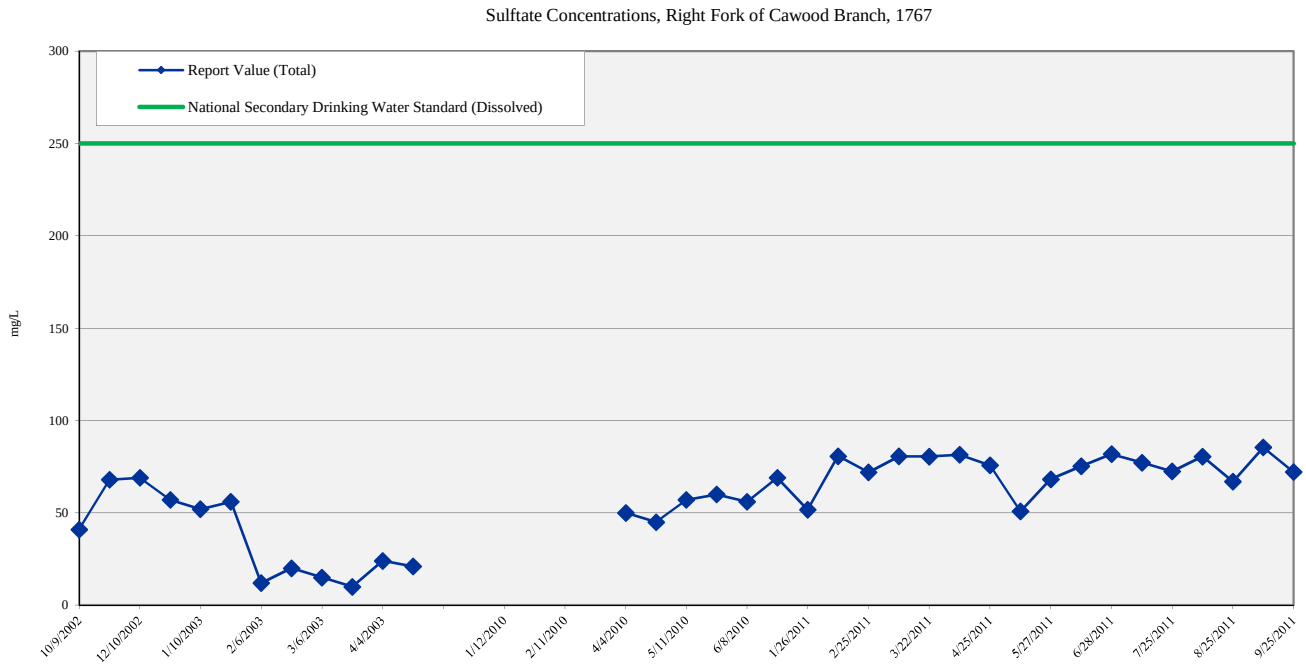
TITLE

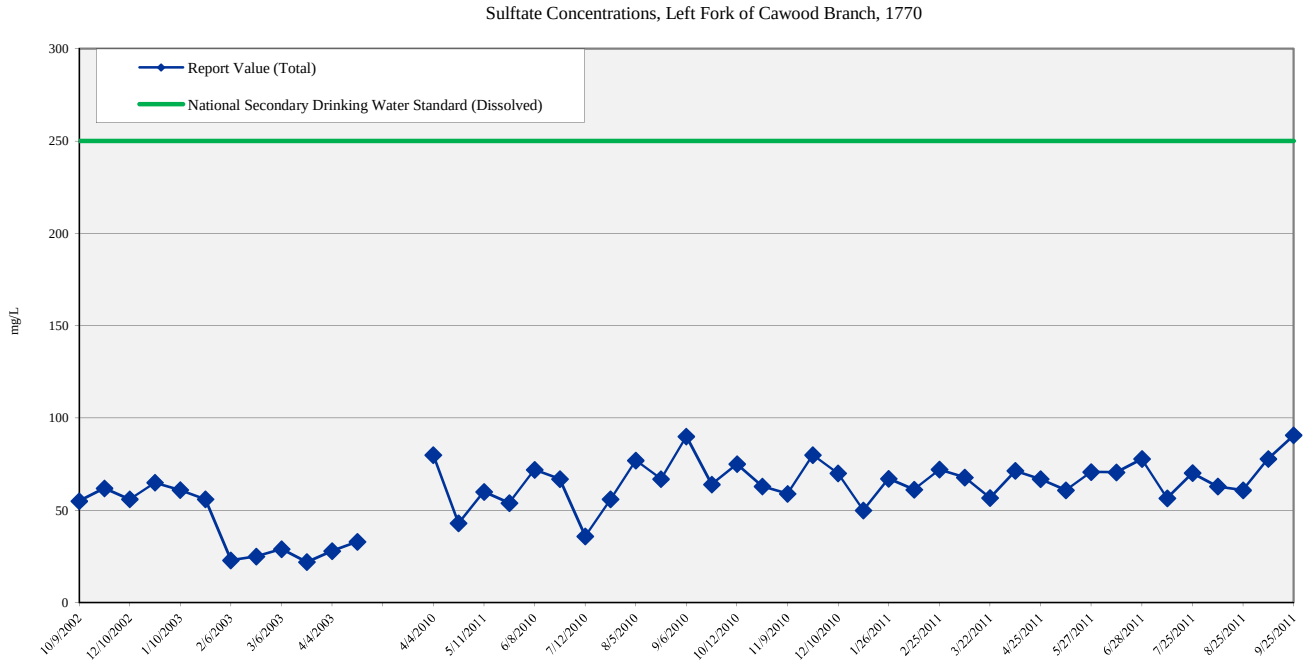
Surface Water Monitoring
Sulfate Concentrations

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
REVIEWED MWB	FILE NO. 10381786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. App G-2.19	





Golder Associates Denver, Colorado

TITLE

Surface Water Monitoring
Sulfate Concentrations

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
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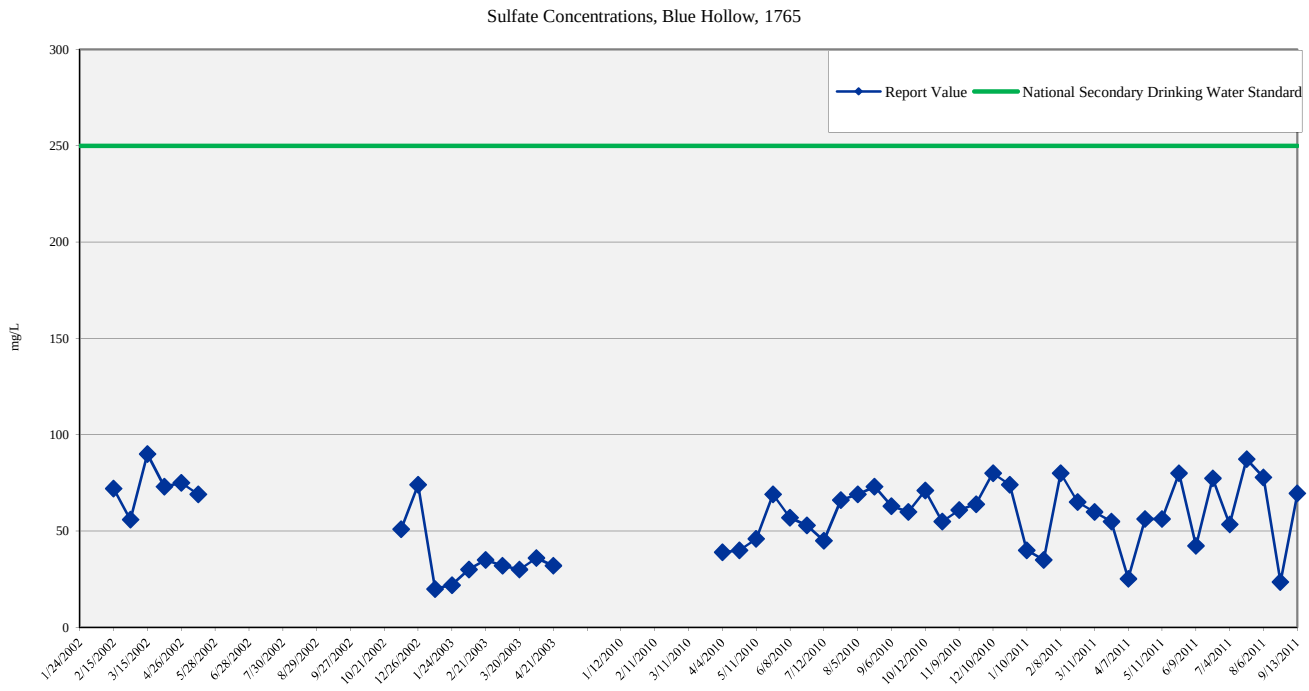


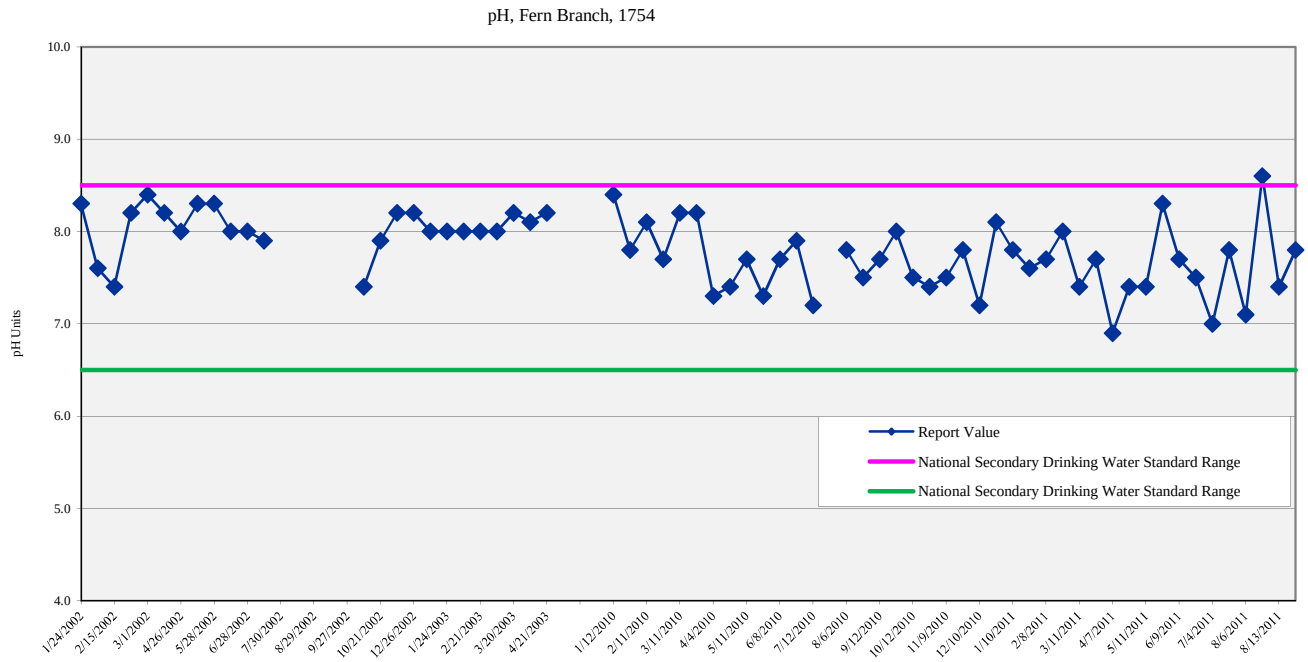
Golder Associates

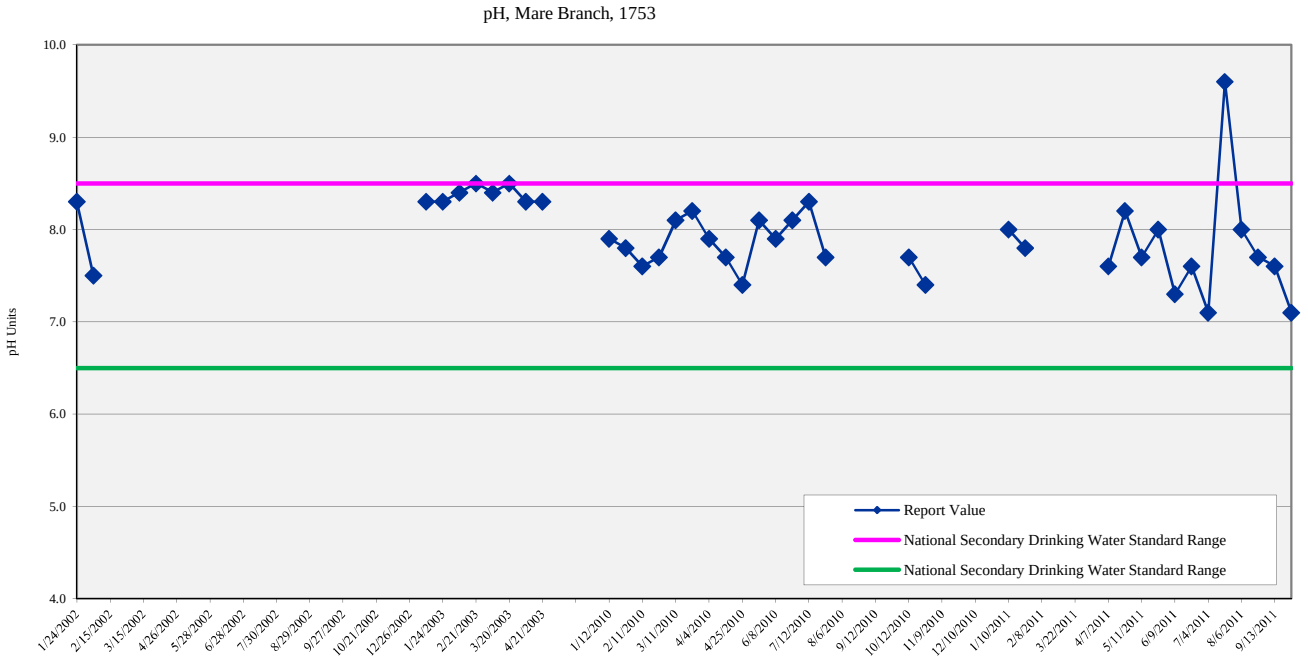
Denver, Colorado

TITLE

Surface Water Monitoring
Sulfate Concentrations

CLIENT/PROJECT **Bledsoe Coal Corporation Bledsoe EA (KYES-53865) Leslie County, KY**	DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**
	CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.
	REVIEWED **MWB**	FILE NO. 103817786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. **App G-2.21**





Golder Associates

Denver, Colorado

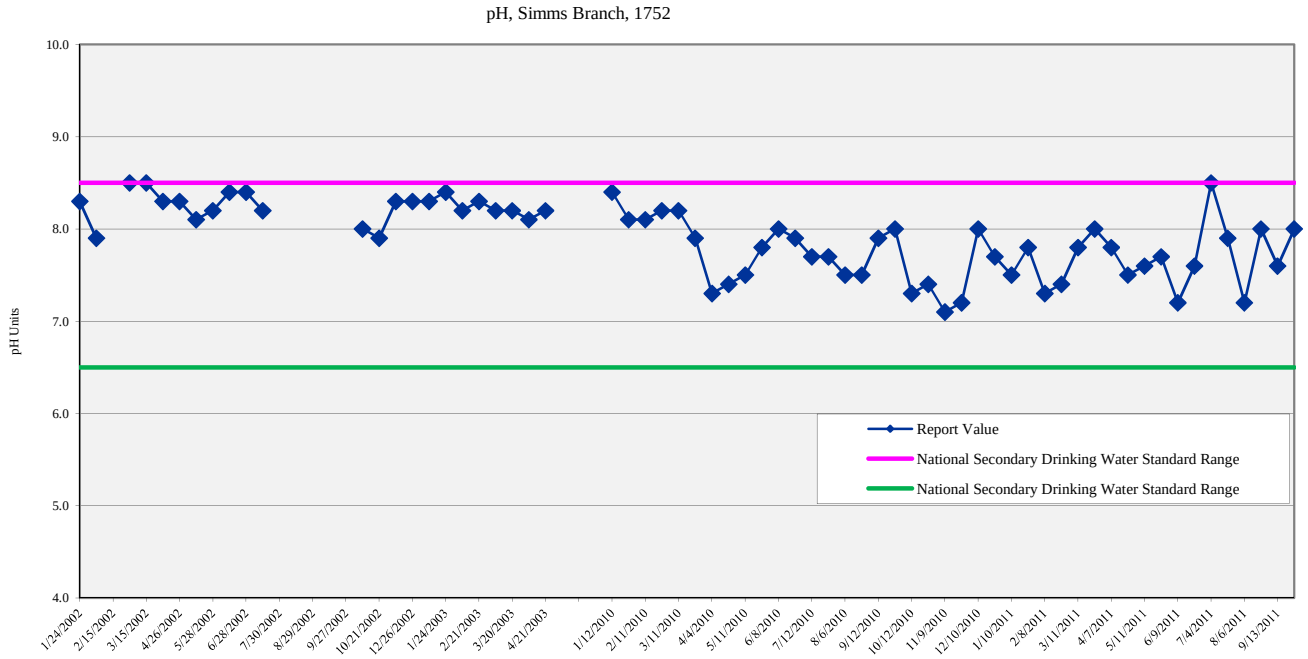
TITLE

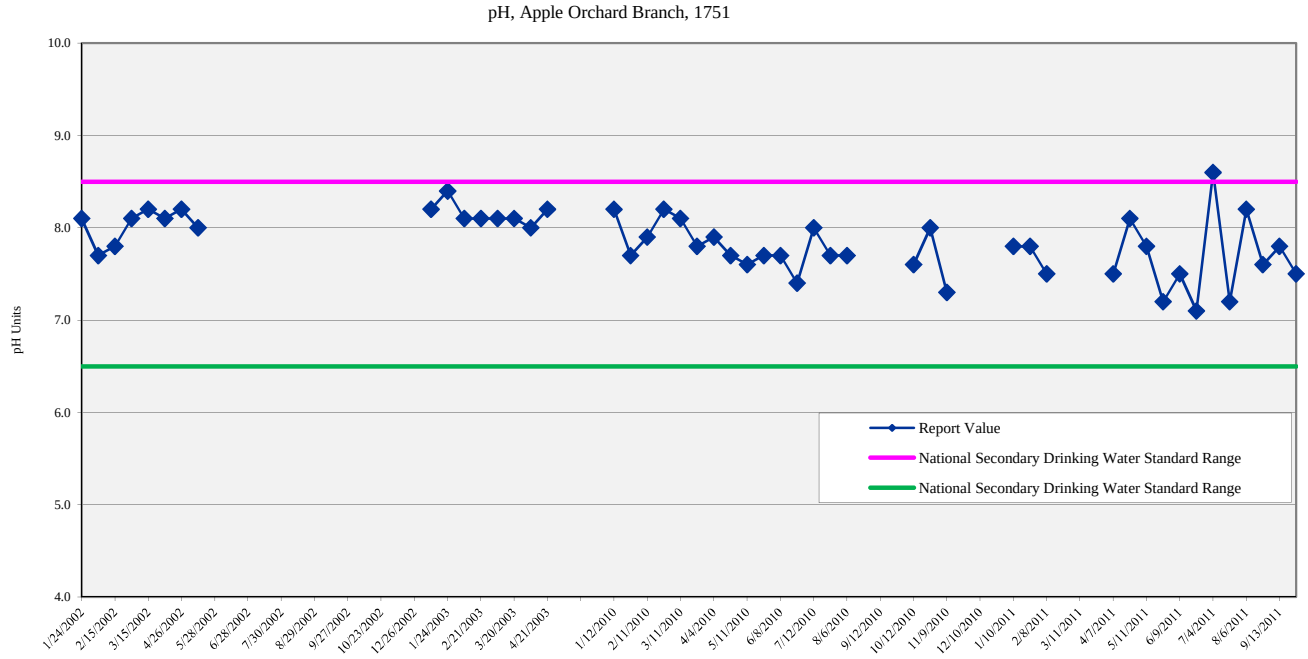
Surface Water Monitoring
pH Values

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**
CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.
REVIEWED **MWB**	FILE NO. 103-81786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. **App G-2.22**



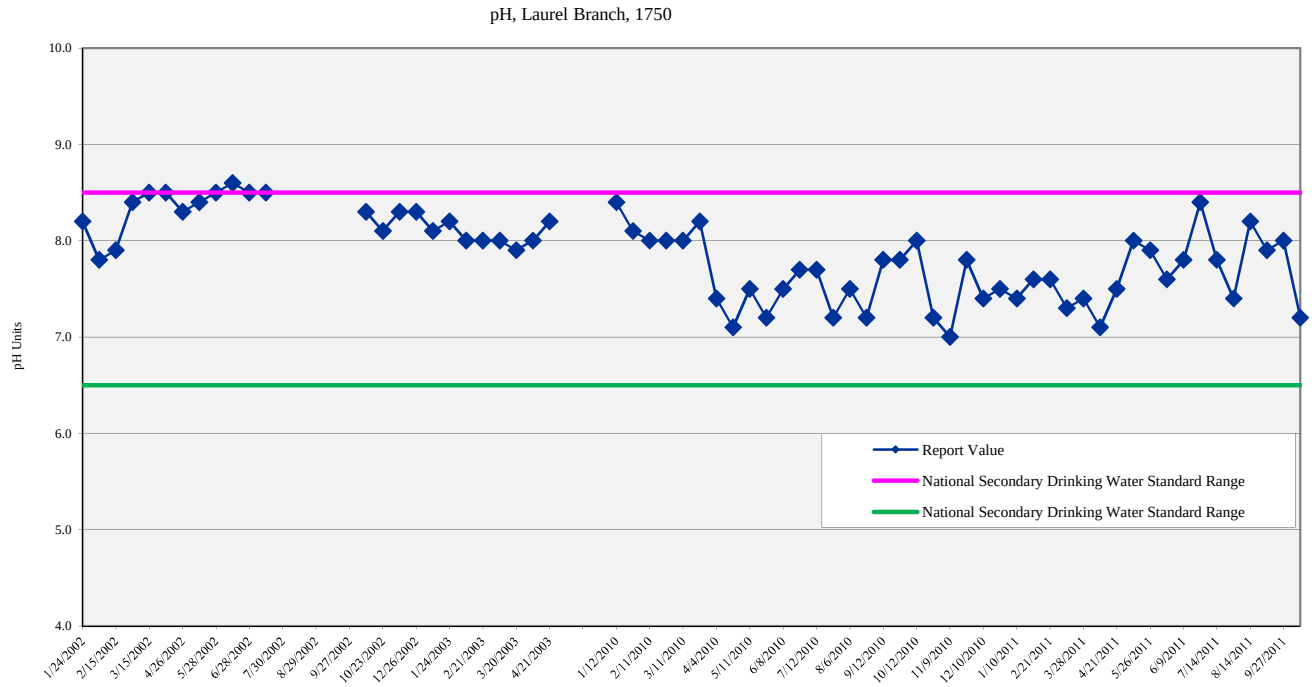


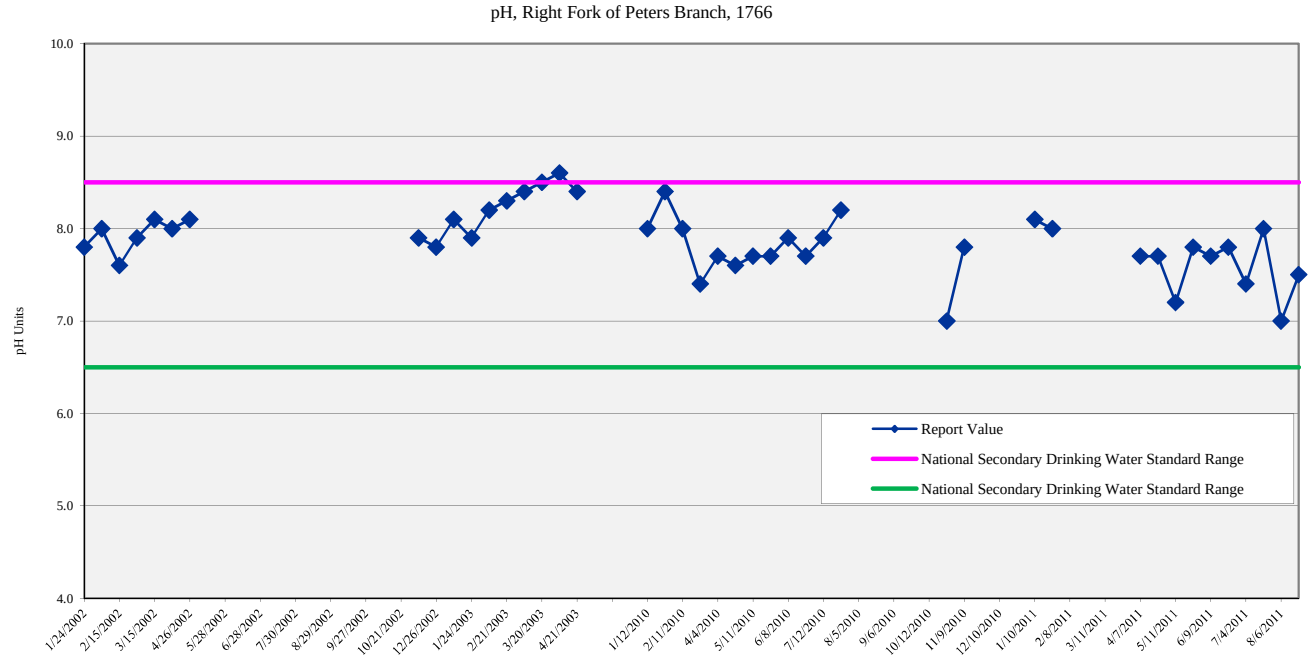
Golder Associates — Denver, Colorado

TITLE: **Surface Water Monitoring pH Values**

CLIENT/PROJECT: **Bledsoe Coal Corporation, Bledsoe EA (KYES-53865), Leslie County, KY**

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
REVIEWED MWB	FILE NO. 103817786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. App G-2.23	





Golder Associates Denver, Colorado

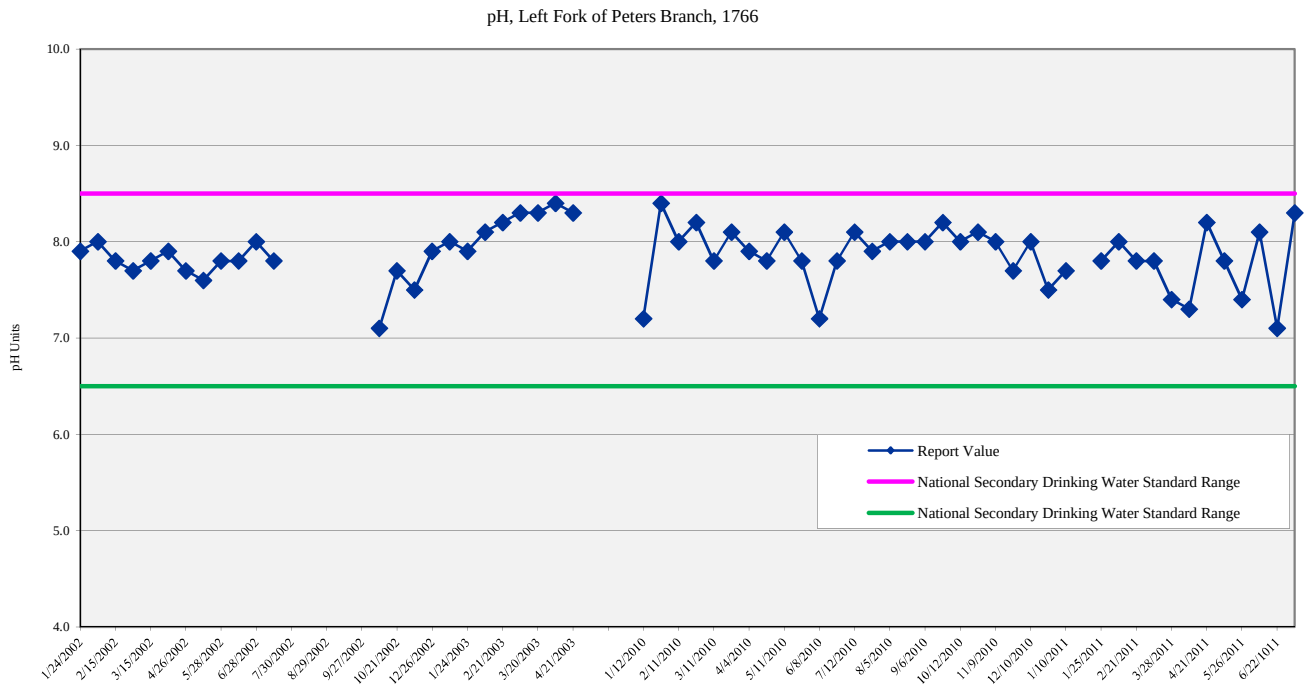
TITLE

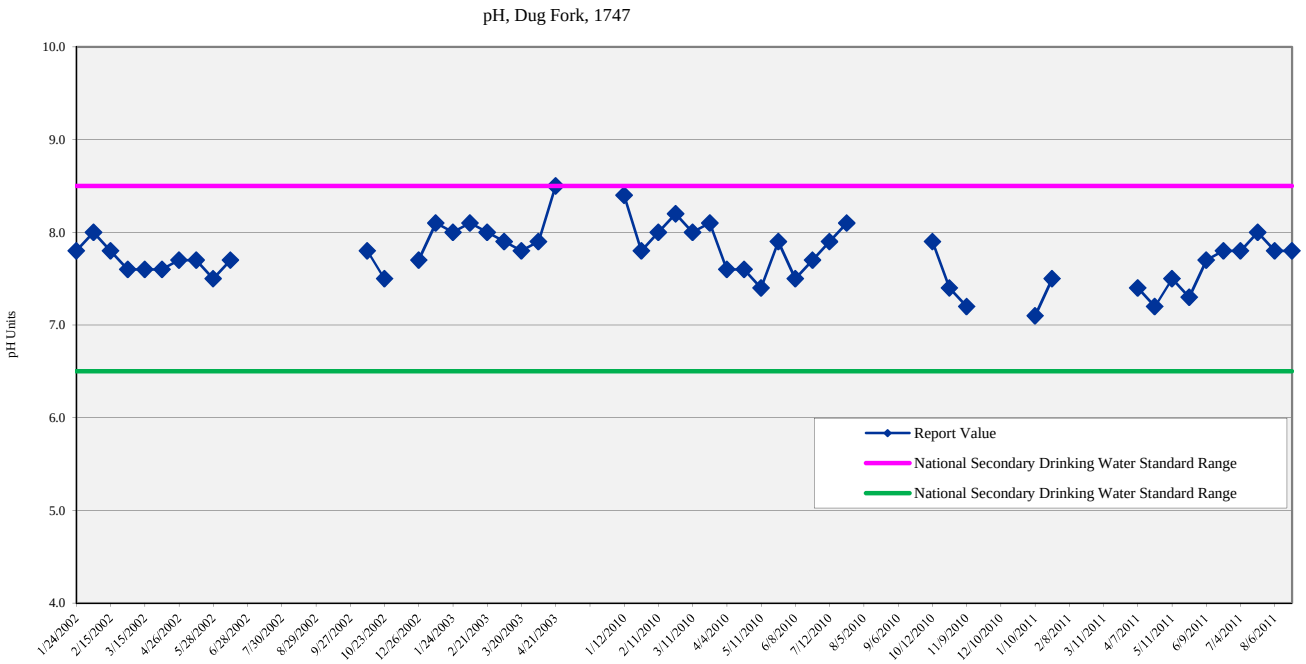
Surface Water Monitoring
pH Values

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**
CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.
REVIEWED **MWB**	FILE NO. 103817 86 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. **App G-2.24**





Golder Associates Denver, Colorado

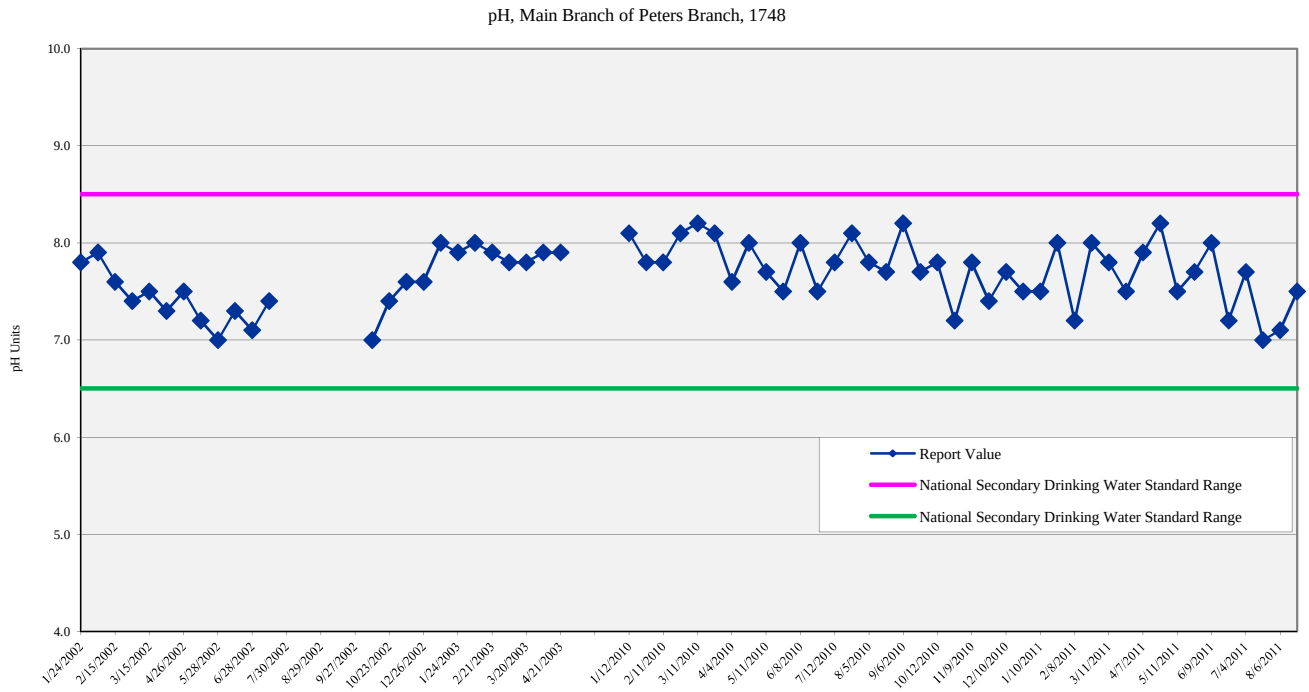
TITLE

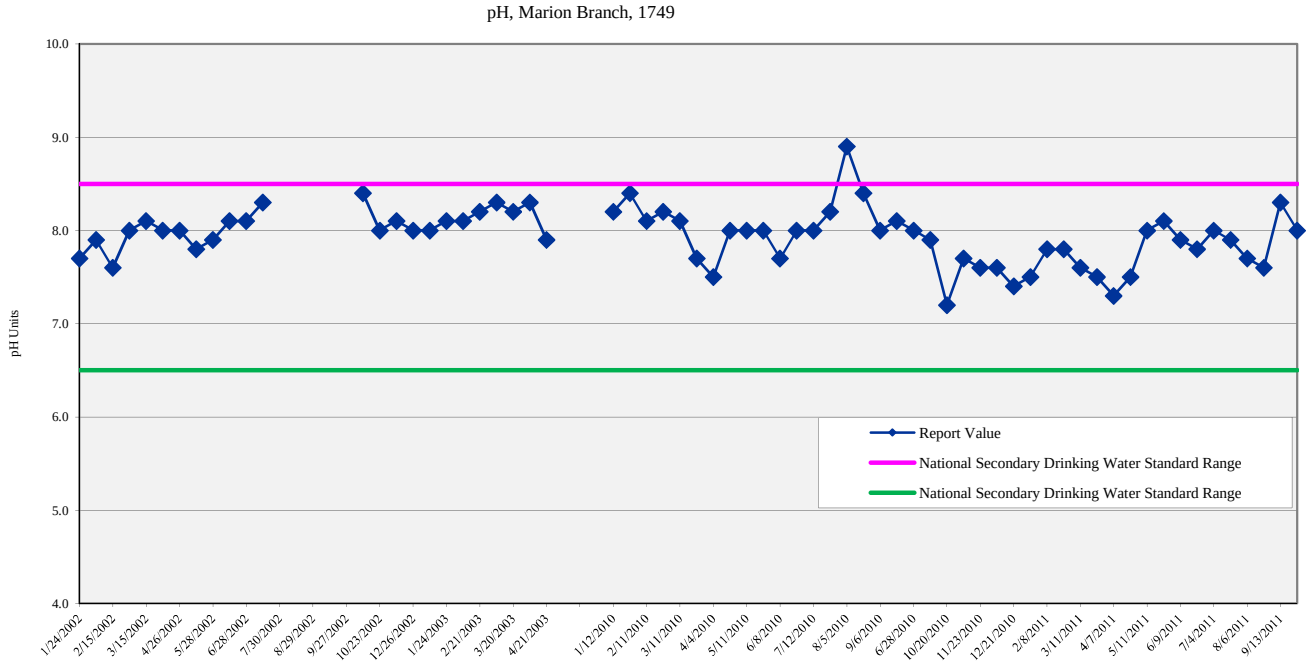
Surface Water Monitoring
pH Values

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
REVIEWED MWB	FILE NO. 103-81786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. App G-2.25	





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TITLE: **Surface Water Monitoring pH Values**

CLIENT/PROJECT: **Bledsoe Coal Corporation, Bledsoe EA (KYES-53865), Leslie County, KY**

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
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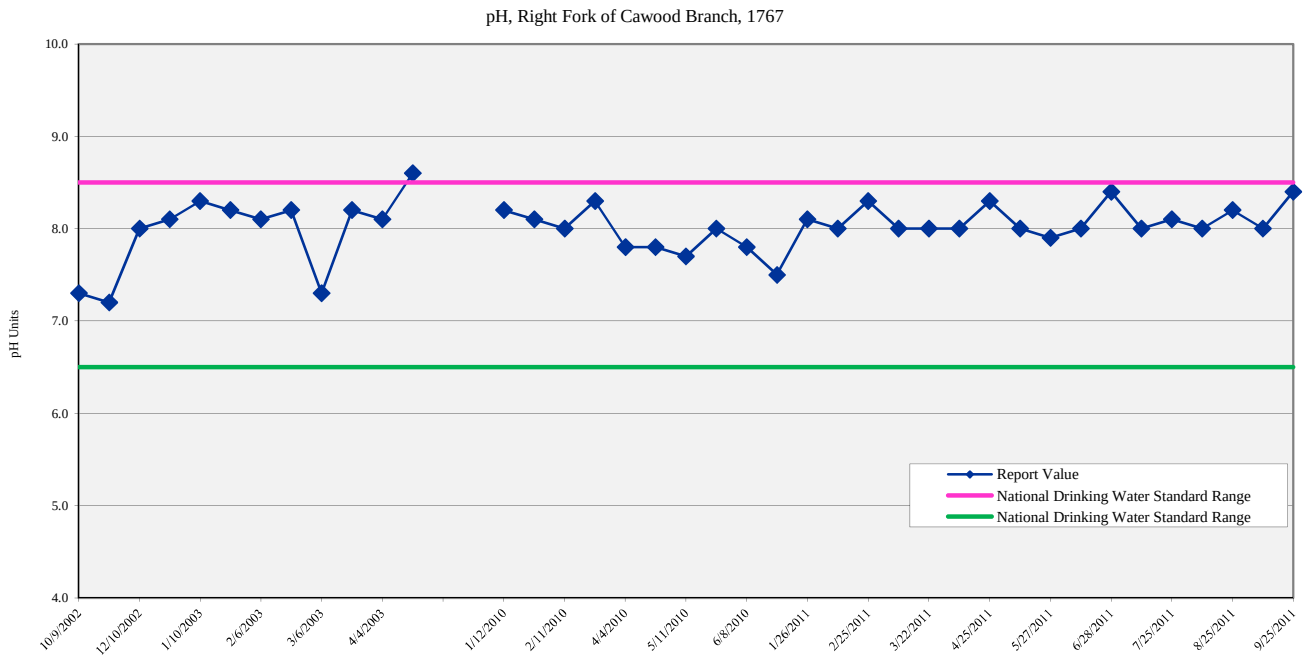

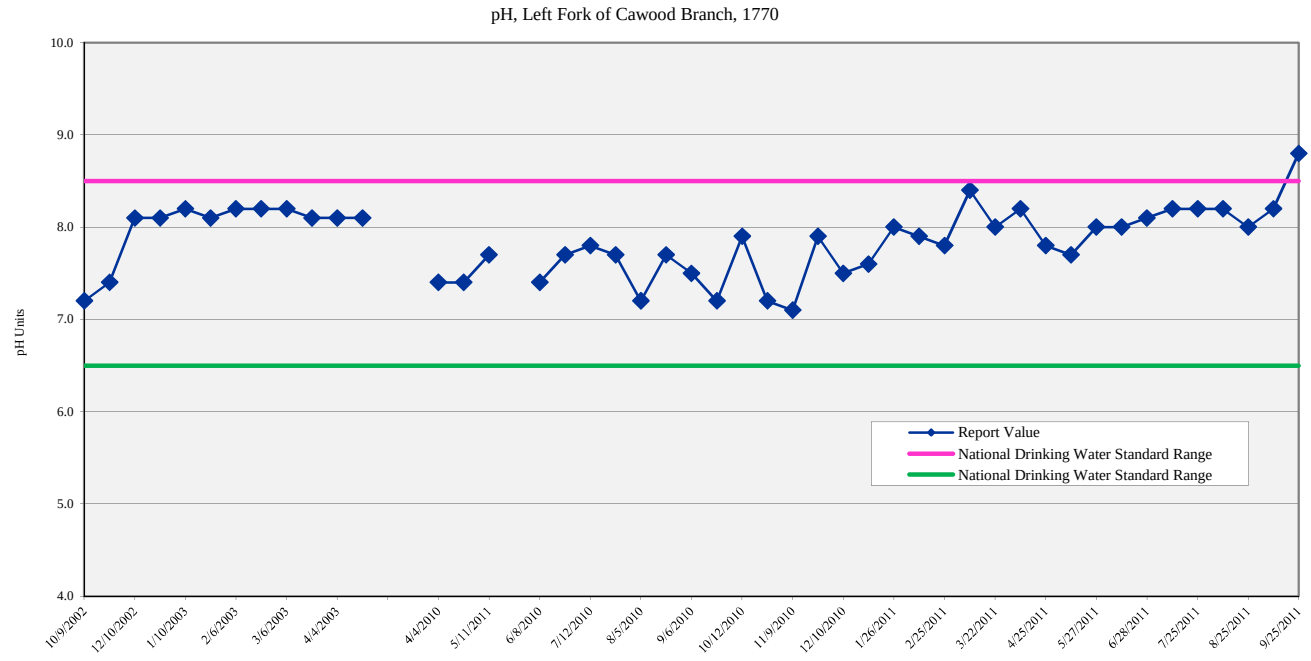

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Denver, Colorado

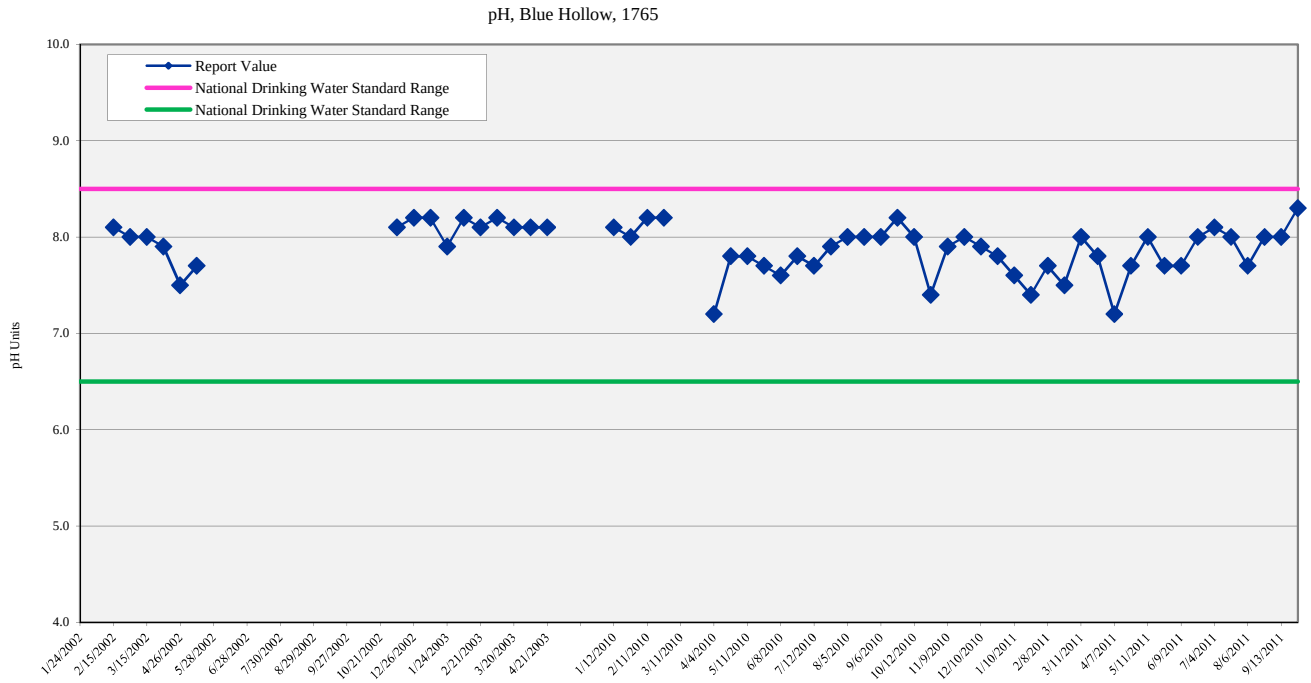
TITLE

Surface Water Monitoring
pH Values

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**
CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.
REVIEWED **MWB**	FILE NO. 103817 86 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. **App G-2.27**



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Denver, Colorado

TITLE

Surface Water Monitoring
pH Values

CLIENT/PROJECT	**Bledsoe Coal Corporation** **Bledsoe EA (KYES-53865)** **Leslie County, KY**		
DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**	
CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.	
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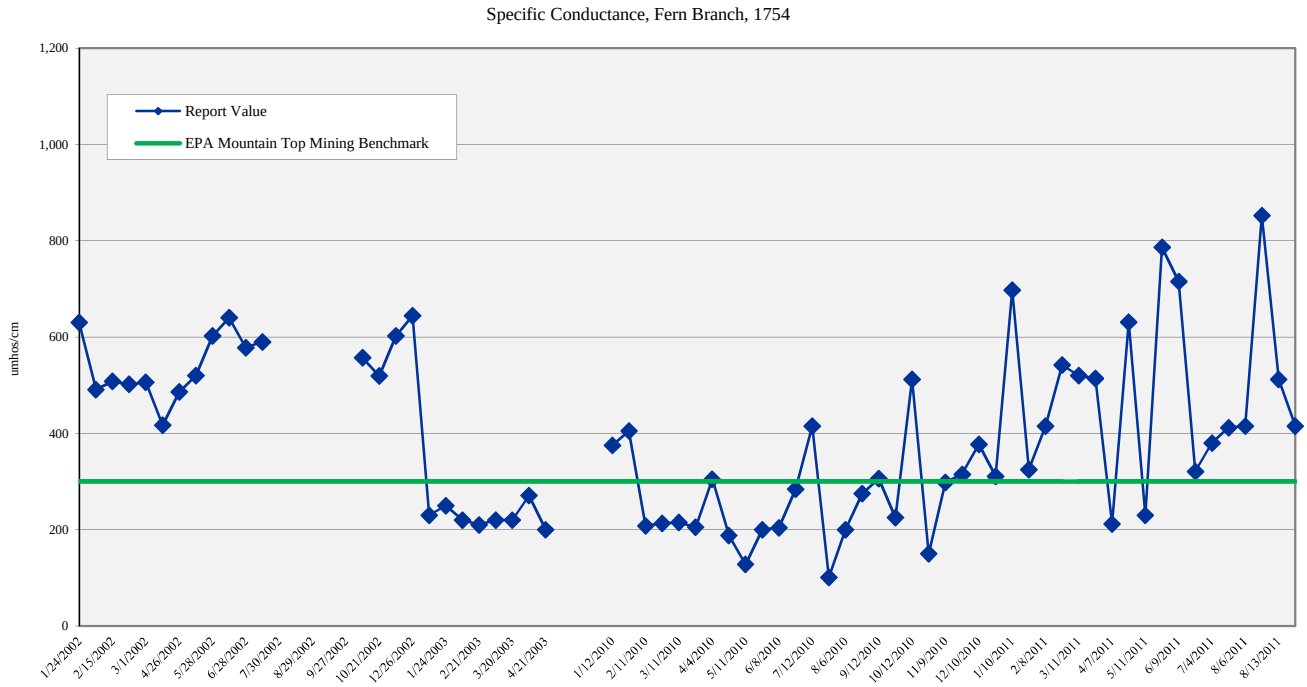

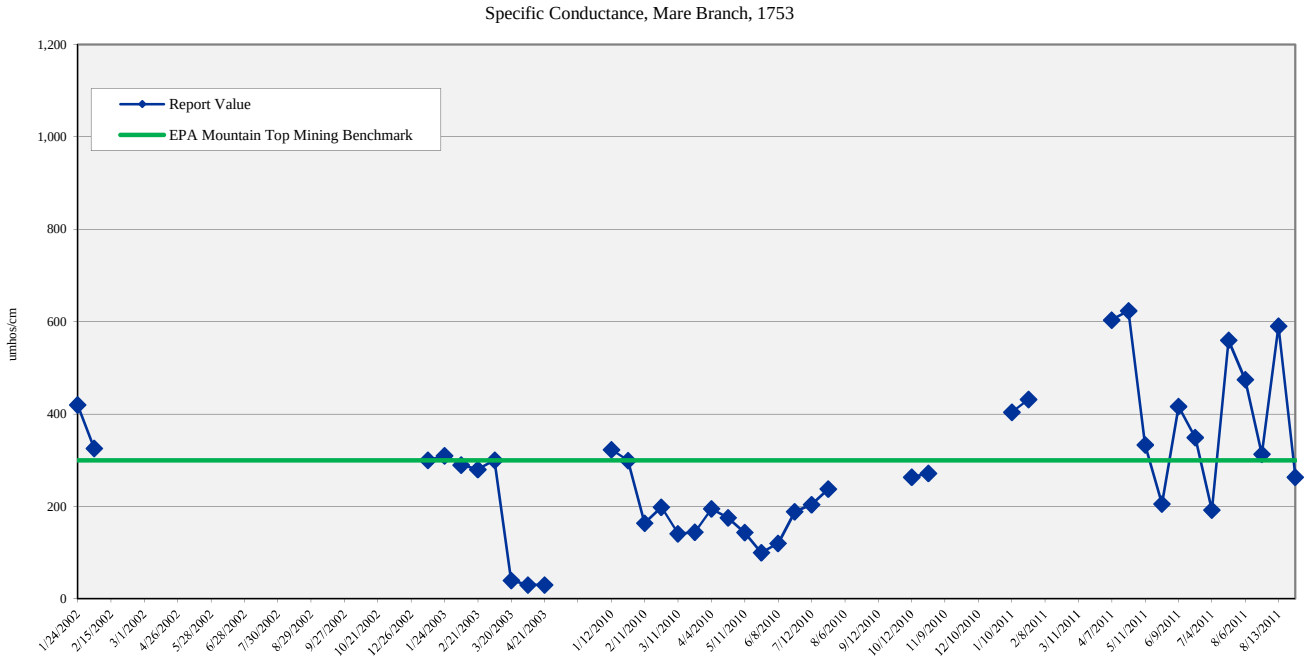

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Denver, Colorado

TITLE

Surface Water Monitoring
Specific Conductance

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**
CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.
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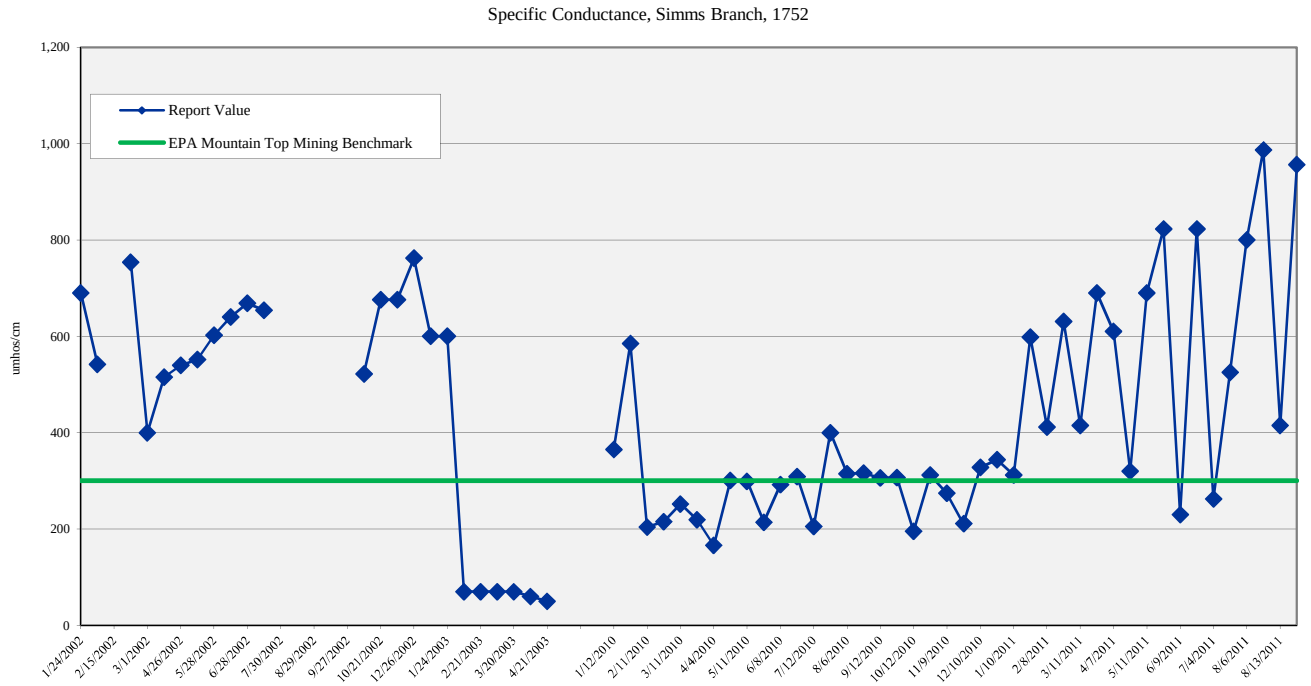

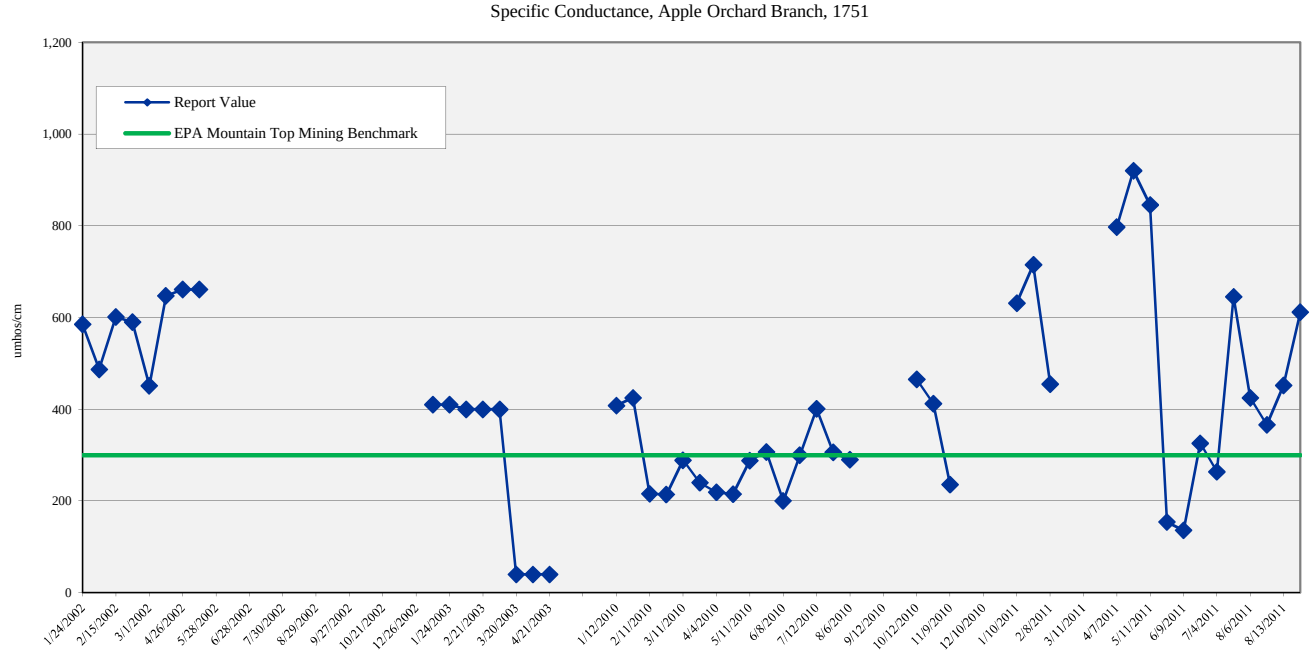

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TITLE: **Surface Water Monitoring Specific Conductance**

CLIENT/PROJECT: **Bledsoe Coal Corporation, Bledsoe EA (KYES-53865), Leslie County, KY**

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
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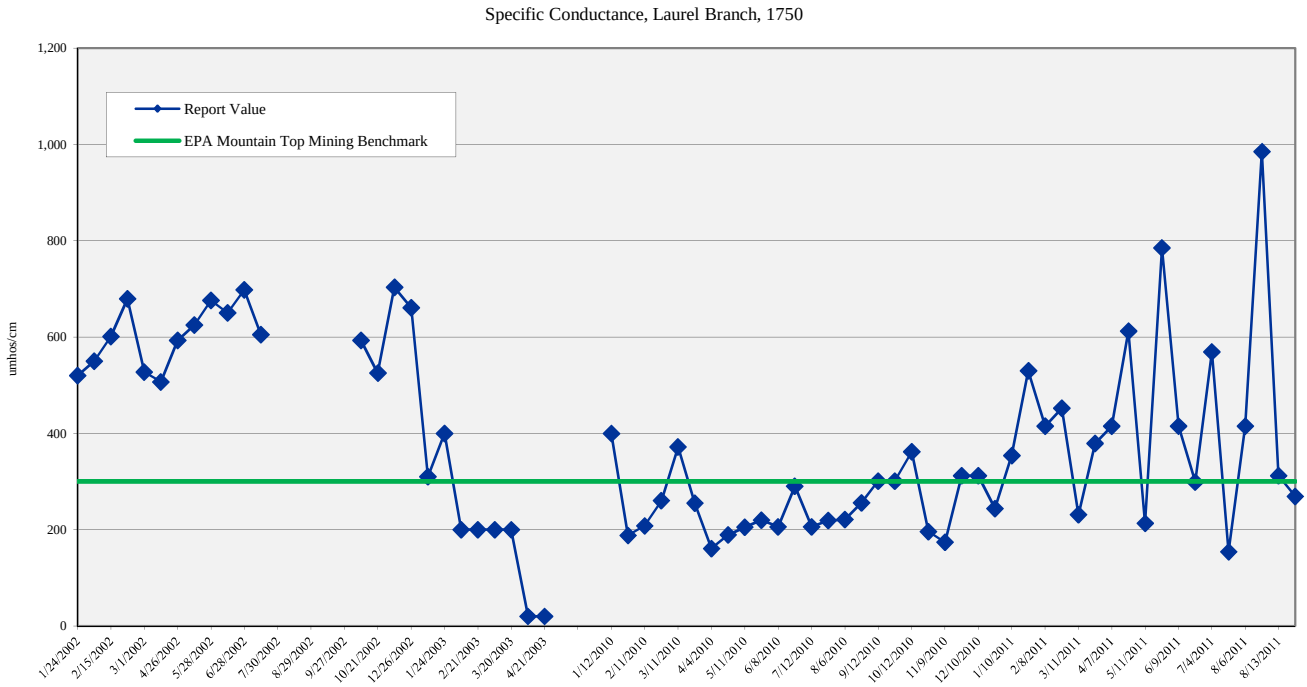

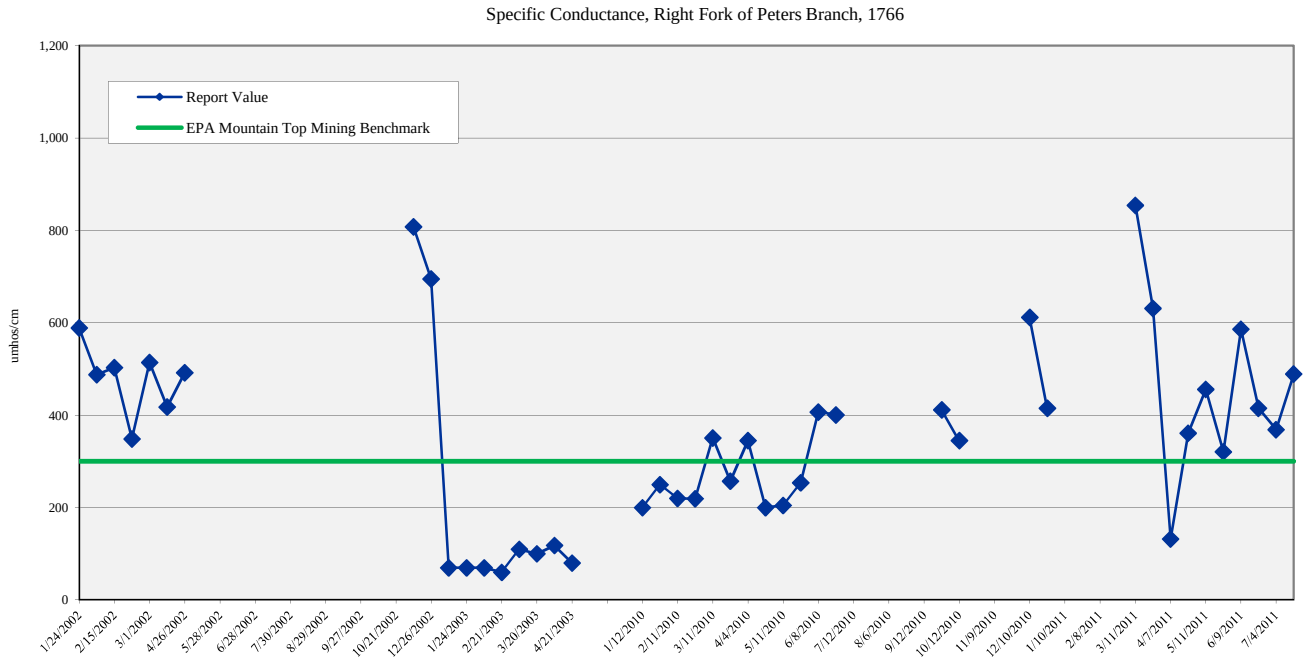

Golder Associates Denver, Colorado

TITLE

Surface Water Monitoring
Specific Conductance

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
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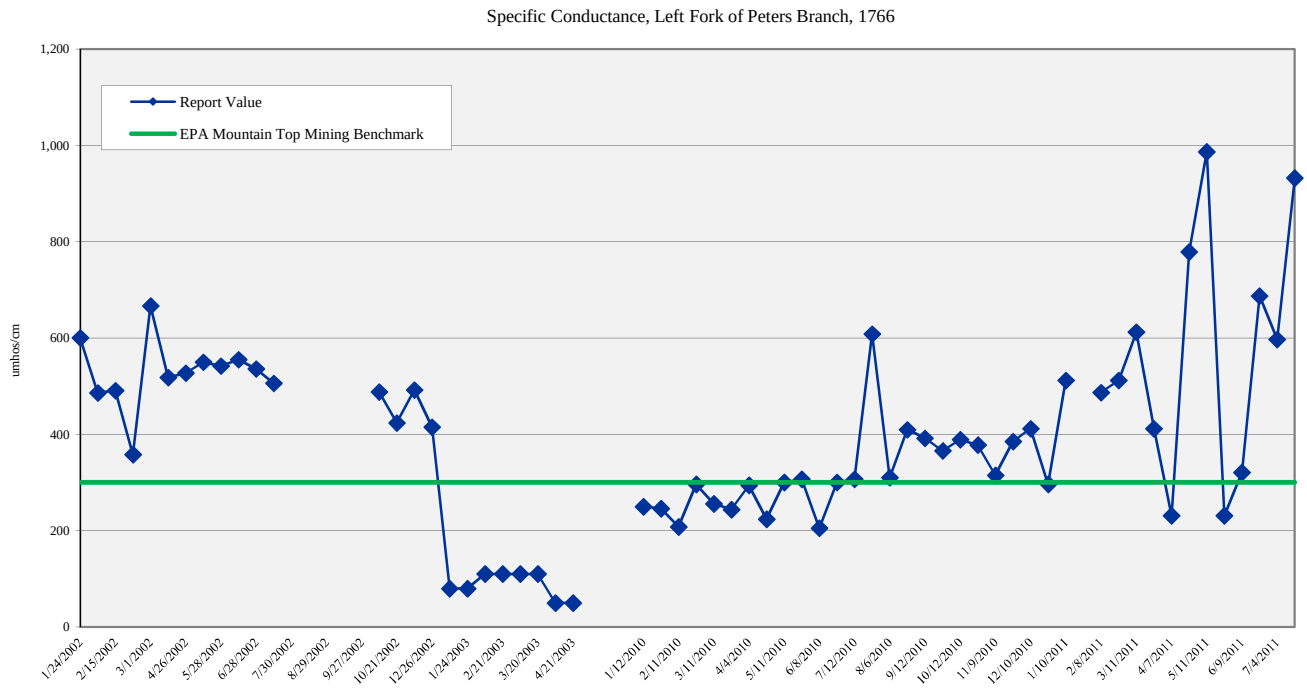

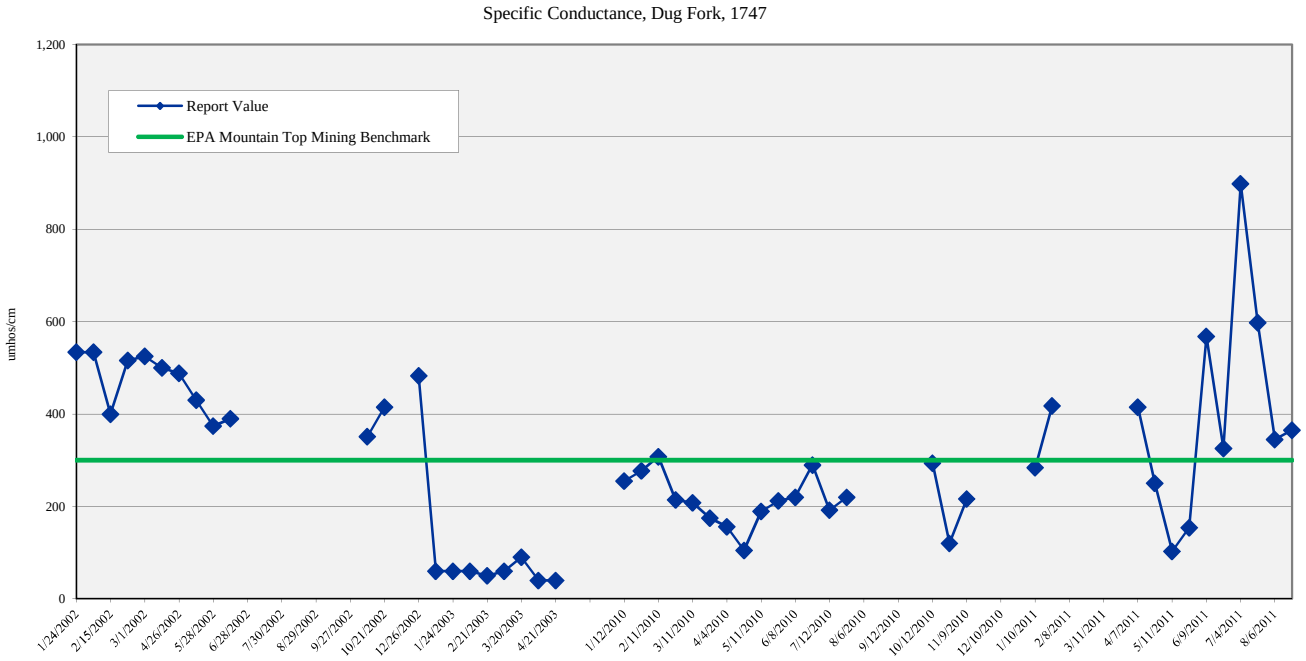

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TITLE: **Surface Water Monitoring Specific Conductance**

CLIENT/PROJECT: **Bledsoe Coal Corporation, Bledsoe EA (KYES-53865), Leslie County, KY**

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
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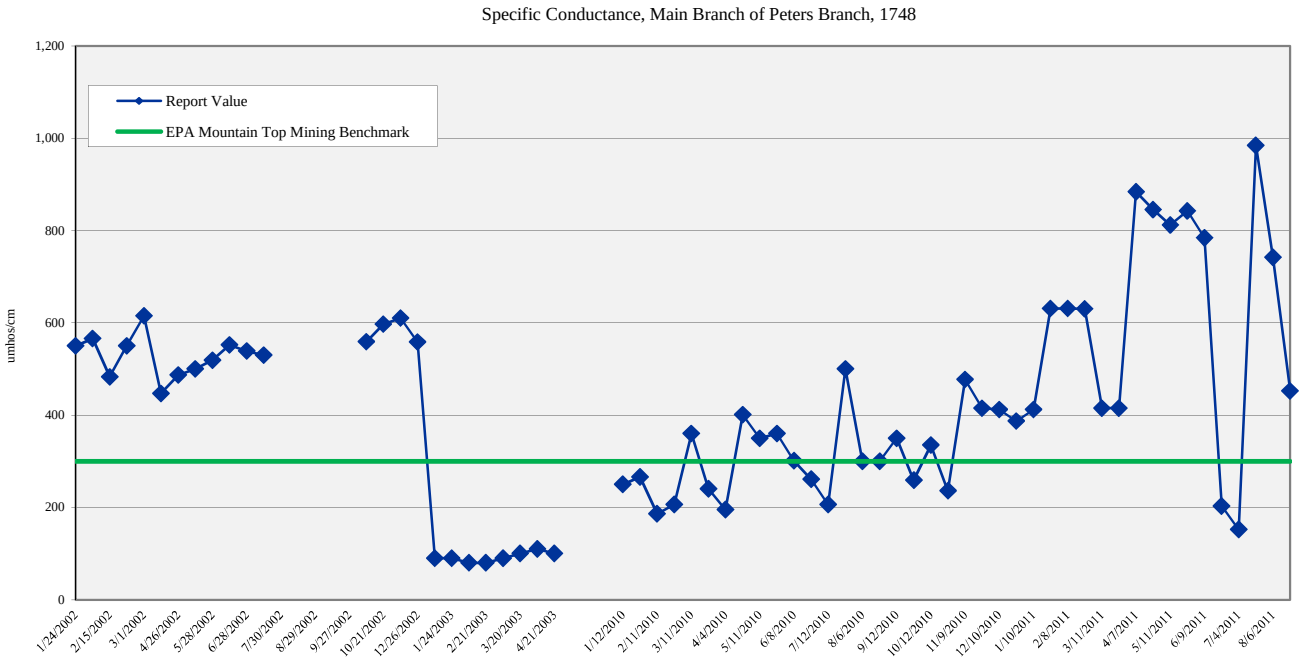

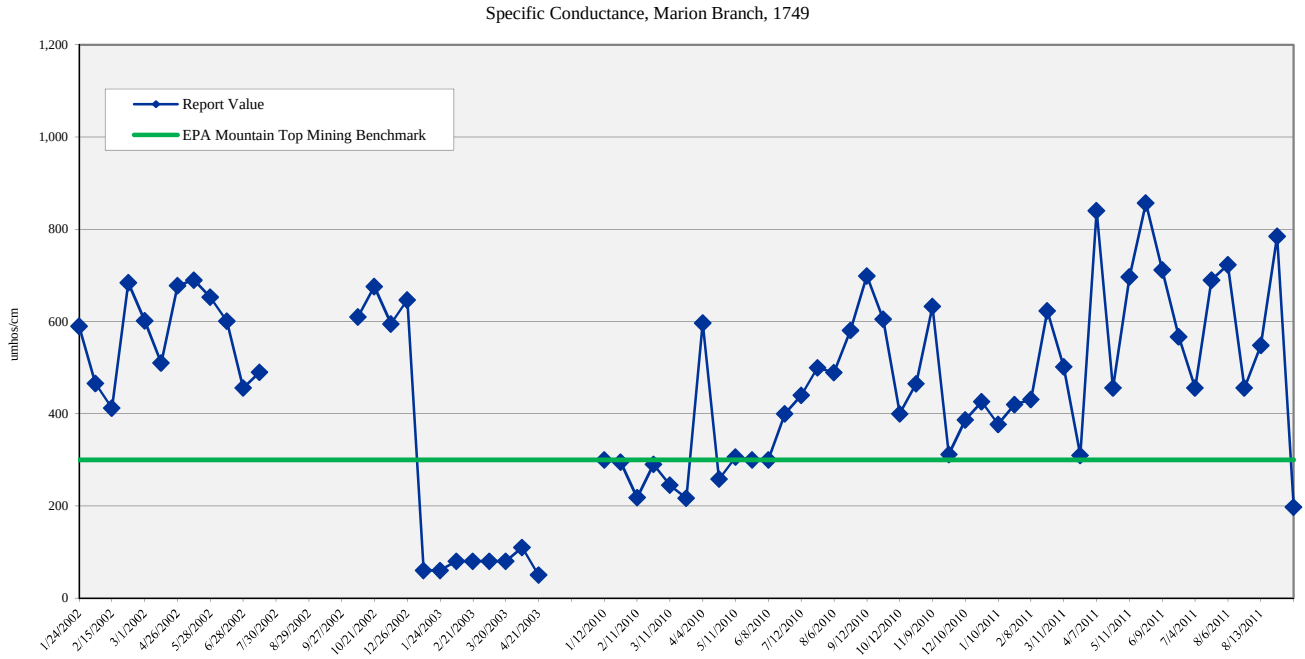

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TITLE

Surface Water Monitoring
Specific Conductance

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**	
CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.	
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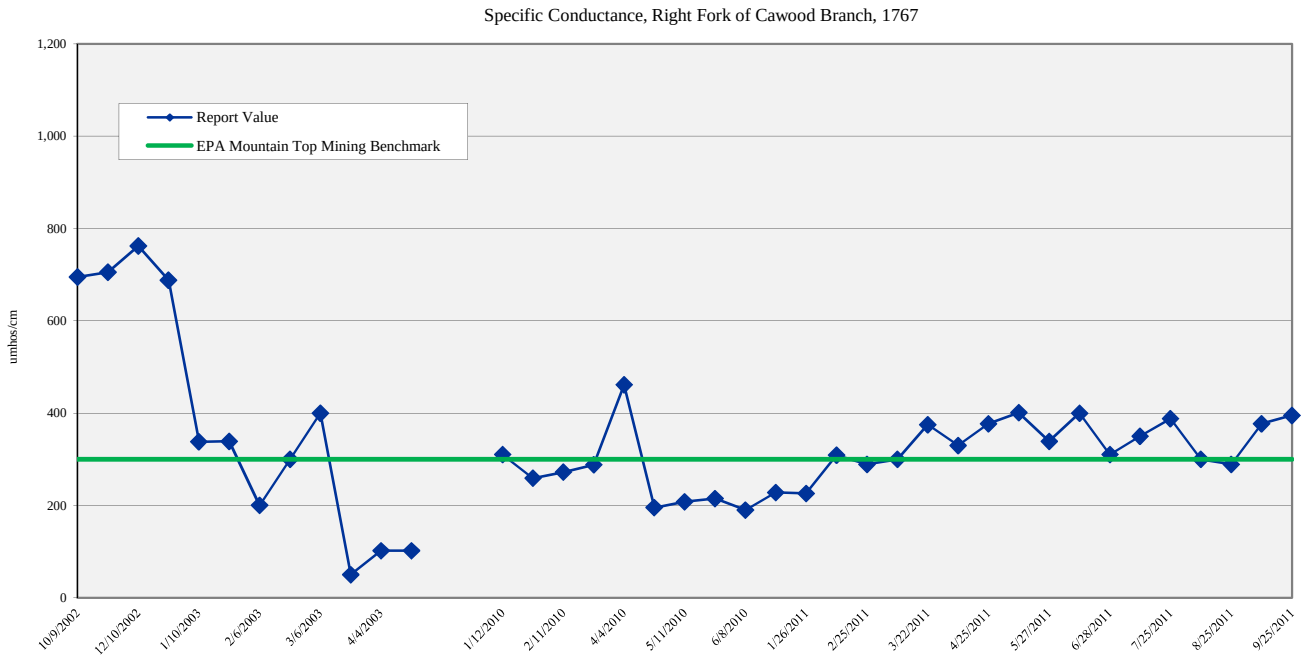

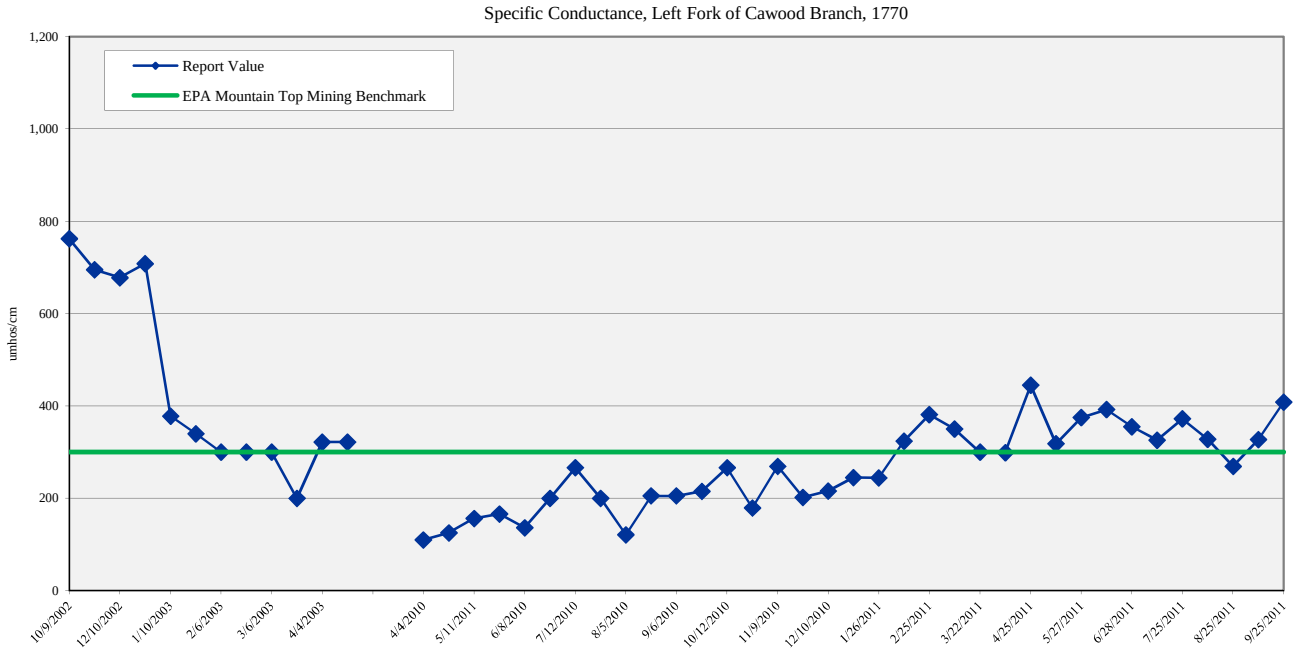

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Denver, Colorado

TITLE

Surface Water Monitoring
Specific Conductance

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
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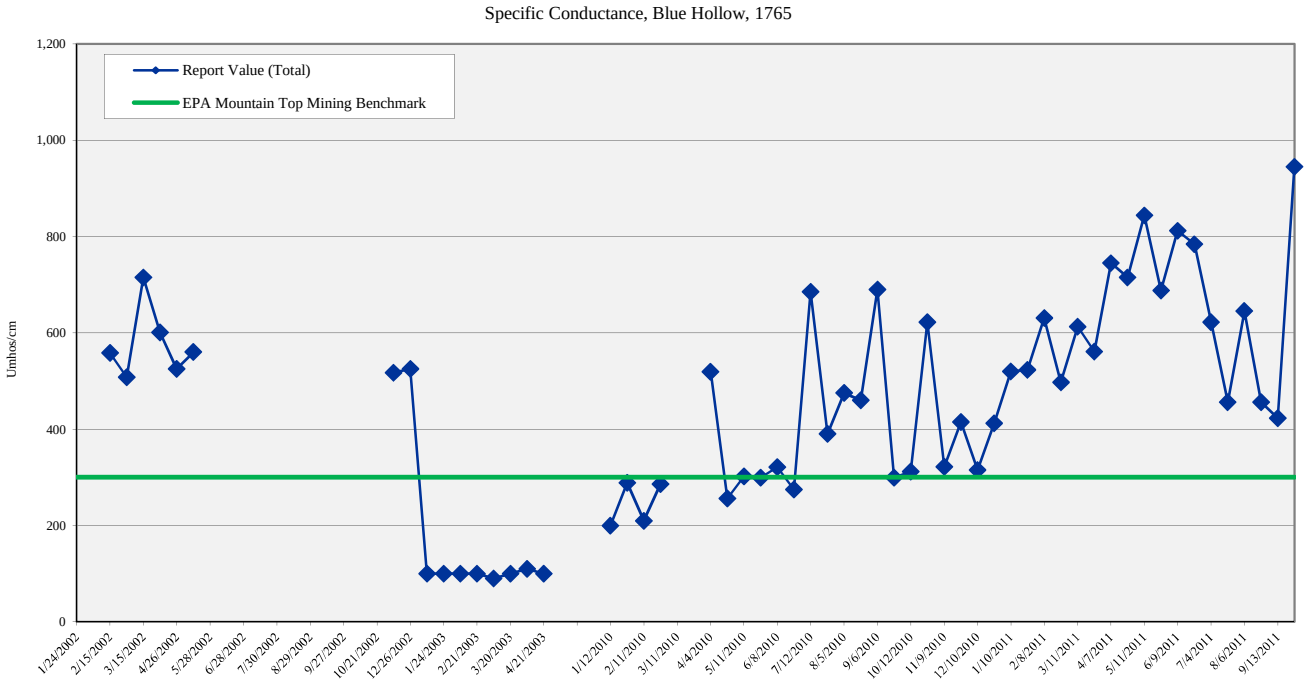

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Denver, Colorado

TITLE

Surface Water Monitoring
Specific Conductance

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN	SEM	DATE	Jun-12	JOB NO.	103-81786
CHECKED	EJP	SCALE	As Shown	DWG NO./REV. NO.	
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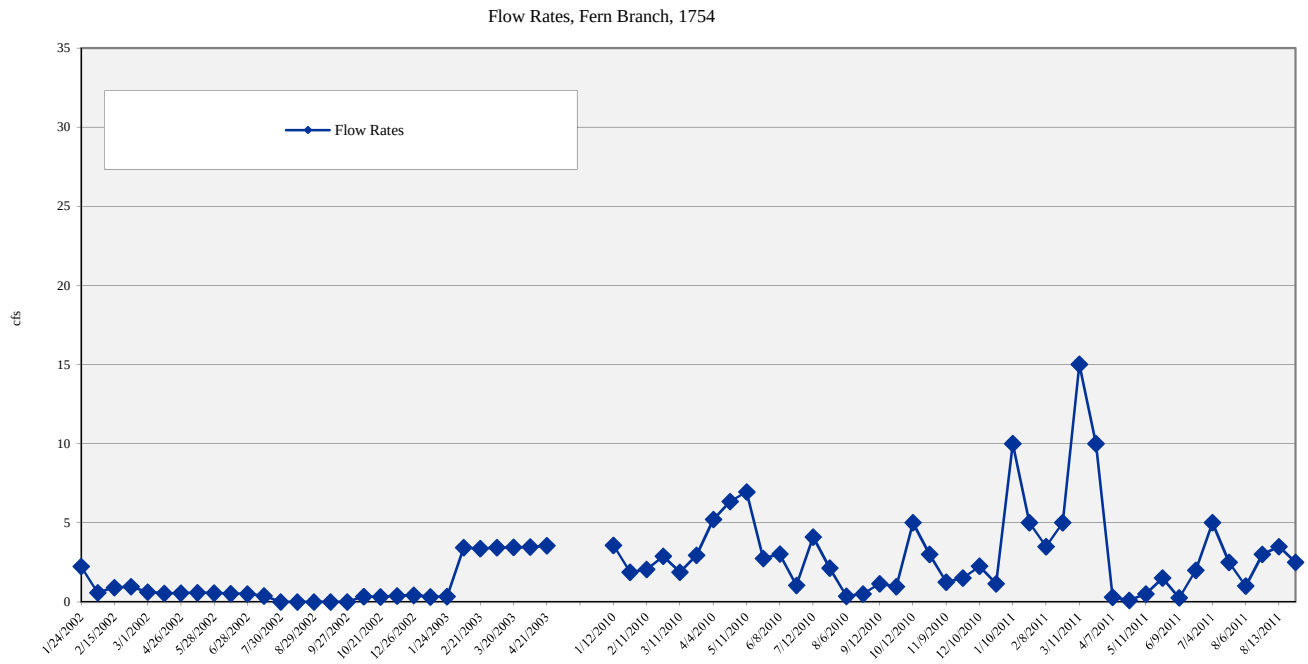
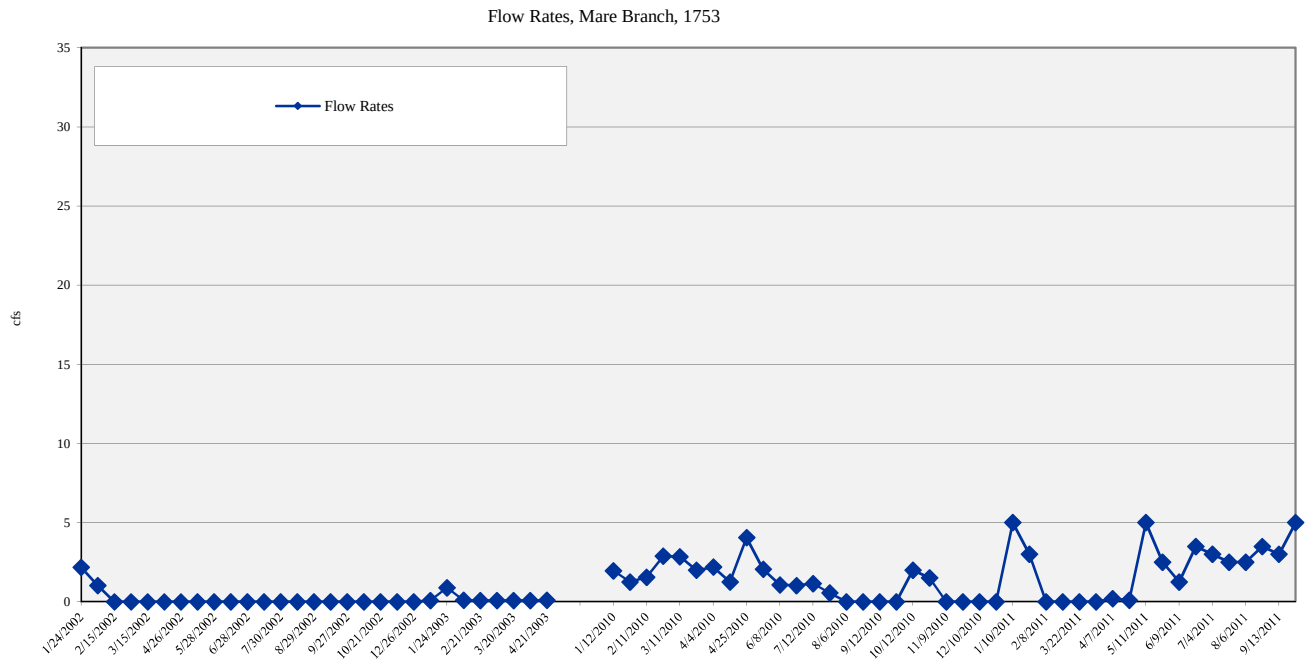




Golder Associates

Denver, Colorado

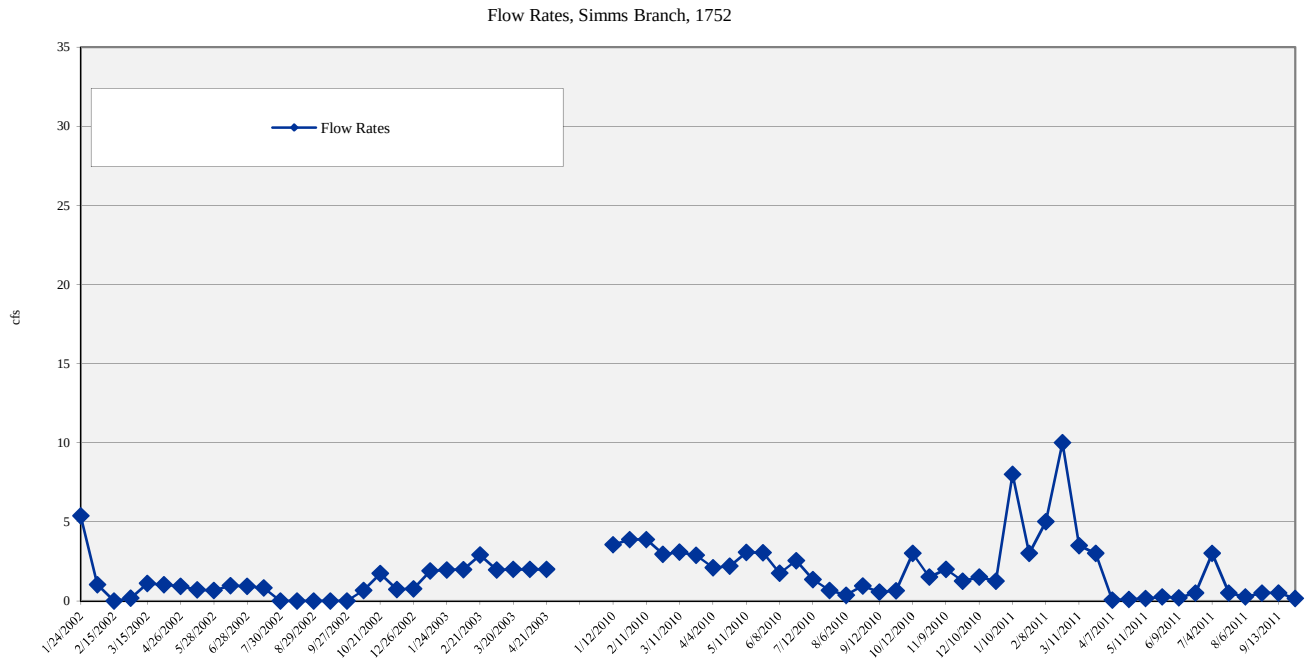
TITLE

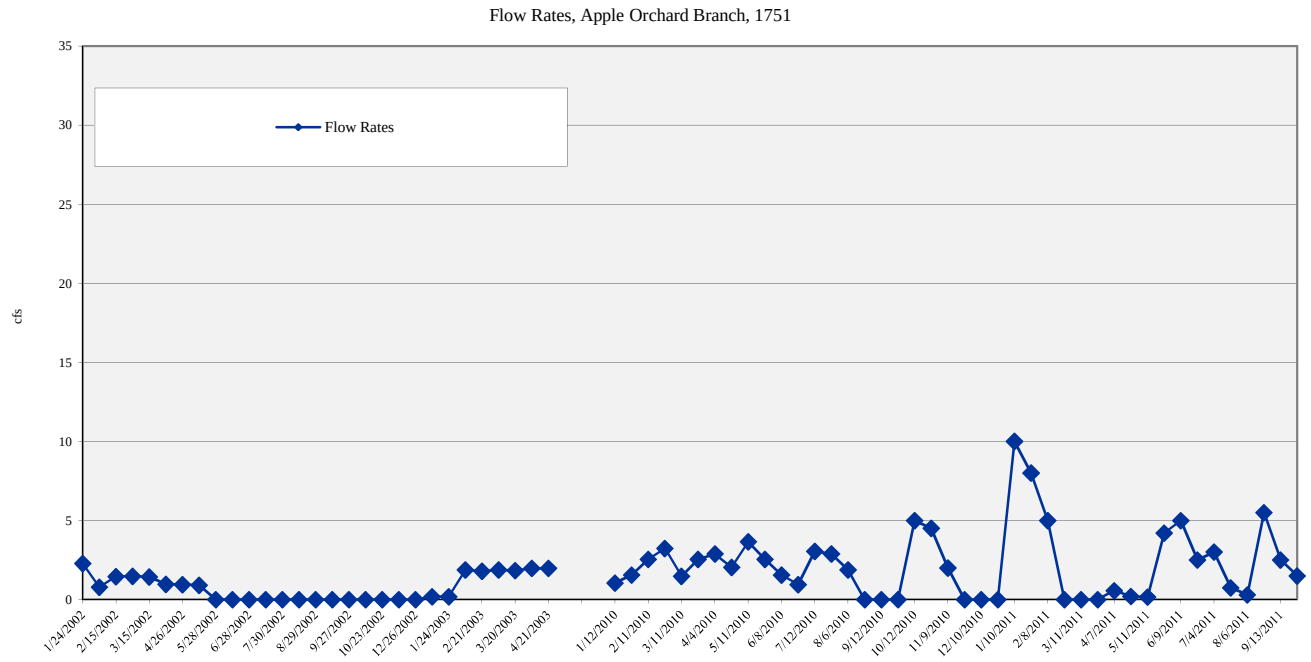
Surface Water Monitoring
Flow Rates

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**	
CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.	
REVIEWED **MWB**	FILE NO. 103-81786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO. **App G-2.36**	





Golder Associates Denver, Colorado

TITLE

Surface Water Monitoring
Flow Rates

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
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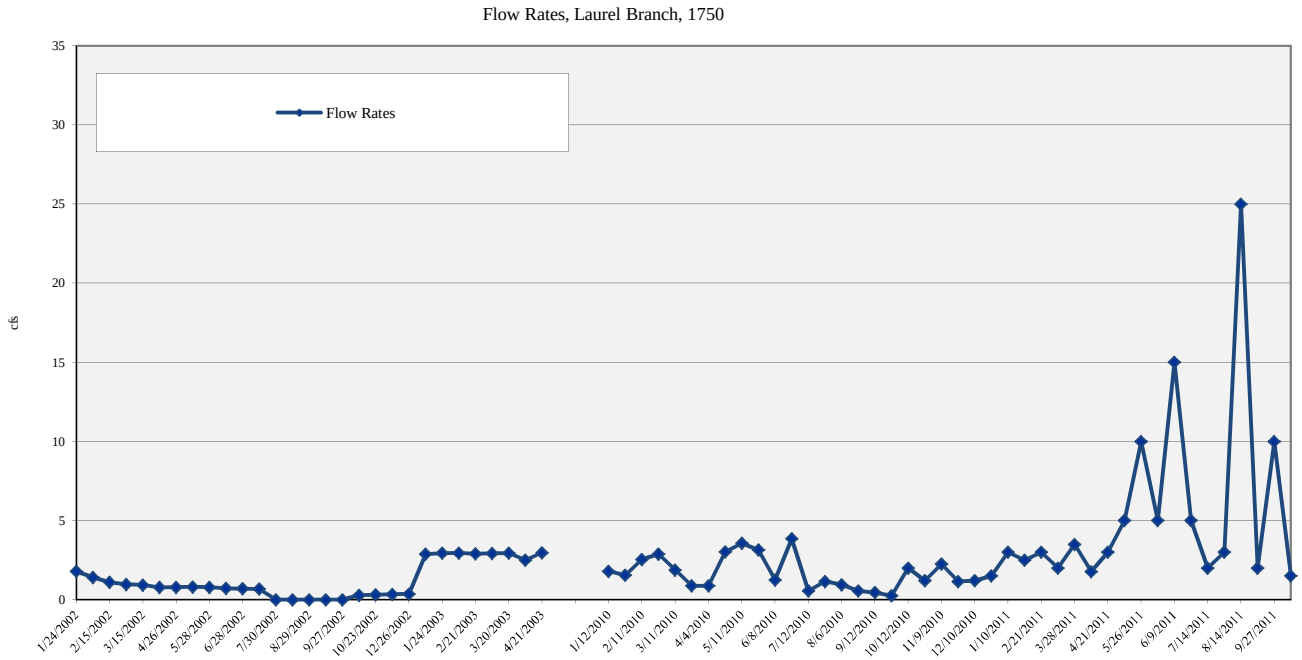

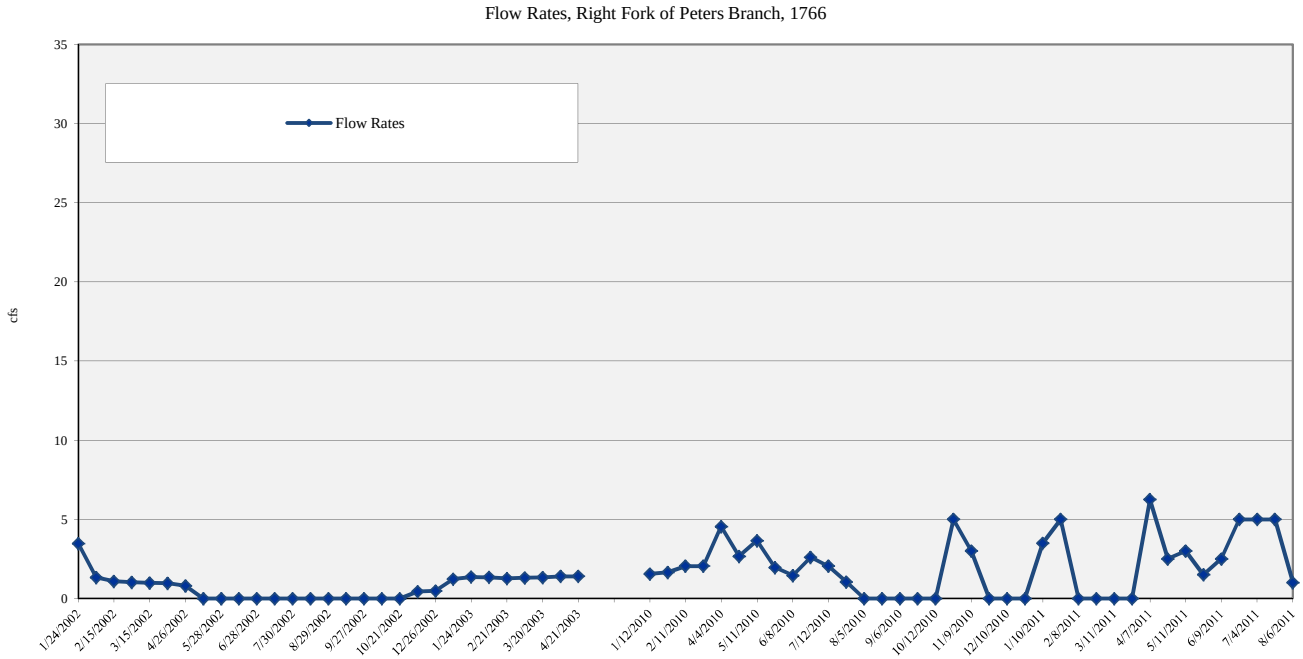

Golder Associates Denver, Colorado

TITLE

Surface Water Monitoring
Flow Rates

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
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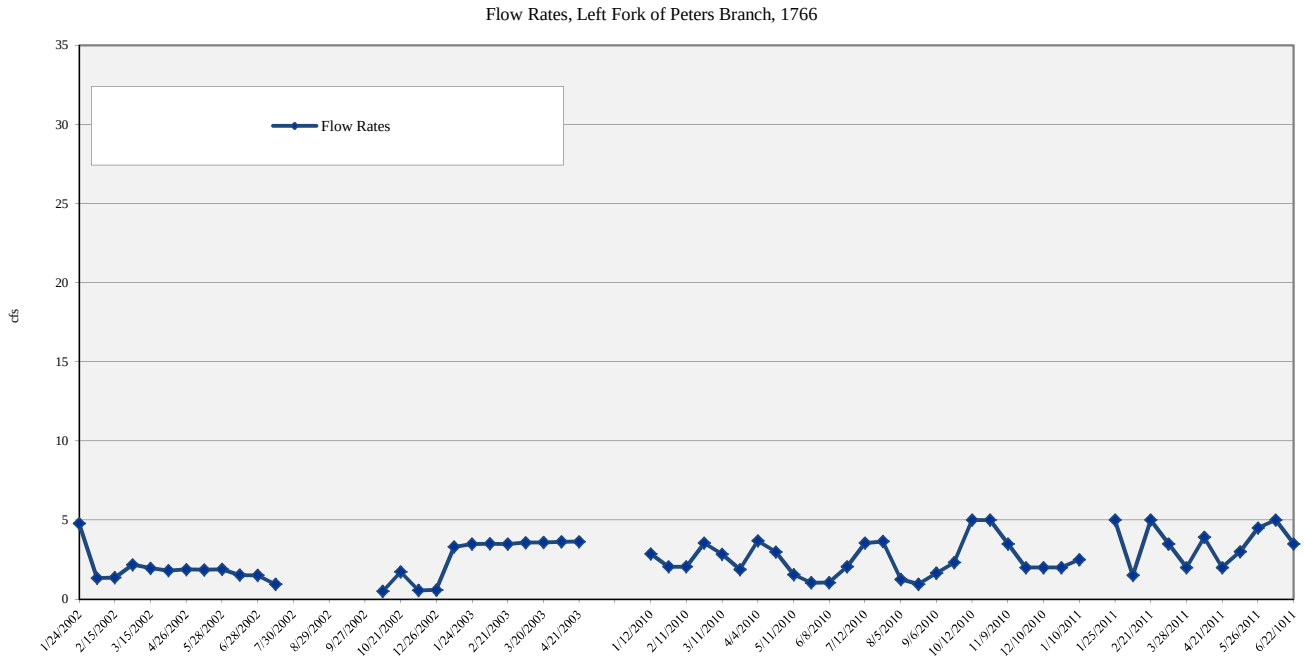

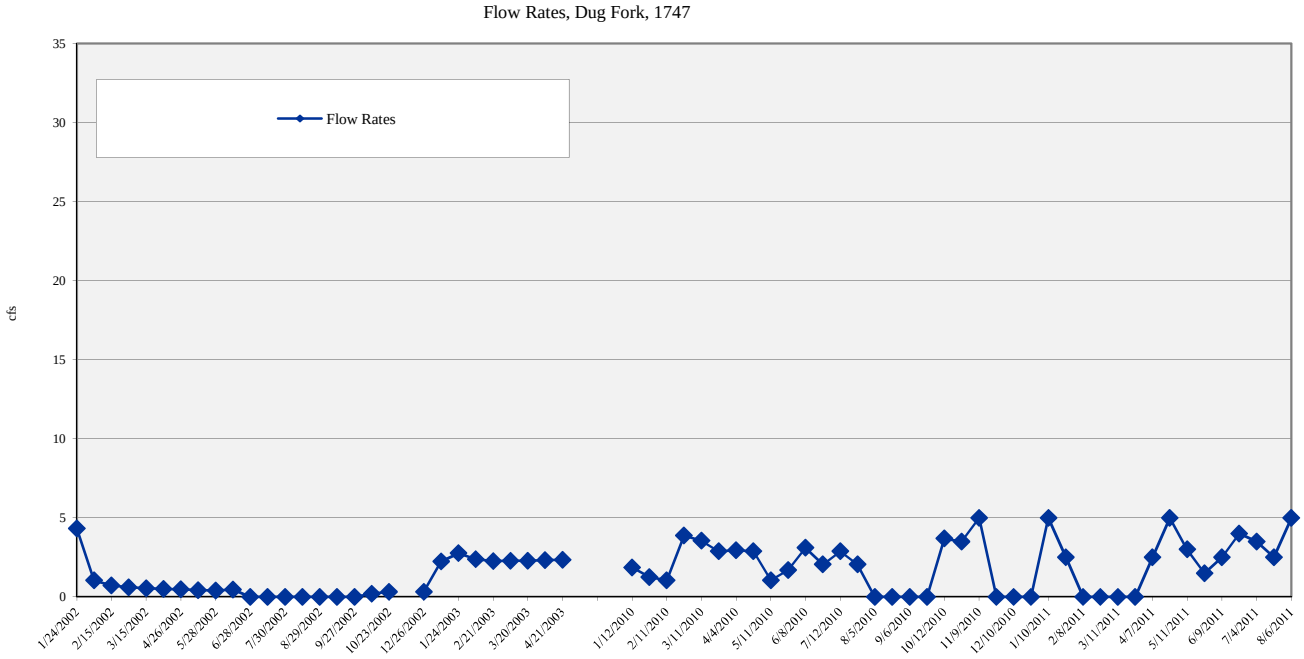

Golder Associates Denver, Colorado	TITLE **Surface Water Monitoring Flow Rates**		
CLIENT/PROJECT **Bledsoe Coal Corporation Bledsoe EA (KYES-53865) Leslie County, KY**	DRAWN **SEM**	DATE **Jun-12**	JOB NO. **103-81786**
	CHECKED **EJP**	SCALE **As Shown**	DWG NO./REV. NO.
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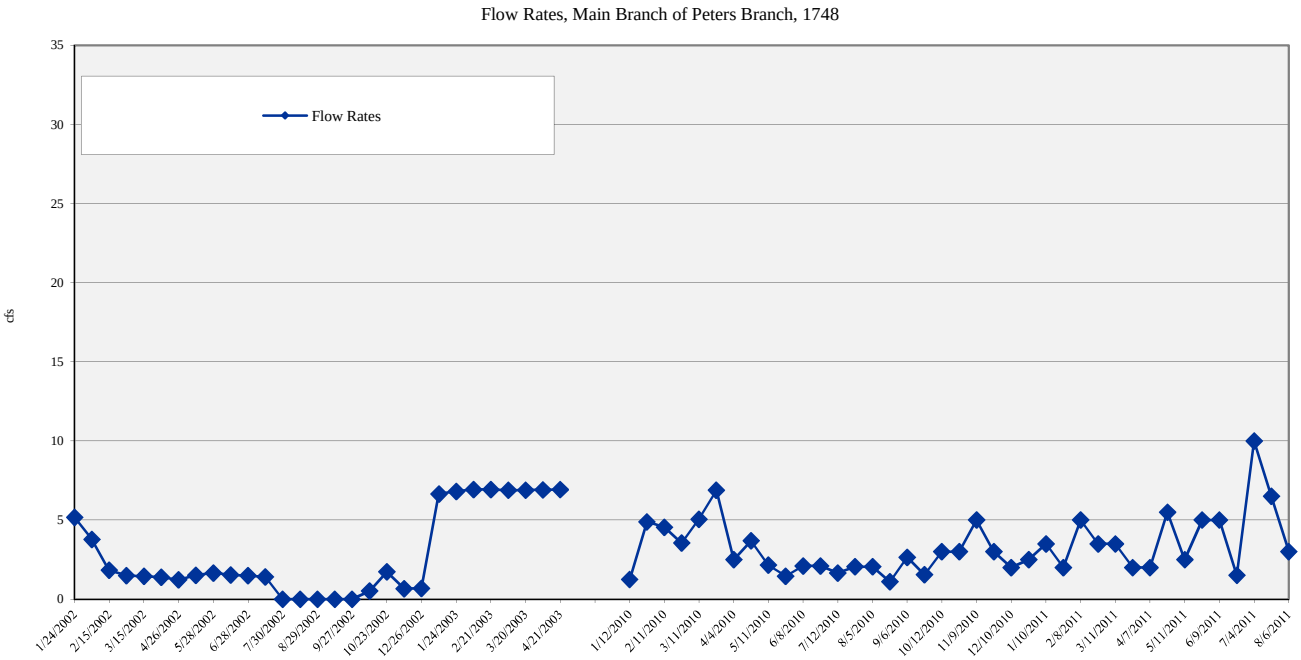

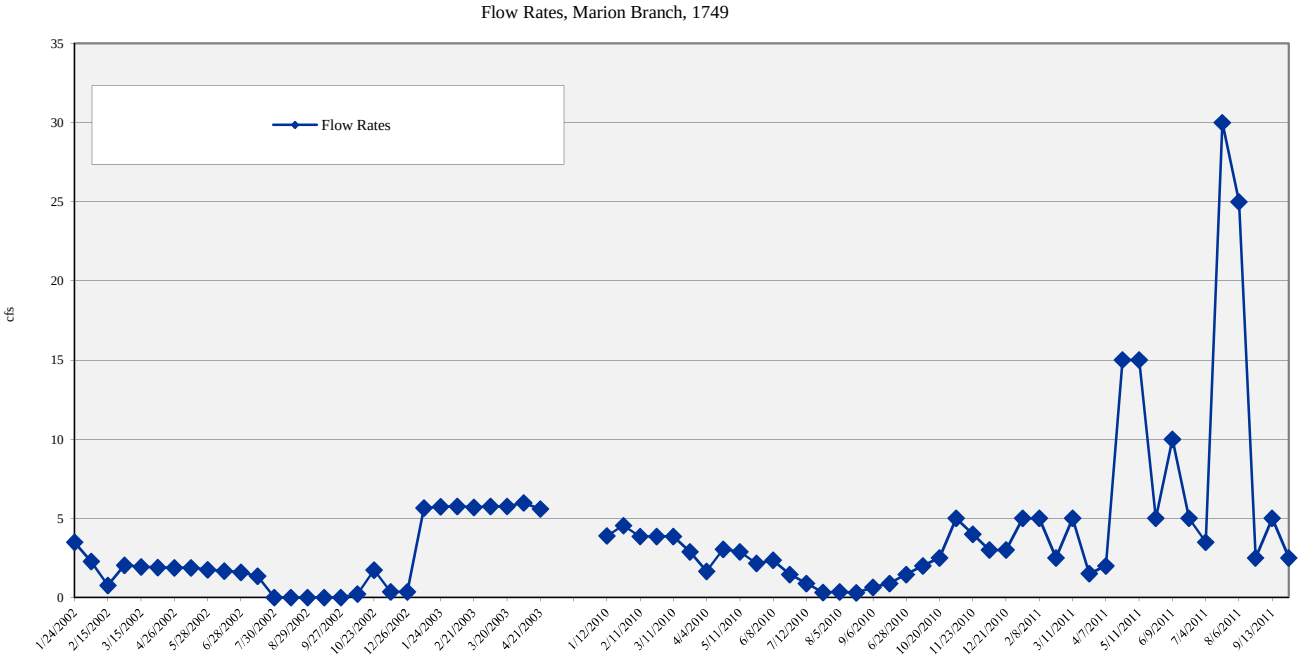

Golder Associates — Denver, Colorado

TITLE

Surface Water Monitoring
Flow Rates

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
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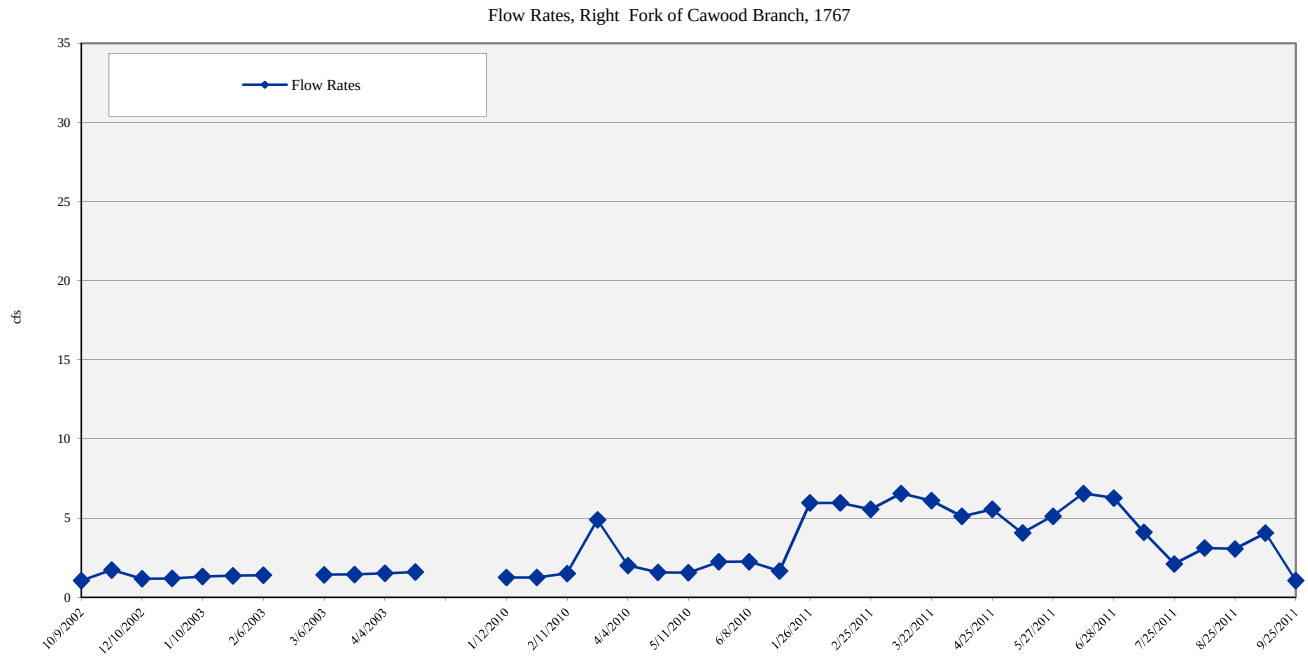

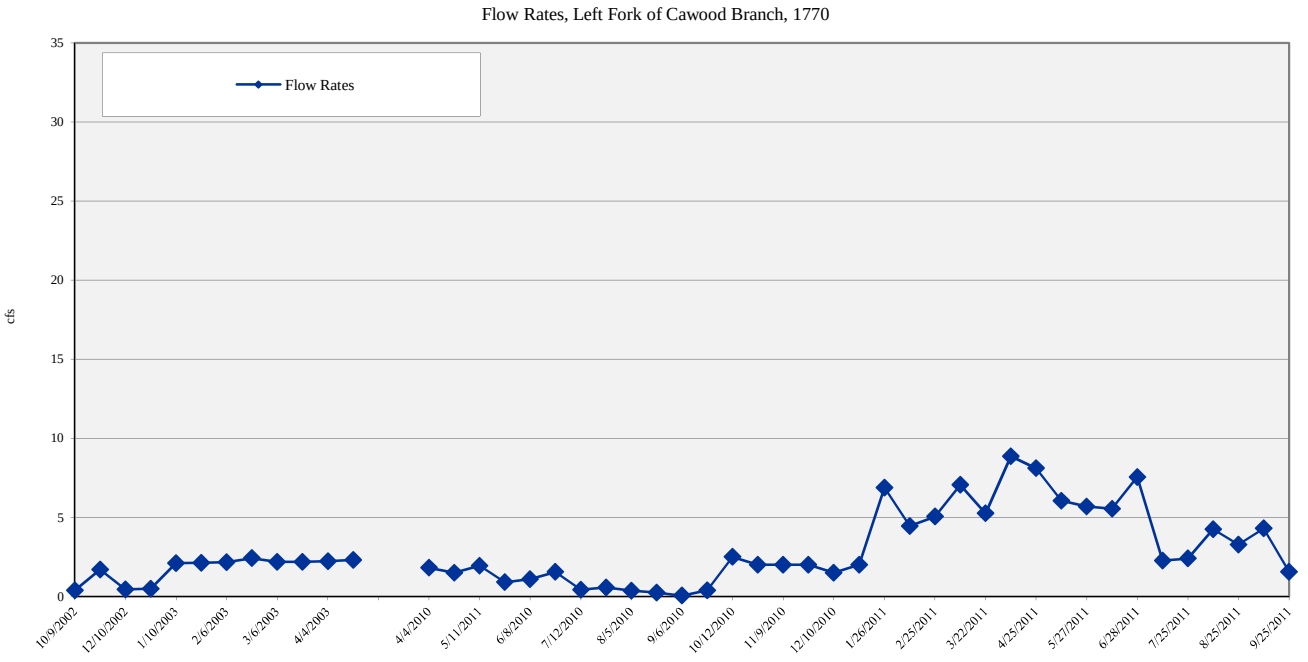

Golder Associates

Denver, Colorado

TITLE

Surface Water Monitoring
Flow Rates

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN SEM	DATE Jun-12	JOB NO. 103-81786	
CHECKED EJP	SCALE As Shown	DWG NO./REV. NO.	
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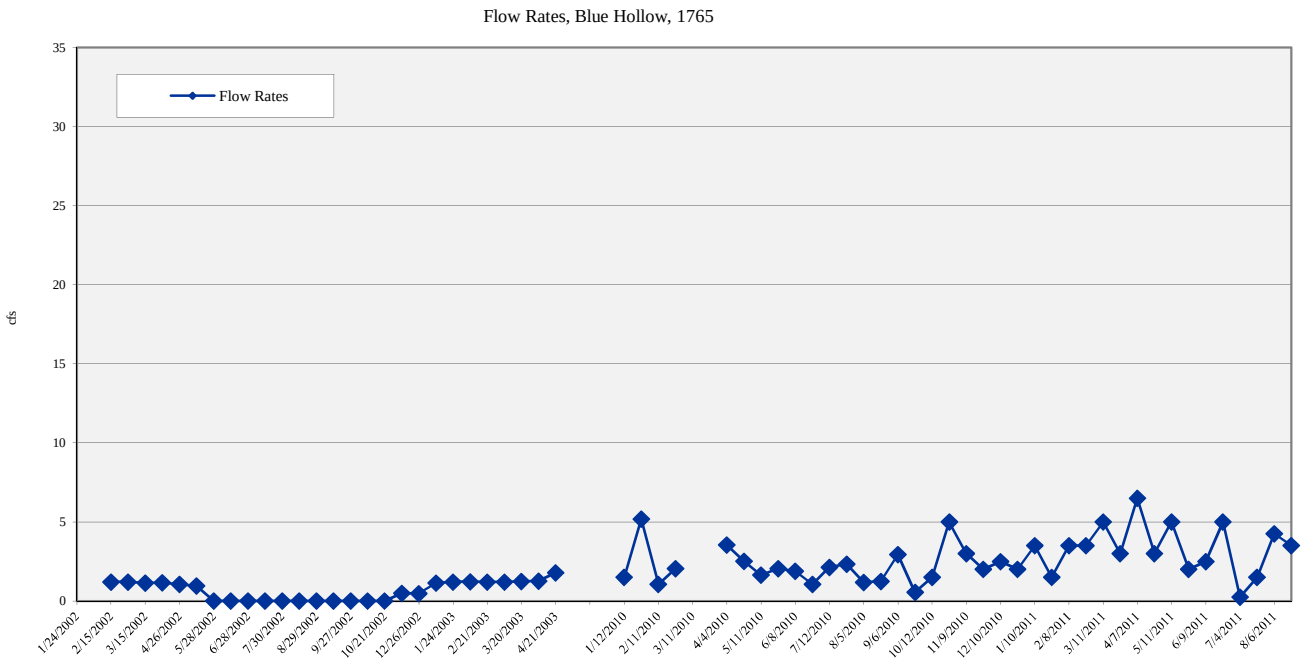

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Denver, Colorado

TITLE

Surface Water Monitoring
Flow Rates

CLIENT/PROJECT

Bledsoe Coal Corporation
Bledsoe EA (KYES-53865)
Leslie County, KY

DRAWN	SEM	DATE	Jun-12	JOB NO.	103-81786
CHECKED	EJP	SCALE	As Shown	DWG NO./REV. NO.	
REVIEWED	MWB	FILE NO.	10381786 RPT-DFT BledsoeCoalEA APP-G.xlsx	FIGURE NO.	App G-2.42

APPENDIX H
GHG EMISSION CALCULATIONS

Beechfork Mine:

Amount:	Equipment:	Electric or Diesel	Total Horsepower	Operating Load Per Week
2	Joy 14 CM Miner	Electric	814 Each	5
4	DBT Carrier	Electric	115 Each	5
6	DBT Bridge	Electric	60 Each	5
4	Fletcher Double Head Roofbolter	Electric	100 Each	5
6	S + S Scoop	Electric	65 Each	5
1	Fairchild Scoop	Electric	65	5
3	Damascus Buggy	Electric	10 Each	5
2	Power Center	Electric		5
3	West Virginia Arm Railrunners	Electric	60 Each	5
1	Brookville 20 Ton	Diesel	143	5
1	Brookville 3 Ton	Diesel	60	5
1	Brookville Mantrip	Diesel	60	5
2	Low Track	Diesel	60 Each	5
1	A.L. Lee 3 Wheeler	Electric	10	5
1	Volvo Loader	Diesel	200	5

Man Power = 112
9.5 hours per man / per day
5 - Production Day / Per Week

Emission Calculations for Combustion Sources
Beech Fork Mine, Bledsoe Coal

Equations [a]:
$CO_2 = 1x10^{-3}$ x Fuel x HHV x EF
$CH_4 = 1x10^{-3}$ x Fuel x HHV x EF
$N_2O = 1x10^{-3}$ x Fuel x HHV x EF

HHV = high heating value =		**0.138**	MMBtu/gal
EF = emissions factors by pollutant:	CO_2	**73.96**	kg/MMBtu
	CH_4	**3.00E-03**	kg/MMBtu
	N_2O	**6.00E-04**	kg/MMBtu

Description	Capacity (hp)	Fuel Type	Heat Input Rate [b] (MMBtu/hr)	Fuel Consumption [c] (gal/yr)	GHG Emissions (metric tons/yr) [d]			
					CO_2	CH_4	N_2O	CO_2e
Brookville 20 Ton	143	Diesel	0.36	6,519	66.5	0.0027	0.00054	66.76
Brookville 3 Ton	60	Diesel	0.15	2,735	27.9	0.0011	0.00023	28.01
Brookville Mantrip	60	Diesel	0.15	2,735	27.9	0.0011	0.00023	28.01
Low Track	60	Diesel	0.15	2,735	27.9	0.0011	0.00023	28.01
Low Track	60	Diesel	0.15	2,735	27.9	0.0011	0.00023	28.01
Volvo Loader	200	Diesel	0.51	9,116	93.0	0.0038	0.00075	93.36

[a] Equations and emission factors based on Tier 1 calculation methodology from 40 CFR 98 Subpart C, Tables C-1 and C-2.
[b] Converted from hp rating.
[c] Calculated based on MMBtu/hr, HHV, and 2,470 hours per year (based on 5 days/week, 9.5 hours/day).
[d] CO_2 equivalents calculated by: CH_4 x 21 = CO_2e, based on 40 CFR 98 Subpart A
N_2O x 310 = CO_2e, based on 40 CFR 98 Subpart A.

Electricity

2009 KWH	2010 KWH	2011 KWH
868000	721000	987000
980000	896000	1085000
854000	903000	1071000
938000	945000	1127000
658000	952000	990000
721000	945000	924000
651000	966000	1036000
749000	945000	1722000
805000	959000	896000
798000	1057000	910000
854000	1015000	1001000
791000	1057000	1001000
9,667,000	11,361,000	**12,750,000 TOTAL**
		highest year

Emission Calculations for Indirect Emission Sources (Electricity Usage)
Beech Fork Mine, Bledsoe Coal

Equations [a]:

CO_2 = Electricity Usage (MWh) x Emission Factor (lb/MWh) x (1 ton/2204.623 lb)

CH_4 = Electricity Usage (MWh) x Emission Factor (lb/MWh) x (1 ton/2204.623 lb)

N_2O = Electricity Usage (MWh) x Emission Factor (lb/MWh) x (1 ton/2204.623 lb)

EF = emissions factors by pollutant:

CO_2	**1,489.54**	lb CO_2/MWh
CH_4	**26.27**	lb CH_4/MWh
N_2O	**25.47**	lb N_2O/MWh

Description	**Annual Consumption** [b] (KWh/yr)	**GHG Emissions (metric tons/yr)** [c]			
		CO_2	CH_4	N_2O	CO_2e
Annual Electricity Usage	12,750,000	8,614.5	151.9	147.3	57,468.15

[a] Emission factors based on *The Climate Registry*, Table 14.1 - SRSO SERC South US Subregion.
[b] Electricity usage based on highest electricity consumption for last 3 years from customer billing history.
[c] CO_2 equivalents calculated by: CH_4 x 21 = CO_2e, based on 40 CFR 98 Subpart A
N_2O x 310 = CO_2e, based on 40 CFR 98 Subpart A.