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100 S. Olive Street, West Palm Beach, FL 33401

October 21, 2022

VIA E-FILING

Kimberly Bose, Secretary Federal Energy Regulatory Commission 888 First Street, N.E. Washington, DC 20426

Subject: Lewis Ridge Pumped Storage, LLC

Lewis Ridge Pumped Storage Project, FERC Project No. 15249

Notice of Intent, Pre-Application Document, and Request to Use Traditional

Licensing Process for the Lewis Ridge Pumped Storage Project

Dear Secretary Bose:

Lewis Ridge Pumped Storage, LLC (LRPS), in accordance with the requirements of 18 Code of Federal Regulation (CFR) Section 5, herein electronically files with the Federal Energy Regulatory Commission (Commission or FERC) the Notice of Intent (NOI) and Pre-Application Document (PAD) for the licensing of the Lewis Ridge Pumped Storage Project (Project) (FERC No. 15249). The preliminary permit, issued by the Commission to Lewis Ridge Pumped Storage, LLC on March 3, 2022 (effective March 1, 2022), will expire either 48 months from the effective date (March 1, 2026) or on the date that a development application submitted by the Lewis Ridge Pumped Storage, LLC has been accepted for filing, whichever occurs first.

The unconstructed Project is located in the Upper Cumberland River Basin in Bell County, Kentucky near the borders of Tennessee and Virginia. The Project would be a closed loop pumped storage hydroelectric generating facility located at a site historically used for mining. The Project is anticipated to provide 287 megawatts (MW) of generation capacity.

Pursuant to 18 CFR §4.38, §5.5(c), and §5.6(a), the NOI and PAD are being distributed electronically to the relevant resource agencies, Native American tribes, non-governmental organizations, and other potential interested parties included on the attached distribution list.

LRPS requests Commission approval to use the Traditional Licensing Process (TLP) for the relicensing of the Project (Attachment A). As provided in 18 CFR §5.3(d)(1), we note that comments on the request to use the TLP must be filed with the Commission within 30 days of this letter. Pursuant to 18 CFR §5.3(d)(2), LRPS has published notice of the request to use the TLP in a daily newspaper of general circulation in the one county in which the Project is located (Bell County, Kentucky); the notice contains the information required by that section.

Kimberly Bose, Secretary
Lewis Ridge Pumped Storage Project
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Notice of Intent, Pre-Application Document, and Request to Use Traditional Licensing Process
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In accordance with 18 CFR §5.5(e), Section 7 of the Endangered Species Act and the joint agency regulations at 50 CFR part 402, Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act, and the implementing regulations at 50 CFR 600.920, LRPS hereby requests to be designated as the Commission's non-federal representative for the purposes of consultation under Section 7 of the Endangered Species Act. LRPS requests authorization to initiate consultation under Section 106 of the National Historic Preservation Act and to implement regulations at 36 CFR Section 8000.2(c)(4).

Should the Commission approve the use of the TLP, LRPS proposes to host a joint agency and public meeting (JAM) of the Project in accordance with 18 CFR §4.38 no earlier than 30 days, but no later than 60 days, from the Commission's TLP approval.

Currently, LRPS proposes to hold the JAM in Pineville, Kentucky on January 25, 2023. The date and location of the meeting may be altered after consultation with jurisdictional agencies and other licensing participants and pending FERC's decision regarding the LRPS request to use the TLP. If FERC requires that LRPS use the Integrated Licensing Process (ILP), then FERC will hold a scoping meeting in accordance with the regulations at CFR §5.8.

Please direct any questions pertaining to the Project or process to Sandy Slayton by phone at (206) 919-3976 or email at sandy@ryedevelopment.com.

Sincerely,

Erik Steimle Vice President

Lewis Ridge Pumped Storage, LLC

Attachments: Distribution List

Request for Use of Traditional Licensing Process

Notice of Intent

Pre-Application Document

Lewis Ridge Pumped Storage Project (P-15249)

Distribution List

Elected Officials

Office of Senator Mitch McConnell Lexington Office 771 Corporate Drive, Suite 108 Lexington, Kentucky 40503

Office of Senator Rand Paul Lexington Office 771 Corporate Drive, Suite 105 Lexington, Kentucky 40503

Office of Representative Harold "Hal" Rogers Somerset Office 551 Clifty Street Somerset, Kentucky 42503

Johnnie Turner Kentucky State Senator (29th District) P.O. Box 351 Harlan, Kentucky 40831

Adam Bowling Kentucky House of Representatives (87th District) P.O. Box 2928 Middlesboro, Kentucky 40965

Federal Agencies

Director
Bureau of Indian Affairs
U.S. Department of the Interior
MS - 4606
1849 C Street NW
Washington, DC 20240

Kim Amendola
Deputy Regional Administrator
National Oceanic and Atmospheric
Administration
National Marine Fisheries Service
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-01930

Commanding Officer United States Coast Guard 95 Peyton Street Barboursville, West Virginia 25504

Mso Paducah United States Coast Guard 225 Tully Street Paducah, Kentucky 42003-0170

Hydropower Coordinator U.S. Army Corps of Engineers Nashville District 110 9th Ave S Nashville, Tennessee 37203

U.S. Army Corps of Engineers Eastern Regulatory Division Nashville District 501 Adesa Parkway, Suite B 250 Lenoir City, Tennessee 37771

U.S. Department of Energy P.O. Box 10940 Pittsburgh, Pennsylvania 15236-0940 Andrew L. Raddant
Regional Environmental Officer
U.S. Department of the Interior
Office of Environmental Policy and
Compliance
15th State Street, 8th Floor
Boston, Massachusetts 02109

Daniel Blackman Regional Administrator U.S. Environmental Protection Agency Region IV 61 Forysth Street, S.W. Atlanta, Georgia 30303

Leopoldo "Leo" Miranda-Castro Regional Director, Southeast Region U.S. Fish and Wildlife Service Ecological Services 1875 Century Boulevard Atlanta, Georgia 30345

John Faustini
Regional Hydrologist and FERC Hydropower
Coordinator, Southeast Region
U.S. Fish and Wildlife Service
Ecological Services
1875 Century Boulevard
Atlanta, Georgia 30345

Lee Andrews
Field Supervisor
U.S. Fish and Wildlife Service
Kentucky Field Office
Interior Region 2 - South Atlantic-Gulf
330 West Broadway, Room 265
Frankfort, Kentucky 40601

Jeff Duncan
Regional Hydropower Coordinator
U.S. National Park Service
Southeast Region
1924 Building
100 Alabama Street SW
Atlanta, Georgia 30303

Tribes

Tim "Healing Spirit" Jordan Chief Southern Cherokee Nation of Kentucky P.O. Box 1750 Henderson, Kentucky 42419

Richard Sneed Principal Chief Eastern Band of Cherokee Indians Qualla Boundary P.O. Box 455 Cherokee, North Carolina 28719

Craig Harper Chief Peoria Tribe of Indians of Oklahoma 118 South Eight Tribes Trail Miami, Oklahoma 74355

Deborah Dotson President Delaware Nation P.O. Box 825 Anadarko, Oklahoma 73005

Douglas Lankford Chief Miami Tribe of Oklahoma P.O. Box 1326 Miami, Oklahoma 74355-1326

State Agencies

Director

Kentucky Department for Environmental

Protection

300 Fair Oaks Lane

Frankfort, Kentucky 40601

Robert Miller

Kentucky Department for Environmental

Protection

Division of Water

London Regional Office

875 S Main Street

London, Kentucky 40741

Gordon R. Stone

Commissioner

Kentucky Department for Natural Resources

300 Sower Boulevard, 2nd Floor

Frankfort, Kentucky 40601

Lonis Morgan, Environmental Control

Manager

Kentucky Division of Mine Reclamation and

Enforcement

1804 E Cumberland Avenue

Middlesboro, Kentucky 40965

Matthew Catron

Regional Biologist

Kentucky Department of Fish & Wildlife

Resources

#1 Sportsman's Lane

Frankfort, Kentucky 40601

Kentucky Department of Fish & Wildlife

Resources

Arnold Mitchell Building

#1 Game Farm Road

Frankfort, Kentucky 40601

Craig Potts

Executive Director and State Historic

Preservation Officer

Kentucky Heritage Council

The Barstow House

410 High Street

Frankfort, Kentucky 40601

Kentucky Tourism, Arts, and Heritage

Cabinet

500 Mero Street, Fifth Floor

Frankfort, Kentucky 40601

Kenya Stump

Executive Director

Kentucky Office of Energy Policy

300 Sower Boulevard

Frankfort, Kentucky 40601

Kentucky Chamber of Commerce

464 Chenault Road

Frankfort, Kentucky 40601

Kentucky Coal & Marketing & Export

Council

Cabinet for Economic Development

300 West Broadway

Frankfort, Kentucky 40601

Kentucky Public Service Commission

211 Sower Boulevard

P.O. Box 615

Frankfort, Kentucky 40602

Patrick Morrisey

Attorney General

West Virginia Office of Attorney General

Building 1, Room E-26

State Capitol Complex

1900 Kanawha Boulevard E

Charleston, West Virginia 25305

Daniel Cameron Attorney General Office of the Attorney General 700 Capital Avenue, Suite 118 Frankfort, Kentucky 40601-3449

Local Governments

Debbie Gambrel
County Clerk
Bell County
101 Courthouse Square
P.O. Box 157
Pineville, Kentucky 40977

Sandra Wilson City Clerk City of Middlesboro City Hall 221 N. 21st Street Middlesboro, Kentucky 40965

Albey Brock
Bell County Judge Executive
101 Courthouse Square
P.O. Box 339
Pineville, Kentucky 40977

Non-Governmental Organizations

Ashley Wilmes Director Kentucky Resource Council P.O. Box 1070 Frankfort, Kentucky 40602

Tom Fitzgerald Kentucky Resource Council P.O. Box 1070 Frankfort, Kentucky 40602

Licensee

Sandy Slayton Vice President Lewis Ridge Pumped Storage, LLC 830 NE Holladay Street Portland, Oregon 97232

Erik Steimle Vice President Rye Development 100 S. Olive Street West Palm Beach, Florida 33401

Lesley Brotkowski Senior Licensing Coordinator Kleinschmidt Associates 233403 Stettin Ridge Court Wausau, Wisconsin 54401

Lewis Ridge Pumped Storage Project FERC Project No. 15249

Request to Use the Traditional Licensing Process

Lewis Ridge Pumped Storage, LLC (LRPS, Permittee, or potential applicant) is including in this filing to use the Federal Energy Regulatory Commission's (FERC or Commission) Traditional Licensing Process (TLP) for the licensing of the Lewis Ridge Pumped Storage Project (Project). The following sections outline how use of the TLP will: a) comply with the criteria outlined in 18 CFR Section 5.3 (C)(1)(ii)(A-F); b) benefit the participants to the process, and c) provide FERC with the information it needs to complete its licensing obligations. Any comments on this request to use the TLP must be filed with the Commission within 30 days of the filing date of this request with FERC, or by November 20, 2022.

A. Likelihood of Timely License Issuance [18 CFR § 5.3(c)(1)(ii)(A)]

Through use of the TLP, LRPS anticipates the timely issuance of an original license for the Project. The TLP will provide agencies and stakeholder with manageable timeframes while also allowing flexibility in scheduling and a collaborative process. Section 2.0 of the Pre-Application Document (PAD) outlines a Process Plan and Schedule following the TLP which, if approved, will ultimately assist the Commission in achieving its goal of issuing a timely license for this Project.

B. Complexity of the Resource Issues [18 CFR § 5.3(c)(1)(ii)(B)]

LRPS does not anticipate complex resource issues at the Project that would require use of the FERC's Integrated Licensing Process (ILP). LRPS has developed a preliminary listing of resource issues and informational needs in Section 6.0 of the PAD. LRPS believes that additional remaining resource issues will be identified through the Joint Agency and Public Meeting anticipated to be held on January 25, 2023, and subsequent site visit and consultation activities. It is LRPS' belief that the resource issues at the Project are relatively simple, as compared to other Projects of this size, and can be adequately addressed, studied, and/or mitigated.

The unconstructed Project is located in Bell County, Kentucky on private land. No federal or tribal lands are in the preliminary Project Boundary. With the exception of the interconnection line, which runs along existing roads, the Project is located in an area historically used for mining. The land on which the Project features are to be located has been previously disturbed for the mining operations or roads. LRPS believes that the Project location is advantageous in utilizing previously disturbed area to minimize resource impacts. The Project will be closed loop, which further limits scope of operational impacts to resource issues due to not having an ongoing hydrologic connection to a natural body of water for the purpose of water storage.

LRPS is committed to public health and safety and will take all necessary steps to ensure that this Project is engineered and designed to ensure a stable, lasting, and safe Project. LRPS will confirm site stability throughout the design phase of the Project, in geotechnical evaluations, engineering, and Project design. The Project engineering and design process as it pertains to site feasibility does not involve complex coordination of resource agencies or stakeholders that would lend itself to requiring the use of the ILP.

C. Level of Anticipated Controversy [18 CFR § 5.3(c)(1)(ii)(C)]

LRPS expects limited controversy associated with the licensing of the Project. LRPS has initiated consultation with resource agencies and stakeholders, as further described in Appendix A of the PAD. LRPS has also evaluated readily available information on the existing environment surrounding the Project and identified where additional information is needed, as detailed in Sections 5.0 and 6.0 of the PAD. Based on the discussions during initial outreach, the limited responses to initial consultation, and the anticipated low complexity of issues identified to date, it is not anticipated at the Project will result in controversy that cannot be resolved within the TLP. Use of the TLP will enable LRPS to reach agreement with the resource agencies and stakeholders on protection, mitigation, & enhancement measures for the Project, as may be determined necessary.

D. Relative Cost of the Traditional Licensing Process Compared to the Integrated Licensing Process [18 CFR § 5.3(c)(1)(ii)(D)]

LRPS fully expects that for all participants of this licensing, the TLP would be more economical than the ILP. The use of the TLP would allow for the potential of a shorter period of preapplication activity, minimize the preparation of formal documents and filings, and further reduce reviews associated with such filings, which would all have the potential to benefit all participants, including resource agencies and stakeholders.

The TLP is also likely to be more efficient for the agencies and stakeholders expected to participate. The timelines and more flexible nature of the TLP will provide the stakeholders and LRPS more options to schedule meetings and develop pre-filing documentation. This flexibility will better allow for the licensing parties to perform such activities in coordination with other ongoing relicensing and routine activities. This schedule will help reduce the overall cost of the licensing effort for LRPS, and the licensing participants.

E. The Amount of Available Information and Potential for Significant Disputes Over Studies [18 CFR § 5.3(c)(1)(ii)(E)]

As presented in the attached PAD, baseline information exists for environmental resources at the Project. To address information gaps, LRPS will work with the resource agencies and stakeholders on needed data collection efforts to address potential resource concerns

associated with the Project. LRPS does not anticipate any significant resource concerns or disputes over studies. LRPS has initiated pre-PAD consultation with the agencies and stakeholders, offering to meet with those interested in learning more about the Project and FERC licensing process. Meetings have been held with the U.S. Fish and Wildlife Service, Kentucky Cabinet for Economic Development, and Kentucky Resources Council. This early consultation has allowed LRPS to identify areas where additional resource information is needed to characterize the existing environment and evaluate potential Project effects. LRPS has identified several studies that will be conducted. Through the Joint Agency and Public Meeting and subsequent site visit and consultation activities, LRPS anticipates that remaining information needs or resource issues will be identified. LRPS plans to work with the interested parties during the development of the study plans to allow for collaborative study plan development. The success of these early efforts in advancing study plan development diminishes the potential for significant disputes over studies. Should a significant dispute arise, LRPS would initiate FERC's dispute resolution process outlined in 18CFR §4.38(b)(6)(i).

F. Other Pertinent Factors [18 CFR § 5.3(c)(1)(ii)(F)]

LRPS plans to collaboratively work with the agencies and stakeholders to develop appropriate study scopes to analyze identified issues. The Applicant is committed to conducting necessary studies to effectively evaluate the issues and anticipates no significant disputes over studies. LRPS believes that the TLP is the most efficient, effective, least burdensome, and most appropriate means to obtain an original license for the Project. For all of the foregoing reasons, LRPS respectfully requests that the Commission grant this request and authorize the LRPS to use the TLP for the licensing of the Project.

As required by 18 CFR § 5.3(d)(1), LRPS is concurrently providing copies of this request to all affected resource agencies, Native American tribes, and potentially interested parties. As required by 18 CFR § 5.3(d)(2), the LRPS is publishing notice of this request simultaneously with the publication of notice of availability of the NOI and PAD in Middlesboro Daily News, a newspaper of general circulation in Bell County, Kentucky.

By this notice, the LRPS is notifying the resource agencies, Native American tribes, and potentially interested parties that comments on this application must be provided to the Commission and the LRPS no later than 30 days following the filing date of this document. All comments should reference **Project No. 15249-000** — **Lewis Ridge Pumped Storage Project**, and they should address, as appropriate to the circumstances of the request, the following topics:

- Likelihood of timely license issuance;
- Complexity of the resource issues;

- Level of anticipated controversy;
- Relative cost of the TLP compared to the ILP;
- The amount of available information and potential for significant disputes overstudies; and
- Other factors believed by the commenter to be pertinent.

United States of America Federal Energy Regulatory Commission

Lewis Ridge Pumped Storage, LLC

Project No. 15249

Notice of Intent of Lewis Ridge Pumped Storage, LLC to File an Application for an Original License for the Lewis Ridge Pumped Storage Project (FERC P-15249)

Pursuant to 18 C.F.R. Section 5.5 of the Federal Energy Regulatory Commission's (Commission or FERC) regulations, Lewis Ridge Pumped Storage, LLC (Permittee, potential applicant, or LRPS) hereby gives notice and declares its intent to apply for an original license for the proposed Lewis Ridge Pumped Storage Project (FERC P-15249) (Project).

Simultaneously, the Permittee is filing its Pre-Application Document (PAD) with the Commission and proposes to conduct pre-filing activities utilizing the Traditional License Process (TLP).

1. The potential applicant's name and address:

Lewis Ridge Pumped Storage, LLC 100 S. Olive Street West Palm Beach, FL 33401

The Permittee requests that all correspondence and service of documents related to this notification and subsequent proceedings be addressed to:

Sandy Slayton Vice President Lewis Ridge Pumped Storage, LLC 830 NE Holladay Steet Portland, OR 97232 Phone: (206) 919-3976

Email: sandy@ryedevelopment.com

2. Project number:

P-15249

3. The license expiration date, if any:

Not applicable. The Project does not possess a FERC license and involves the construction of new facilities.

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4. An unequivocal statement of the potential applicant's intention to file an application for an original license:

Lewis Ridge Pumped Storage, LLC unequivocally declares its intent to file an application for an original license for the Lewis Ridge Pumped Storage Project, P-15249.

5. The type of principal project works licensed, if any, such as dam and reservoir, powerhouse or transmission lines:

This is a Notice of Intent (NOI) for an unconstructed project.

Preliminary Project Description:

As proposed, the Project would consist of the following: (1) a 5,450-foot-long, 135-foot-high roller compacted concrete dam for the upper reservoir with an integrated overflow spillway; (2) an upper reservoir with a surface area of 24 acres and a storage capacity of 2,300 acre-feet; (3) a 3,850-foot-long steel penstock with the upper section likely being 16 feet in diameter and the lower extent bifurcating into two 12 foot diameter steel sections; (4) a steel surge tower or set of energy-dissipating pressure relief valves; (5) a 420-foot-long, 80-foot-wide powerhouse containing two 143.5-megawatt (MW) reversible pump-turbines with a total installed capacity of 287 MW; (6) a 830-foot-long, 80-foot-high roller compacted concrete dam at the lower reservoir with an integrated overflow spillway (7) a 47 acre lower reservoir with a storage capacity of 2,300 acre-feet; and (8) a 2.3-milelong, 161 kilovolt overhead transmission line. The proposed Project would have an estimated annual generation of 671,700 megawatt-hours (Mwh) and a daily energy storage of 2,165 Mwh. The proposed Project would have a storage time of 8 hours at full discharge capacity.

6. The location of the project by state, county, and stream, and, when appropriate, by city or nearby city:

State: Kentucky County: Bell

Stream or body of water: To be determined¹

Nearby cities or towns: Blackmont, Tejay, Balkan, and Callaway

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¹ The preliminary Project design is a closed loop pumped storage project, with recharge water from Tom Fork, a tributary of the Cumberland River located at the Lower Reservoir site. As described in detail in Section 4 of the PAD, the source for the initial fill of water at the Project has not yet been determined.

7. The installed plant capacity:

The proposed installed generation capacity is 287 megawatts (MW).

8. The names and mailing address of:

a. Every county in which any part of the project is located, and in which any Federal facility that is used or to be used by the project is located:

County Clerk
Bell County, Kentucky
101 Courthouse Square
P.O. Box 157
Pineville, Kentucky 40977

b. Every city, town, or similar political subdivision in which any part of the project is or is to be located and any Federal facility that is or is to be used by the project is located:

The proposed Project is located near the unincorporated communities of Blackmont, Tejay, Balkan, and Callaway, Kentucky, which fall under the jurisdiction of the Bell County.

Every city, town, or similar political subdivision that has a population of 5,000 or more people and is located within 15 miles of the proposed project:

City of Middlesboro City Hall 221 N. 21st Street Middlesboro, Kentucky 40965

c. Every irrigation district, drainage district, or similar special purpose political subdivision (A) In which any part of the project is or is proposed to be located and any Federal facility that is or is proposed to be used by the project is located; or (B) That owns, operates, maintains, or uses any project facility or any Federal facility that is or is proposed to be used by the project:

There is no irrigation district, drainage district, or similar special purpose political subdivision in which any part of the Project is located or that owns, operates, maintains, or uses any Project facility.

The Project uses no Federal facilities and occupies no Federal lands.

d. Every other political subdivision in the general area of the Project or proposed Project that there is reason to believe would be likely to be interested in, or affected by, the notification:

There are no other political districts or subdivisions that are likely to be interested in or affected by the notification.

e. Affected Native American Tribes:

The Permittee is not aware that the proposed Project affects any Native American tribe. The following is a listing of Native American tribes that may have some level of interest in the area surrounding the Project and have been included on the Project licensing Distribution List:

Southern Cherokee Nation of Kentucky P.O. Box 1750 Henderson, Kentucky 42419

Eastern Band of Cherokee Indians Qualla Boundary P.O. Box 455 Cherokee, North Carolina 28719

Peoria Tribe of Indians of Oklahoma 118 South Eight Tribes Trail Miami, Oklahoma 74355

Delaware Nation P.O. Box 825 Anadarko, Oklahoma 73005

Miami Tribe of Oklahoma P.O. Box 1326 Miami, Oklahoma 74355-1326

PRE-APPLICATION DOCUMENT

LEWIS RIDGE PUMPED STORAGE PROJECT FERC No. 15249

Prepared for:

Lewis Ridge Pumped Storage, LLC

Prepared by:

Kleinschmidt Associates

October 2022

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DEFINITIONS OF TERMS, ACRONYMS, AND ABBREVIATIONS

°C degrees Celsius

CEII Critical Energy Infrastructure Information

CFR Code of Federal Regulations

cfs cubic feet per second
CFU colony-forming unit

cm centimeter

CPUE catch per unit effort

Commission Federal Energy Regulatory Commission

DLA Draft License Application

DO dissolved oxygen

DOI U.S. Department of Interior

EFH Essential Fish Habitat
EJ Environmental justice

EJScreen Environmental Justice Screening and Mapping Tool

EL Elevation

ESA Endangered Species Act

°F Fahrenheit

FEMA Federal Emergency Management Agency
FERC Federal Energy Regulatory Commission

FLA Final License Application
FOIA Freedom of Information Act

FPA Federal Power Act

Installed Capacity The nameplate MW rating of a generator or group of generators

Interested Parties The broad group of individuals and entities that have an interest in a proceeding

IPaC Information, Planning, and Conservation

Kentucky DFWR Kentucky Department of Fish and Wildlife Resources

L liter

LRPS Lewis Ridge Pumped Storage, LLC

MBI Macroinvertebrate Bioassessment Index

mg milligrams

mg/L milligrams per liter

mi² square-miles ml milliliter

MLRA Major Land Resource Area

msl mean sea level

MW megawatt

MWh megawatt hours

NCLD National Land Cover Database
NHD National Hydrography Dataset
NHPA National Historic Preservation Act
NGO Non-governmental organization

NPS National Park Service

NOI Notice of Intent

NWI National Wetlands Inventory

NRCS Natural Resources Conservation Service

NRHP National Register of Historic Places

NTU Nephelometric Turbidity Units

OKNP Office of Kentucky Nature Preserves

PAD Pre-Application Document
PDF Portable Document Format

Permittee Lewis Ridge Pumped Storage, LLC
Potential applicant Lewis Ridge Pumped Storage, LLC

Project Lewis Ridge Pumped Storage Project P-15249

Project Vicinity The general geographic area in which the proposed Project would be located, as

indicated on the Project Vicinity figures

RCC Roller Compacted Concrete

RM river mile

RTE rare, threatened, and endangered species

SCORP Statewide Comprehensive Outdoor Recreation Plan

SHPO State Historic Preservation Office

TBD To be determined

TLP Traditional Licensing Process
TMDL total maximum daily load
TNS terrestrial nuisance species

μS microsiemens

USACE U.S. Army Corps of Engineers
USDA U.S. Department of Agriculture

USFS U.S. Forest Service

USFWS U.S. Fish and Wildlife Service

USGS U.S. Geological Survey

1.0 INTRODUCTION

Lewis Ridge Pumped Storage, LLC (Permittee, potential applicant, or LRPS) is filing with the Federal Energy Regulatory Commission (FERC or Commission) its Notification of Intent (NOI) to file an application for an original license and the Pre-Application Document (PAD) for the unconstructed Lewis Ridge Pumped Storage Project (FERC No. 15249) (Project). LRPS received a Preliminary Permit for the Project from the FERC on March 3, 2022. The Project would be located in Bell County, Kentucky near the communities of Blackmont, Tejay, Balkan, and Callaway (Figure 1-1). The Project would be a closed loop pumped storage hydroelectric generating facility located at a site historically used for mining. The Project is anticipated to provide 287 megawatts (MW) of generation capacity.

The Permittee provides this PAD as required by Title 18 § 5.6 of the U.S. Code of Federal Regulations (CFR). This PAD accompanies the Permittee's NOI to seek an original license for the Project. The Permittee distributed this PAD and NOI simultaneously to federal and state resource agencies, local governments, Native American tribes, members of the public, and others identified as potentially interested in the licensing proceeding, as listed in the Distribution List. This PAD includes existing, relevant, and reasonably available information related to the Project. The information presented in this PAD provides participants in this licensing the information necessary to identify issues and related information needs.

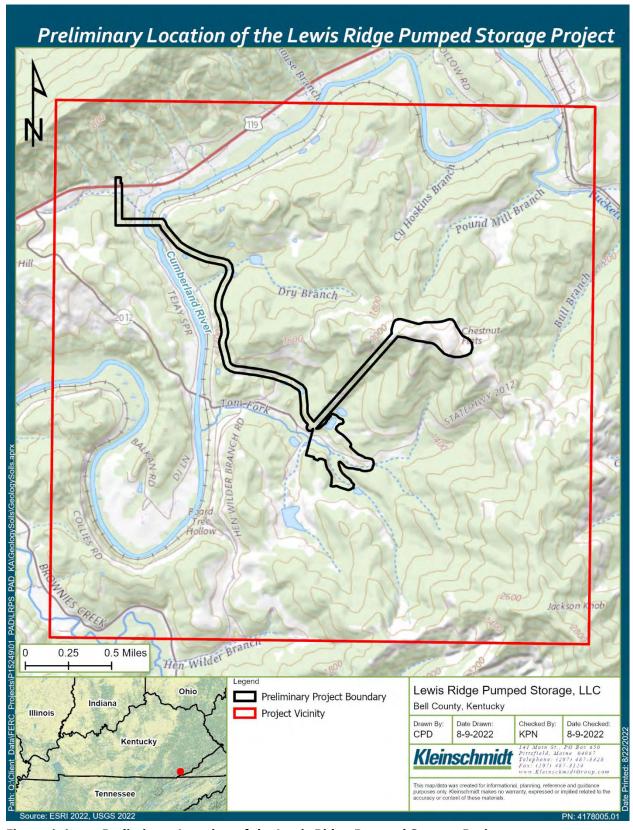


Figure 1-1: Preliminary Location of the Lewis Ridge Pumped Storage Project

1.1 Authorized Agents

The following person is authorized to act as agent for the Permittee pursuant to 18 CFR § 5.6(d)(2)(i):

Sandy Slayton Vice President Lewis Ridge Pumped Storage, LLC 830 NE Holladay Street Portland, Oregon 97232 Phone: (206) 919-3976

Email: sandy@ryedevelopment.com

1.2 PAD Content

This PAD follows the content and form requirements of 18 CFR § 5.6 (c) and (d), with minor changes in form for enhanced readability. This PAD is organized into two volumes. Volume I contains the public information required by 18 CFR § 5.6 (c) and (d) for distribution to Federal and state resource agencies, local governments, Native American Tribes, members of the public, and others likely to be interested in the relicensing proceeding. Volume 2 contains drawings of Project works that meet the definition of Critical Energy Infrastructure Information (CEII) pursuant to FERC's June 23, 2003 Order No. 630-A. Consistent with that order, the Licensee is distributing Volume II only to FERC.

Volume I (Public) of the PAD is organized as follows:

- Table of Contents; List of Tables; List of Figures; List of Appendices; and Definitions of Terms, Acronyms, and Abbreviations.
- Section 1.0 Introduction
- <u>Section 2.0</u> Process Plan and Schedule, Communications Protocol, and Traditional Licensing Process (TLP) Flow Chart, per 18 CFR § 5.6(d)(1).
- Section 3.0 General Description of the River Basin, per 18 CFR § 5.6(d)(3)(xiii).
- <u>Section 4.0</u> Description of Preliminary Project Location, Facilities, and Operation, per 18 CFR § 5.6(d)(2).
- <u>Section 5.0</u> Description of the Existing Environment by Resource Area, per 18 CFR § 5.6(d)(3)(ii-xii).
- <u>Section 6.0</u> Preliminary Listing of Potential Issues, Informational Needs, and Mitigation by Resource, per 18 CFR § 5.6(d)(4)(i-ii).
- Section 7.0 Relevant Resource Management Plans, per 18 CFR § 5.6(d)(4)(iii-iv).

Appendices:

- Appendix A Summary of Contacts and Correspondence Made in Preparing the PAD 18 CFR § 5.6 (d)(5)
- o Appendix B Geologic Maps
- o Appendix C Mining Map
- Appendix D USDA NRCS Physical Soil Properties of Bell and Harlan Counties, Kentucky
- o Appendix E Rare Species Information
- Appendix F EJScreen Reports (Version 2.0) for Census Tract 9604, Block Groups 1 and 2

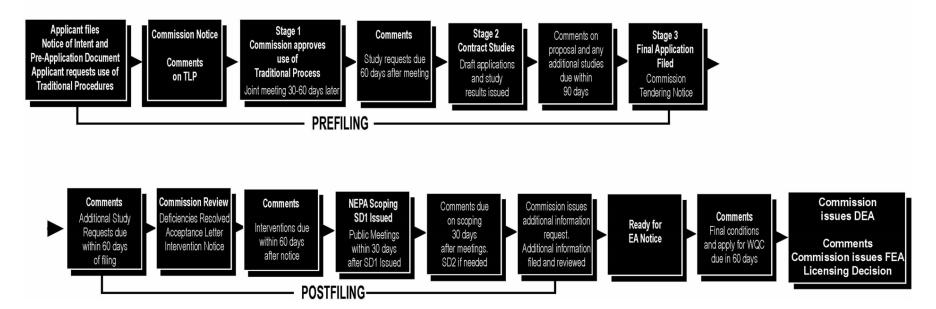
Volume II (CEII) of the PAD is organized as follows:

• Single-line Diagram for the Project

2.0 PLANS, SCHEDULE, AND PROTOCOLS

18 CFR 5.6(d)(1) requires "The pre-application document must include a plan and schedule for all pre-application activity that incorporates the time frames for pre-filing consultation, information gathering, and studies set forth in this part. The plan and schedule must include a proposed location and date for the scoping meeting and site visit required by §5.8(b)(3)(viii)."

Pursuant to 18 CFR § 5.3(b) and (c), the Permittee is requesting FERC's approval to use the Traditional Licensing Process (TLP) for the Project. The Permittee is submitting this request to FERC concurrently with the submittal of the NOI and PAD. Under the TLP, the three-stage pre-filing consultation process described in 18 CFR § 4.38 would be completed and documented. The first stage includes coordination between the Permittee, resource agencies, affected Native American tribes, stakeholders, and the public and includes initial information gathering, notification of interested parties, and study planning and implementation. The second stage involves study implementation and additional data gathering as well as development of a Draft License Application (DLA) and review of the DLA by resource agencies and optionally, FERC. The third stage commences with the filing the Final License Application (FLA), whereby FERC initiates its own review and public comment process, ultimately issuing a license for the Project. Figure 2-1 depicts the regulatory milestones of the TLP.



Source: FERC 2004

Figure 2-1: FERC Traditional Licensing Process Chart

2.1 Process Plan and Schedule through Filling of License Application

Table 2-1 provides the Process Plan and Schedule for the Project, which outlines actions by FERC, LRPS, and other participants in the licensing process through filing of the FLA. This Process Plan and Schedule for the Project assumes FERC approval of the TLP and is based upon the NOI/PAD filing date of October 21, 2022 and all subsequent dates are derived from the NOI/PAD filing date. The Process Plan and Schedule is subject to change throughout the licensing process; however, regulatory timeframes in 18 CFR Part 16 will be respected.

Table 2-1: Pre-Filing Process Plan and Schedule

Responsible			2 11 21
Party	Pre-Filing Milestone	Tentative Date	Regulatory Reference
_	First Stage Co		
LRPS	File NOI/PAD with FERC	10/21/2022	18 CFR § 5.5, 5.6
LRPS	Submit TLP request	10/21/2022	18 CFR § 5.5, 5.3(d)(1)
LRPS	Publish notice of NOI/PAD and TLP	10/21/2022	18 CFR § 5.3(d)(2)
	request in daily or weekly newspaper		
LRPS	Request FERC name licensee as non-	10/21/2022	18 CFR § 5.5(e); Federal
	federal representative for consultation		Endangered Species Act
	regarding ER and Section 106 (formally		(ESA): 50 CFR; National
	allows licensee to consult with U.S. Fish		Historic Preservation
	and Wildlife Service [USFWS], Native		Act (NHPA): 36 CFR §
	American tribes, and State Historic		800.2
	Preservation Officer (SHPO)		
Participants	Comments on the request to use TLP	11/21/2022	18 CFR § 5.3
	due to FERC	(30 days after TLP request	
		submittal)	
FERC	Notice of Commencement of	12/20/2022 (Within 60	18 CFR § 5.8
	Proceeding and action on use of TLP	days of PAD/NOI filing)	
LRPS	Notify FERC, public of Joint Meeting	15 days before scheduled	18 CFR § 4.38(b)(3)(ii)
	and Site Visit	Joint Meeting	
LRPS	Publish notice of Joint Meeting and Site	14 days before Joint	18 CFR § 4.38(g)
	Visit	Meeting	
LRPS. Public Hold Joint Meeting and Site Visit for		1/25/2023	18 CFR § 4.38(b)
meeting at	consultation with agencies, Native	(30 to 60 days from FERC	
which all	American tribes, and public. Location to	approval to use TLP)	
Participants are	be in Pineville, KY. Location and date		
invited to	indicated are tentative.		
attend.			
LRPS	File copy of Joint Meeting record with	Promptly following the	18 CFR § 4.38(b)
	FERC. Provide to any resource agency,	Joint Meeting, as available.	
	Native American tribe, or member of		
	the public upon request.		
Participants	Interested resource agencies, Native	No later than 60 days after	18 CFR § 4.38(b)
	American tribes and members of the	the Joint Meeting.	
	public provide written comments/study	(A 60-day extension may	
	requests	be requested)	
		1	1

Responsible				
Party	Pre-Filing Milestone	Tentative Date	Regulatory Reference	
	Second Stage C	onsultation		
LRPS	Complete studies Year 1 studies: 2022 Year 2 studies: 2023		18 CFR § 4.38(c)	
LRPS Distribute DLA to resource agencies, Native American tribes and interested parties with written request for review and comment		To be determined. At least 6 months prior to filing the FLA.	18 CFR § 4.38(c)	
Participants	Comments on DLA	90-day comment period	18 CFR § 4.38(c)(5), 16.8(c)(5)	
LRPS	If written comments show a substantive disagreement with conclusions on resource impacts, proposed protection or enhancement measures the licensee must hold a Joint Meeting with disagreeing party	Within 60 days of receiving comments 15-day notice of meeting to FERC	18 CFR § 4.38(c)(6)	
	Third Stage Consultation			
LRPS	File FLA with FERC	To be determined. Prior to preliminary permit expiration on 3/03/2026.	18 CFR § 5.17, 4.38(d)	

2.2 Proposed Communications Protocols

Effective communication is essential for meeting the TLP consultation requirements. The Permittee anticipates that the means of communication will be email, meetings, documents, and telephone. The licensing process for the Project is open to the general public and interested individuals and organizations are encouraged to participate. FERC provides additional information on participation at https://www.ferc.gov/industries-data/resources/how-get-involved. Additional information on the proposed communication protocols, as well as information on how to be added to the Permittee's Project Distribution List is provided below.

2.2.1 Parties to the Licensing

In general, there are two categories of participation in a FERC licensing – Interested Parties and Licensing Participants. Interested Parties are a broad group of individuals, agencies, and non-governmental organizations (NGO) that have an interest in the licensing. Sometimes this group is referred to as "stakeholders." Licensing Participants are a subset of Interested Parties. Licensing Participants are the individuals and entities that actively participate in the licensing process. Any Interested Party may elect to be a Licensing Participant. Licensing Participants generally have a specific interest in the licensing and may receive communications related to their specific interest.

2.2.2 General Communications

The Permittee's goal is to keep open communications during the licensing process and provide all Interested Parties with easy access to licensing information. The Permittee will use electronic communications, such as email, as a primary means of providing information during the licensing process. Communications include written correspondence, emails, and notes from individual and conference telephone calls.

2.2.3 Meetings

The Permittee recognizes a number of Native American tribes, agencies, groups, and individuals may want to participate in the licensing process. The Permittee will work with Licensing Participants to develop meeting schedules that include practical locations and times to accommodate the majority of participants. In general, the Permittee will schedule meetings between the hours of 9:00 a.m. and 3:00 p.m. Meetings may be in-person or by conference call. The Permittee will endeavor to begin and end meetings in a timely manner.

To the extent possible, the Permittee will notify Licensing Participants at least two weeks in advance of the next planned public meeting. At that time, the Permittee will provide a meeting agenda via email and/or by mail. The Permittee will also distribute any documents or other information that will be the subject of meeting discussions.

2.2.4 Documents

The Permittee will maintain copies of all public information including Distribution Lists, announcements, notices, communications, and other documents related to the licensing of the Project. Information may be obtained by contacting LRPS at info@lewisridgeproject.com. Key documents will also be available on the Project website: www.lewisridgeproject.com. The Permittee prefers to receive all documents electronically in either portable document format (PDF) or an appropriate MS Office format. Email electronic documents to LRPS at the following email address: info@lewisridgeproject.com. Hard copy documents may be mailed to Rye Development, Lewis Ridge Project, 830 NE Holladay Street, Portland, Oregon 97232.

All applicable documents received will be incorporated into the consultation record for the licensing and made available for distribution to the public.

Documents submitted to and issued by the FERC for the Project are available through FERC's eLibrary under Docket P-15249 (https://www.ferc.gov/ferc-online/elibrary). In addition, all materials filed with or issued by FERC will be available for review and copying at the FERC offices in Washington, DC:

Federal Energy Regulatory Commission Public Reference Room, Room 2-A Attn: Secretary 888 First Street, N.E. Washington, DC 20426

The Permittee will maintain a hard copy of the NOI and PAD at the Bell County Public Library, Pineville Branch, which is located at 214 Walnut Street, Pineville, Kentucky 40977. The background reference material is available via special request by contacting LRPS via email at info@lewisridgeproject.com or via mail at the following address: Rye Development, Lewis Ridge Project, 830 NE Holladay Street, Portland, Oregon 97232.

2.2.4.1 Restricted Documents

Certain Project-related documents may be restricted from public viewing for regulatory and statutory reasons. Critical Energy Infrastructure Information (CEII) (18 CFR § 388.113) relates to the design and safety of dams and appurtenant facilities. Access to CEII documents is restricted to protect national security and public safety. Anyone seeking CEII information from FERC must file a CEII request. FERC's website at https://www.ferc.gov/ceii-filing-guide contains additional details related to CEII.

Information related to protecting sensitive information is also restricted from public viewing. Archaeological or other culturally important information is restricted under Section 106 of the NHPA. Endangered and threatened species are protected by the federal Endangered Species Act of 1973 (16 USCA §§ 1531-1543, P.L. 93-205) and Kentucky endangered species laws. While migratory birds are protected by the Migratory Bird Treaty Act of 1918 (16 U.S.C. §§ 703-712, July 3, 1918, as amended) and eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d, 54 Stat. 250, as amended), specific species locations are not restricted. Anyone seeking this information from FERC must file a Freedom of Information Act (FOIA) request. Instructions for FOIA are available on FERC's website at https://www.ferc.gov/foia.

2.2.4.2 Study Requests

In developing the PAD, the Permittee has collected and summarized readily available information regarding the proposed Project and potential effects on the human and natural environments. The PAD, however, may also indicate areas where there is limited information related to areas of potential concern regarding the Project's operation. In those cases, any party may request additional studies or investigations, as detailed below.

The TLP requires specific information from parties requesting studies related to the licensing. Study requests must be submitted no later than 60 days after the Joint Meeting. Each interested

resource agency, Native American tribe, organization and members of the public must provide the Permittee with written comments and study requests that conform with the regulatory requirements contained in 18 CFR § 16.8.

As specified by 18 CFR § 16.8 (b)(4) of FERC's regulations, any study request must:

- Identify its determination of necessary studies to be performed or information to be provided by the potential applicant;
- Identify the basis for its determination;
- Discuss its understanding of the resource issues involved, and its goals objectives for these resources;
- Explain why each study methodology recommended is more appropriate than any other available methodology alternatives, including those identified by the potential applicant pursuant to paragraph (b)(2)(vi) of this section;
- Document that the use of each study methodology recommended is a generally accepted practice; and
- Explain how the studies and information requested will be useful to the agency, Native American tribe, or member of the public in furthering its resource goals and objectives.

Parties submitting requests should also describe any available cost-share funds or in-kind services that the sponsor of the request may contribute towards the study effort. It is preferred that requests are formatted in MS Word or PDF format and sent via email to ensure timely receipt.

Study requests can be sent to LRPS at info@lewisridgeproject.com.

2.2.4.3 Document Distribution

The Permittee will distribute, whenever possible, all documents electronically in standard MS Word format or PDF. Some documents may be distributed in hard copy for convenience or by request. Distribution of information will follow the guidelines presented in Table 2-2.

Table 2-2: Document Distribution for the Lewis Ridge Pumped Storage Project

Document	Method	Distribution
Public Meeting Notices	Email, U.S. Mail*, and	Public and all Potential Interested
	Newspapers	Parties
Meeting Agendas	Email or U.S. Mail*	Interested Parties
Meeting Summaries	Email or U.S. Mail*	On Request
Process Plan & Schedule	Email or U.S. Mail*	On Request
Major Documents: Notice of Intent, Pre-Application Document, Proposed Study Plans, Study Reports, Draft License Application, Final License Application, etc.		Notice of availability by U.S. Mail or Email to Interested Parties; all documents will be distributed electronically whenever possible.
PAD support documents	Lewis Ridge Pumped Storage, LLC corporate office	On Request

^{*} U.S. Mail service by special request.

2.2.4.4 Mailing Lists

LRPS will maintain a Distribution List of all Interested Parties including Licensing Participants. Any interested entity or individual may request to be added to the Permittee's Distribution List by emailing info@lewisridgeproject.com. The list will include standard U.S. Post Office addresses for distributing notices and documents for public review.

After the Permittee files the FLA, FERC will establish an official Service List for parties who formally intervene in the proceeding. Intervention is a formal legal process in the FERC regulations. Additional information may be found on FERC's website at http://ferc.gov/resources/guides/how-to/intervene.asp. Once FERC establishes a Service List, any written documents filed with FERC must also be sent by the originator to the Service List. A Certificate of Service must be included with documents filed with FERC.

Table 2-3: Mailing Lists for the Lewis Ridge Pumped Storage Project

Entity	Туре	Description
Lewis Ridge Pumped Storage, LLC	Project No. 15249 Distribution List	A list of Interested Parties prepared by the potential applicant in anticipation of the Project licensing proceeding.
	Project No. 15249 Mailing List	A mailing list of Interested Parties prepared and maintained by FERC throughout the Project licensing proceeding.
FERC	Project No. 15249 Service List	A mailing list of parties that have formally intervened in the licensing proceeding, prepared and maintained by FERC after it accepts the License Application.

2.2.5 Telephone

After the Joint Meeting, the Permittee may hold additional meetings via conference call. These and any other routine telephone calls among Licensing Participants that pertain to the Project will be documented as part of consultation.

After the License Application is filed, it is anticipated that FERC will provide public notice of any decisional telephone calls in which it participates prior to acceptance of the License Application. FERC will provide prior public notice of any decisional telephone calls in which it participates after the Commission formally accepts the License Application.

2.3 References

Federal Energy Regulatory Commission (FERC). 2004. Handbook for Hydroelectric Project Licensing and 5 MW Exemptions from Licensing. Available online: https://www.ferc.gov/sites/default/files/2020-04/licensing-handbook.pdf. Accessed: June 2022.

3.0 GENERAL DESCRIPTION OF RIVER BASIN

18 CFR 5.6(d)(3)(xiii) requires "A general description of the river basin or sub-basin, as appropriate, in which the proposed project is located, including information on: (A) the area of the river basin or sub-basin and length of stream reaches therein; (B) Major land and water uses in the project area; (C) all dams and diversion structures in the basin or sub-basin, regardless of function; and (D) Tributary rivers and streams, the resources of which are or may be affected by project operations."

3.1 River Basin and Sub-Basins Description

The Project is a closed loop pumped storage project, located in the Upper Cumberland River Basin, in southeast Kentucky near the borders of Tennessee and Virginia. The nearest major river is the Cumberland, located just over a half a mile from the Lower Reservoir at approximately river mile (RM) 659. The Cumberland River flows in a western direction for approximately 688 miles from the Appalachian Mountains to the confluence with the Ohio River and the mouth of the Tennessee River (Olson 2021). The Project is located within the Upper Cumberland River Watershed (HUC8 05130101), which is part of the Upper Cumberland River Basin (HUC6 051301), which is part of the larger Cumberland River Basin (HUC4 0513) (USGS 2022). These river basins and sub-basins are shown on Figure 3-1.

The drainage area of the Cumberland River Basin (HUC4 0513) is approximately 18,000 square miles (Olson 2021). The Cumberland River Basin (HUC4 0513) stretches across 70 Kentucky and Tennessee counties (Cumberland River Compact 2022a). The drainage area of the Upper Cumberland River Basin (HUC6 051301) is approximately 10,688 square miles. The drainage area of the Upper Cumberland River Watershed (HUC8 05130101) is 2336 square miles. The Upper Cumberland River Watershed (HUC8 05130101) crosses Bell, Clay, Harlan, Knox, Laurel, Leslie, Letcher, McCreary, and Whitley Counties in Kentucky, and Campbell, Claiborne, and Scott Counties in Tennessee (Cumberland River Compact 2022b).



Figure 3-1: Cumberland River Basin and Sub-Basins

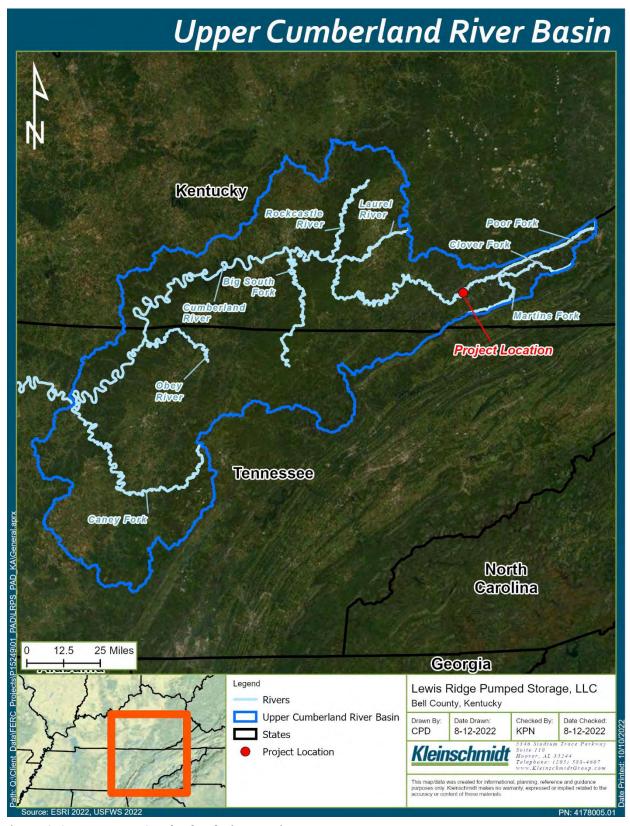


Figure 3-2: Upper Cumberland River Basin

3.2 River Basin Tributaries and Dams

The Cumberland River Basin (HUC4 0513) includes over 22,000 miles of streams and rivers (Cumberland River Compact 2022a). The mainstem of the Cumberland River flows in a westerly direction with its tributaries draining from the north or south (Kentucky EEC 1998). Clover Fork, Martin's Fork, and Poor Fork form the headwaters of the Cumberland River in southeast Kentucky in the city of Harlan (Olson 2021). Between Harlan, Kentucky and Celina, Tennessee, the Cumberland River flows 310 miles and drains 6,400 square miles from over 7,900 miles of tributaries and streams (Cumberland River Compact 2019). Along this stretch, the Cumberland River receives water from streams and creeks such as Rockcastle, Laurel, Big South Fork, Caney Fork, and Obey River (World Atlas 2022). The Cumberland River flows naturally for 135 miles before reaching Lake Cumberland (formed by Wolf Creek Dam). Near Celina, Tennessee, Caney Fork and Obey River join the Cumberland River and it continues through Nashville, Tennessee where the river is dammed to form Old Hickory Lake and Cordell Hull Lake (World Atlas 2022).

The U.S. Army Corps of Engineers (USACE) operates eight dams on the Cumberland River (Wolf Creek Dam, Dale Hollow Dam, Center Hill Dam, Cordell Hull Dam, Old Hickory Dam, J. Percy Priest Dam, Cheatham Dam, and Barkley Dam) and two dams on its tributaries (Martin's Fork Dam and Laurel River Dam) (USACE 2022; Olson 2021). The locations of these dams are shown on Figure 3-3. Major impoundments in the Upper Cumberland Watershed include Lake Cumberland on the mainstem of the Cumberland River, Laurel River Lake, Martins Fork Lake, Cranks Creek Reservoir, Wood Creek Lake, Lake Linville, and Cannon Creek Reservoir (Kentucky EEC 2000).

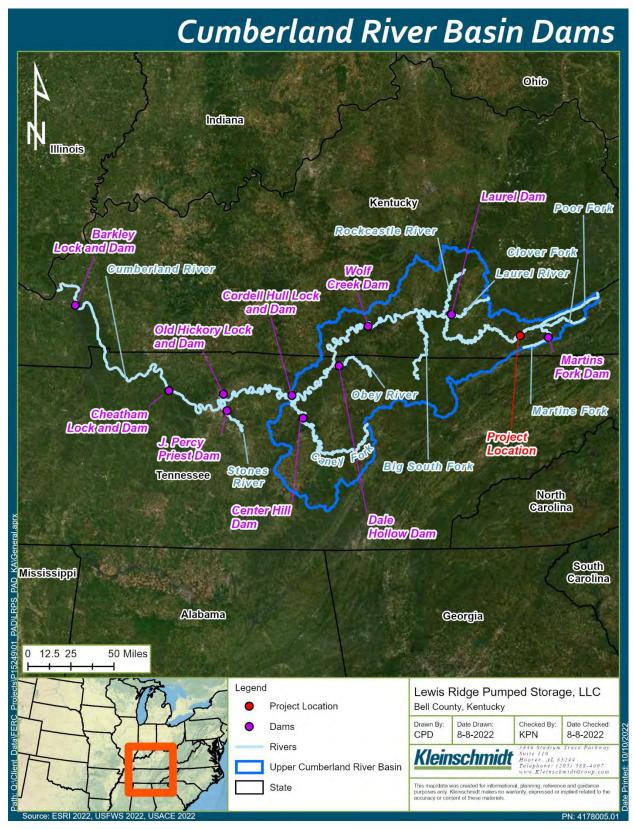


Figure 3-3: USACE Dams on the Cumberland River

3.3 Major Land Uses

The proposed Project is in the Cumberland Plateau Major Land Resource Area (MLRA) 125. The area's general topography is characterized by long, steep side slopes between narrow ridgetops and narrow stream floodplains. Major land uses in the Cumberland Plateau MLRA include commercial timber production and farming (corn, hay, tobacco, and vegetable production). Extensive acreage of forested areas exists in national forests, wildlife management areas, state parks, and privately owned tracts by coal and timber companies within the Cumberland Plateau MLRA. (NRCS 2006).

3.4 Major Water Uses

Public supply, livestock, and irrigation are the major water uses within the Cumberland Plateau MLRA. Total withdrawals average 915 million gallons per day with 84 percent sourced by surface water (from precipitation and perennial streams). Reservoirs within the Cumberland Plateau MLRA provide water for municipal and industrial users, while springs provide for domestic use and livestock. (NRCS 2006).

3.5 Climate

Average annual precipitation for the Cumberland Plateau MLRA is 45-60 inches, and as high as 75 inches in higher elevation areas. Most of the rainfall occurs during summer thunderstorms with half of the annual precipitation occurring during the growing season. Annual temperatures average 50-60 degrees Fahrenheit (°F) and the freeze-free period averages 200 days. (NRCS 2006).

3.6 References

Cumberland River Compact. 2019. Our Cumberland River Basin. Available online:

https://cumberlandrivercompact.org/wp-

content/uploads/2019/11/OurCumberlandRiverBasin PartOne.pdf. Accessed: May 2022.

Cumberland River Compact. 2022a. Cumberland River Basin. Available online: https://cumberlandriverbasin.org/about/ Accessed: August 2022.

Cumberland River Compact. 2022b. Upper Cumberland Watershed. Available online: https://cumberlandriverbasin.org/watershed/upper-cumberland-watershed/ Accessed: August 2022.

Kentucky Environmental and Energy Cabinet (EEC). Kentucky Division of Water. 2000. Cumberland River Basin and Four River Region. Available online at: https://eec.ky.gov/Environmental-Protection/Water/Reports/Reports/BSR1-Cumberland.pdf. Accessed May 2022. Accessed: May 2022.

- Kentucky Environmental and Energy Cabinet (EEC). Kentucky Division of Water. 1998. Removing Fecal Pollution from the Upper Cumberland River Drainage. Available online:

 https://eec.ky.gov/Environmental-Protection/TMDL/Approved%20TMDLs/TMDL-UpperCumberlandandTributariesPathogens.pdf. Accessed: May 2022.
- Natural Resources Conservation Service (NRCS). 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. Available online: https://www.rosemonteis.us/sites/default/files/references/nrcs-2006.pdf. Accessed: May 2022.
- Olson, K.R. 2021. Cumberland River Resource Stewardship and Protection: Managing the Cumberland River and the Land Between the Lakes Landscapes. Journal of Water Resource and Protection. Available online:

 https://www.researchgate.net/publication/349400251 Cumberland River Resource Stew ardship and Protection Managing the Cumberland River and the Land Between the Lakes Landscapes. Accessed: May 2022.
- U.S. Army Corps of Engineers (USACE). 2022. Cumberland River Dams. Available online: https://www.google.com/maps/d/viewer?mid=1ILvFQMLwJRDb7nvK1gCiNXWNW-0&II=36.56067502375252%2C-85.740423&z=8. Accessed: May 2022.
- U.S. Geological Survey (USGS). 2022. Science in Your Watershed 051301 Upper Cumberland. Available online: https://water.usgs.gov/wsc/a_api/wbd/basin05/051301.html. Accessed: August 2022.
- World Atlas. 2022. Cumberland River. Available online: https://www.worldatlas.com/rivers/cumberland-river.html. Accessed: May 2022.

4.0 PRELIMINARY PROJECT LOCATION, FACILITIES, AND OPERATIONS

4.1 Overview

The Project is an unconstructed pumped storage hydroelectric generating facility, which will involve the construction of new water storage, water conveyance, and generation facilities at off-channel locations where no such facilities exist at this time. The proposed Project concept is based on traditional pumped storage technologies of "storing" electric energy in the form of hydraulic potential, by pumping water to Upper Reservoir during off-peak times and allowing it to flow back through hydroelectric turbines when electric demand is peaking. The proposed Project is a closed loop pumped storage project that seeks to derive the benefits of traditional pumped storage, essentially increasing off-peak load and increasing generating capacity during peak demand periods, but in an improved manner that reduces and avoids many of the environmental impacts of the traditional pumped storage facility design. The existing Project site features topography beneficial to a closed loop system. Water will be circulated between a Lower and Upper Reservoir to store/generate power.

The Project is currently in the initial stages of design, permitting, and licensing and exact Project specifications and site-specific locations of the Project features have not been finalized. The specifications associated with the Project as described herein are considered preliminary and may change for reasons such as engineering and geotechnical feasibility, environmental concerns, or site agreements and contracts.

4.2 Project Location

The proposed Project site is located in Bell County, Kentucky, which is in southeast Kentucky near the borders of Tennessee and Virginia. The Project site is located near the communities of Blackmont, Tejay, Balkan, and Callaway and near RM 659 of the Cumberland River.

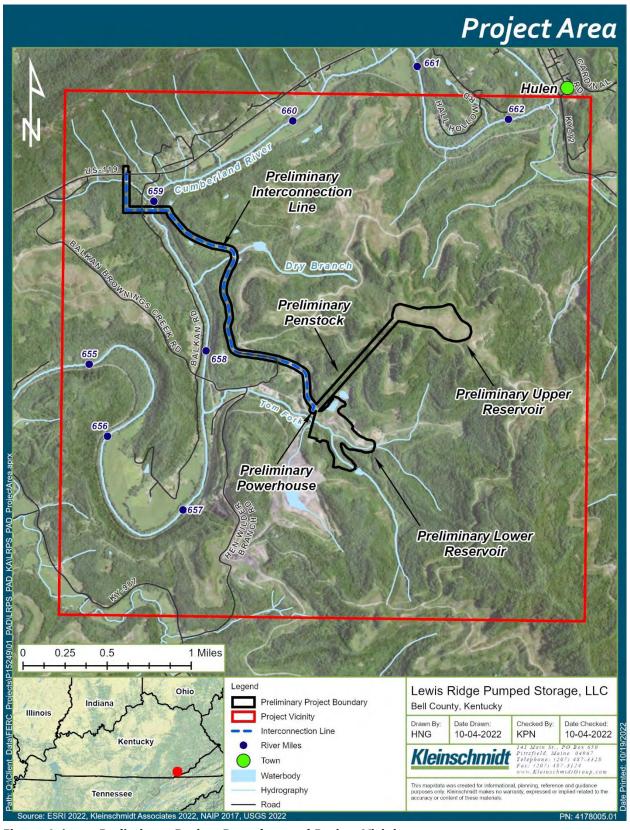


Figure 4-1: Preliminary Project Boundary and Project Vicinity

4.2.1 Preliminary FERC Project Boundary

A preliminary FERC Project Boundary for the proposed Project is shown in Figure 4-1.¹ This preliminary Project Boundary depicts the geographic extent that is anticipated to encompass all land necessary to operate the Project, once construction is completed. The preliminary Project Boundary encompasses approximately 158 acres. The Project is located entirely on private land. There are no lands of the United States in the Project Boundary.

As shown in Figure 4-1 a "Project Vicinity" has been defined for the purpose of this PAD. The Project is unconstructed and in the initial stages of site layout review and design. The Project Boundary in this PAD is considered preliminary. For the purpose of this PAD, environmental resources were described for the area within the Project Vicinity to allow for a broader geographic context of the immediate surrounding area to the Project. It is anticipated that the construction limits of disturbance and any potential changes to the Project Boundary are likely to be located within the defined Project Vicinity.

4.2.2 Project Land Ownership

The preliminary Project Boundary is on private land. There are no Federal or Tribal lands associated with the Project. The site at which the proposed Project facilities are located, with the exception of the Project interconnection line, are located on a site historically used for mining. The key Project features, with the exception of the interconnection line, are located at a site owned largely by Asher Land and Mineral, LLLP. The preliminary location of the Project interconnection line runs adjacent to existing roads across private land.

4.3 Proposed Project Facilities

As proposed, the Project would consist of the following: (1) a 5,450-foot-long, 135-foot-high roller compacted concrete dam for the Upper Reservoir with an integrated overflow spillway; (2) an Upper Reservoir with a surface area of 24 acres and a useable storage capacity of 2,300 acre-feet; (3) a 3,850-foot-long steel penstock with the upper section likely being 16 feet in diameter and the lower extent bifurcating into two 12 foot diameter steel sections; (4) a steel surge tower or set of energy-dissipating pressure relief valves; (5) a 420-foot-long, 80-foot-wide powerhouse containing two 143.5- MW reversible pump-turbines with a total installed capacity of 287 MW; (6) a 830-foot-long, 80-foot-high roller compacted concrete dam at the Lower Reservoir with an integrated overflow spillway; (7) a 47 acre Lower Reservoir with a storage capacity of 2,300 acrefeet; and (8) a 2.3-mile-long, 161 kilovolt overhead interconnection line. The proposed Project would have an estimated annual generation of 671,700 megawatt-hours (MWh) and a daily energy

Pre-Application Document Lewis Ridge Pumped Storage Project (P-15249)

¹ Kentucky does not use the Public Land Survey System in this part of the state, thus township, range, and section are not applicable to the Project Vicinity and not depicted on this figure.

storage of 2,165 MWh. The proposed Project would have a storage time of 8 hours at full discharge capacity. The preliminary Project specifications are provided in Table 4-1.

Table 4-1: Preliminary Project Specifications

Project Description	Specification		
General Information			
FERC Number	P-15249		
Operation Type	Closed Loop Pumped Storage Project		
Project Location	Bell County, Kentucky		
Usable Storage Capacity	2,300 acre-feet		
Gross Storage Capacity	2,600 acre-feet		
Storage Time	8 hours (at full discharge capacity)		
Maximum Gross Head	1,125 feet		
Minimum Gross Head	955 feet		
Average Gross Head	1,038 feet		
Project Generation			
Installed Capacity	287 MW (full reservoir & total for 2 units)		
Average Annual Generation	671,700 MWh		
Average Monthly Generation	55,975 MWh		
Upper Reservoir			
Structure Type	Roller Compacted Concrete (RCC)		
Location	36.770072 Latitude, 83.541272 Longitude		
Minimum Water Surface	Approximately elevation 2,180 feet mean sea level (msl)		
Maximum Water Surface	Approximately elevation 2,300 feet msl		
Surface Area (at normal high water surface elevation 2300 feet MSL)	24 acres		
Dam Height	135 feet (crest at 2,305 feet msl elevation)		
Dam Length	5,450 feet		
Overflow Spillway	Integrated, sized for probable maximum precipitation event and maximum pumping flow		
Water Conduits			
Number of penstocks	1 for upper reach bifurcating to 2 at lower extents		
Diameter of penstocks	16 feet and 12 feet respectively		
Length of penstock	3,850 feet		
Lower Reservoir			
Structure Type	Roller Compacted Concrete (RCC)		
Location	36.760058 Latitude, 83.549833 Longitude		
Minimum Water Surface	Approximately elevation 1,175 feet msl		
Maximum Water Surface	Approximately elevation 1,225 feet msl		

Project Description	Specification	
Surface Area (at normal high water surface elevation 1,225 feet MSL)	47 acres	
Dam Height	80 feet (crest at 1,230 feet msl elevation)	
Dam Length	830 feet	
Overflow Spillway	Integrated, specifications TBD, sized for probable maximum precipitation event after completion of generation cycle (lower reservoir filled)	
Powerhouse		
Location	Attached to Lower Reservoir dam	
Dimensions	420-foot-long, 80-foot-wide	
Pump Turbine-Generators	Two (2) 143.5- MW reversible pump-turbine units	
Rated Flow	3,480 cubic feet per second (cfs) total station flow	
Transformers and Interconnection Lin	nes	
Number of Interconnection Lines	1	
Length of Interconnection Line	2.3 miles	
Interconnection Line Voltage	161 kilovolt	
Number of Transformers	2	
Water Recharge Conveyance System		
Туре	Gravity fed from Tom Fork stream diversion	
Access Roads		
Length of Permanent Access Roads	TBD	
Length of Temporary Access Roads	TBD	

4.4 Proposed Project Operations

The Project would operate as a closed-loop pumped storage project. The Project would pump water from the Lower Reservoir to the Upper Reservoir at times when energy is in excess or in low demand. To generate energy, water would be released from the Upper Reservoir through the penstock to the powerhouse containing two reversible 143.5-MW pump-generator units. This would occur to provide ancillary power services and supplement power generation based on on-peak/off-peak power needs. The Project would have the capacity to generate for 8 hours a day of full discharge, at a maximum of 287 MW, and pump water from the Lower Reservoir to the Upper Reservoir in about 12 hours.

4.5 Initial Fill

As the Project is still in the initial design phase at the time of this PAD, the source for the initial fill of water at the Project has not yet been determined. The preliminary design concept includes a diversion structure in Tom Fork near the Lower Reservoir, which will be used for recharge water,

as described in Section 4.6. It has not yet been determined if initial fill from the drainage basin at the Lower Reservoir will be sufficient, or if temporary pumping from the Cumberland River will be needed to supplement the initial fill of the Project.

LRPS conducted a preliminary hydrologic assessment to gather information on the Lower Reservoir's drainage basin and to estimate the potential evaporation rate at the Project, filling time, and the maximum storm inflow in the drainage basin at the preliminary Lower Reservoir. It was determined that the drainage area of the preliminary Lower Reservoir is 1.82 square miles and that the average annual inflow rate into the Lower Reservoir's drainage basin is 3.3 cfs (or 8,553,600 cubic feet per month). Based on preliminary Project specifications, it was estimated that the Project initial fill duration would be approximately 380 days if 100% diversion of Tom Fork was used.

4.6 Recharge Water

The Project recharge water will be sourced Tom Fork and the associated drainage basin at the Lower Reservoir. The Project is in the initial stages of design, and specifications have not yet been finalized. It is currently envisioned that a new diversion structure across Tom Fork will act as a small dam that can redirect flow by gravity to the Lower Reservoir. A small impoundment of sufficient depth would be created. A small offtake structure would withdraw, by gravity, evaporation and seepage makeup water directly into the Lower Reservoir. When not recharging the system, the gate to the Lower Reservoir would close and water would continue to flow down through the Tom Fork streambed.

Monthly reservoir evaporation volumes (upper and lower individually) range from approximately 131,700 cubic feet to 377,000 cubic feet. The average inflow (annually) is approximately 3.3 cubic feet per second or 8,553,600 cubic feet per month. Therefore, the highest evaporation rate for the combined two reservoirs is only 8% (approximately) of the average monthly stream flow. Seepage losses have not been computed yet given the requirement for further geotechnical investigation.

4.7 One-Line Diagram

The single-line diagram for the Project is considered CEII and is provided in Volume II of this PAD.

4.8 References

Kleinschmidt Associates (Kleinschmidt). 2022, September 22. Lewis Ridge Lower Reservoir Hydrology Memorandum. Document No. 4178005.01_004ME.

5.1 Geology and Soils

18 CFR 5.6(d)(3)(ii) requires "Descriptions and maps showing the existing geology, topography, and soils of the proposed project and surrounding area. Components of the description must include: (A) A description of geological features, including bedrock lithology, stratigraphy, structural features, glacial features, unconsolidated deposits, and mineral resources at the project site; (B) A description of the soils, including the types, occurrence, physical and chemical characteristics, erodability and potential for mass soil movement; (C) A description of reservoir shorelines and streambanks, including: (1) Steepness, composition (bedrock and unconsolidated deposits), and vegetative cover; and (2) Existing erosion, mass soil movement, slumping, or other forms of instability, including identification of project facilities or operations that are known to or may cause these conditions."

5.1.1 Overview

The unconstructed Project is located in Bell County of the Balkan Quadrangle of Kentucky. The area within the majority of the preliminary Project Boundary and Project Vicinity has a history of coal mining, including surface and underground mining methods. Presently, there are active mining permits in the Project Vicinity.

5.1.2 Topography

Figure 5-1 depicts the general topography in the Project Vicinity. The existing ground surface elevations at the Project range from approximately 1,200 to 2,300 feet msl.

The Project is located in an area of southeastern Kentucky with mountainous topography, south of the Pine Mountain Overthrust Fault (USGS and Kentucky Geologic Survey 1988) (Figure B-1 in Appendix B). The Project is located in the level IV ecoregion known as Cumberland Mountain Thrust Block (ecoregion 69e) within the level III Central Appalachians ecoregion (ecoregion 69), which consists of high, steep ridges, hills, coves, narrow valleys (Woods et al. 2002). The Cumberland Mountain Thrust Block is underlain by Pennsylvania shale, siltstone, sandstone, conglomerate, and coal (Woods et al 2002). The sides of many of the mountain peaks and ridges are quite steep. Local relief may be as great as 1,500 feet over a horizontal distance of ½ mile in the area south of the Pine Mountain Overthrust Fault (McGrain and Currens 1978). South of the Pine Mountain Overthrust Fault the rocks of the Breathitt Formation underlie the narrow valleys and form high, rugged hills. The tops of hills and ridges are commonly capped by sandstone. Shales form wide valleys and moderate or gentle slopes on hills (Kilburn et al. 1962).

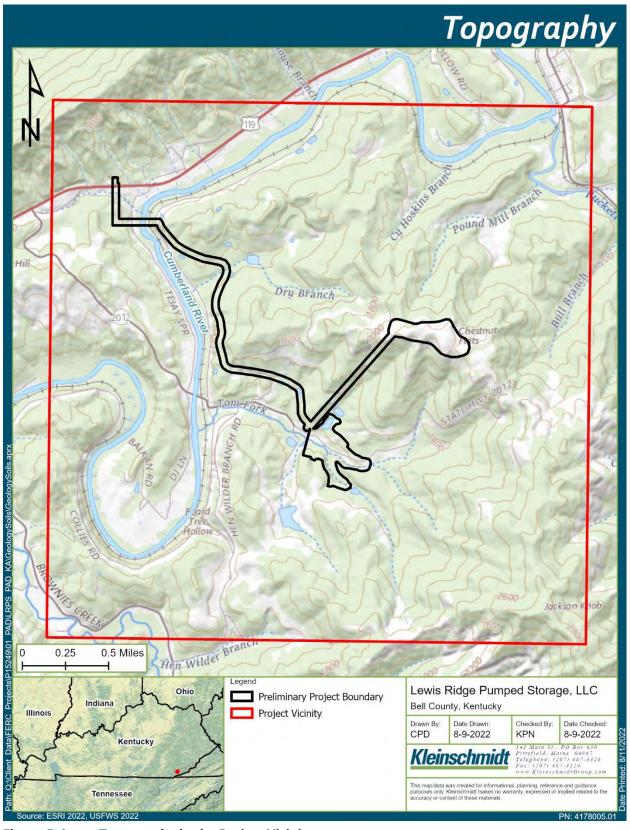


Figure 5-1: Topography in the Project Vicinity

5.1.3 Surficial and Bedrock Geology

The surficial geology of the proposed Project Vicinity consists of sandstone and shale clast loamy colluvium (USGS 1991). The sandstone- and shale-clast loamy colluvium is described as light-gray, brownish-gray, or yellowish-gray, sandy loam to clay loam; poorly sorted and unstratified. It contains angular to subrounded pebble- to boulder-size fragments of sandstone, conglomeratic sandstone, and chips of shale. On steep slopes, the clayey material tends to be unstable, and commonly is associated with instabilities including soil creep and landslides. Mapped areas of colluvium include rock exposures on steep slopes and minor alluvium along streams. Thickness is generally 2 to 7 meters (6.5 to 23 feet), and as much as 25 meters (82 feet) at the foot of some steep slopes.

A geologic map of Kentucky is included in Appendix B as Figure B-1 (USGS and the Kentucky Geologic Survey 1988) and a geologic map of the Balkan Quadrangle, Bell, and Harlan Counties, Kentucky is included in Appendix B as Figure B-2 (Froelich and Tazelaar 1973). The bedrock in the Project Vicinity is mapped primarily as the Breathitt Formation (Froelich and Tazelaar 1973).

Figure 5-2 shows the bedrock geology in the general Project region and Figure 5-3 shows the bedrock geology in the Project Vicinity. As shown, shale is the most common top mapped layer in the Project Vicinity. The U.S. Geological Survey (USGS) and Kentucky Geologic Survey's Geologic Map of Kentucky (1988) confirms the presence of the upper, middle, and lower parts of the Breathitt Formation. The Breathitt Formation (of Pottsville group) consists of sandy shale and coarse ferruginous sandstone with occasional coal seams, with the Pittsburg (Kentucky) coal lying at base. Members of the Hance Formation and the Mingo Formation are located within the Breathitt Formation. Members of the Mingo Formation identified in the Project Vicinity include the Darby coal bed, the Kellioka coal bed, and the Harlan coal bed. Members of the Hance Formation identified in the Project Vicinity include the Mason coal bed, the Mason Rider coal bed, coal beds in the Path Fork coal zone, and coal beds in the Hance coal zone. The Hance Formation is described as mainly shale, some sandstone and coal. The Mingo Formation is described as shales, sandstones, and coals (contains Sandstone Parting, Mingo, and Kellioka coals). At the bottom is the Harlan coal in the east, the Hance coal at the center, and the Bennett Fork coal in the west. (USGS N.d).

A general stratigraphic section includes the Mingo formation, underlain by the Hance and Lee formations. The lithology surrounding the coal seams historically partially mined consists of sandstone, siltstone, and shale. The shale and siltstone are generally medium to dark gray, locally dark gray to black with ironstone nodules common in the lowest third of the unit, interbedded with thin silty sandstone beds. Sandstones are generally light to medium gray, fine to coarse grained, poorly sorted, and generally cross bedded. (Nally & Hamilton Enterprises, Inc. 2007).

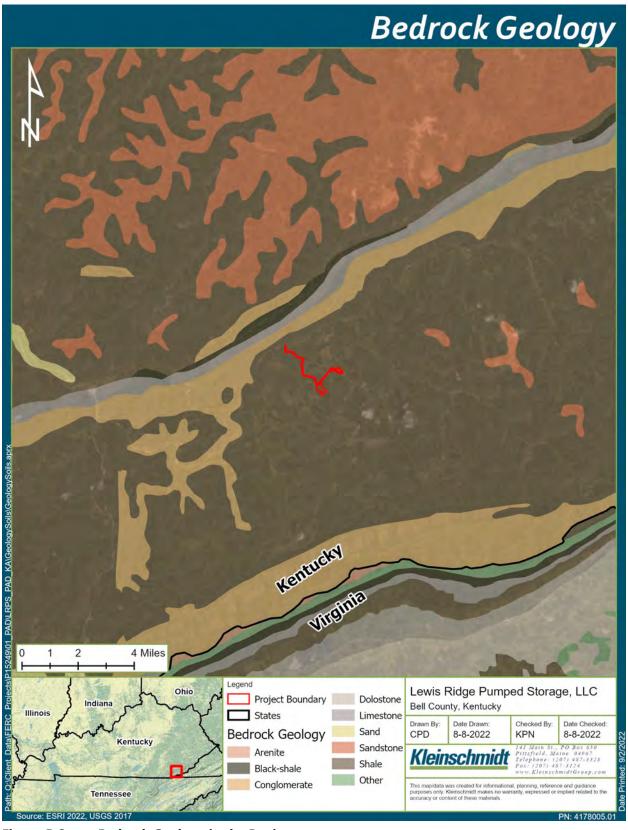


Figure 5-2: Bedrock Geology in the Region

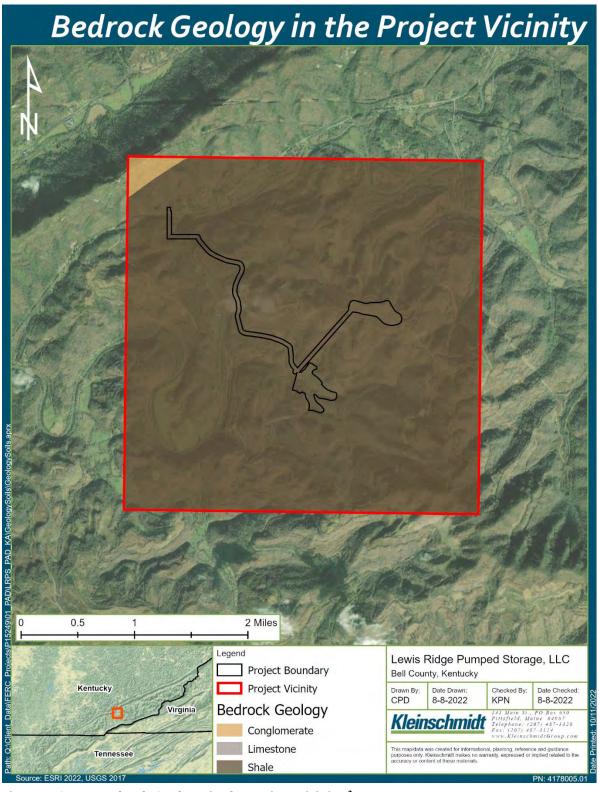


Figure 5-3: Bedrock Geology in the Project Vicinity ²

² Limestone is shown on the legend because a small area (0.1 acres) in the northeastern corner of the Project Vicinity is mapped as limestone, which is not visible at the scale shown.

5.1.4 Soils

The soil types according to the United States Department of Agriculture (USDA) National Resource Conservation Service (NRCS) in the preliminary Project Boundary and Project Vicinity are tabulated in Table 5-1 and Table 5-2, respectively. Soil types in the preliminary Project Boundary and Project Vicinity are depicted on Figure 5-4 and Figure 5-5, respectively (USDA NRCS 2022). Available in Appendix D is the Physical Soil Properties of Bell and Harlan Counties, Kentucky table, which provides a description of physical characteristics, erodibility, and erosion factors associated with each soil type.

Table 5-1: NRCS Mapped Soils in the Preliminary Project Boundary

Мар			% of Preliminary Project
Symbol	Soil Type	Acres	Boundary
ShF	Shelocta-Highsplint-Gilpin complex, 20 to 70 percent slopes, very stony	60.8	39%
FbF	Fairpoint and Bethesda soils, 20 to 70 percent slopes, stony	52.4	33%
GtF	Gilpin-Rayne-Sequoia complex, 25 to 55 percent slopes, very stoney	23.0	15%
GsD	Gilpin-Shelocta silt loams, 12 to 20 percent slopes	12.7	8%
Cr	Craigsville-Philo complex, occasionally flooded	2.8	2%
W	Water	2.5	2%
UrE	Udorthents-Urban land complex, 15 to 35 percent slopes	2.2	1%
Sb	Shelbiana loam, occasionally flooded	1.1	1%
HeF	Helechawa-Varilla-Jefferson complex, 35 to 75 percent slopes, very rocky	0.1	<1%
VrD	Varilla very stony loam, 5 to 20 percent slopes, extremely bouldery	0.1	<1%
	Total	157.6	

Source: USDA NRCS 2022

Table 5-2: NRCS Mapped Soils in the Project Vicinity

Map Symbol	Soil Type	Acres	% of Project Vicinity
SkF	Shelocta-Kimper-Cloverlick complex, 20 to 80 percent slopes, very stony	1,575.1	25%
ShF	Shelocta-Highsplint-Gilpin complex, 20 to 70 percent slopes, very stony	1,199.3	19%
GtF	Gilpin-Rayne-Sequoia complex, 25 to 55 percent slopes, very stony	773.9	12%
FbF	Fairpoint and Bethesda soils, 20 to 70 percent slopes, stony	761.9	12%
HsF	Highsplint-Cloverlick-Guyandotte comples, 35 to 75 percent slopes, very stony	368.7	6%
Sb	Shelbiana loam, occasionally flooded	347.2	6%
SmF	Shelocta-Kimper-Cutshin complex, 20 to 55 percent slopes, very stony	325.5	5%
HeF	Gilpin-Rayne-Sequoia complex, 25 to 55 percent slopes, very stony	187.0	3%
W	Water	127.5	2%
SgE	Shelocta-Gilpin silt loams, 20 to 35 percent slopes	77.6	1%
CgF	Cloverlick-Guyandotte-Highsplint complex, 20 to 80 percent slopes, very stony	70.2	1%
AtF	Alticrest-Totz-Helechawa complex, rocky, 20 to 55 percent slopes		1%
AgB	Allegheny loam, 2 to 6 percent slopes	63.9	1%
VrD	Varilla very stony loam, 5 to 20 percent slopes, extremely bouldery	59.6	1%
Ро	Pope fine sandy loam, occasionally flooded	57.5	1%
Du	Dumps, Mine; tailings; and Tipples	52.9	1%
FbC	Fairpoint and Bethesda soils, 2 to 20 percent slopes	48.7	1%
GsD	Gilpin-Shelocta silt loams, 12 to 20 percent slopes	27.3	<1%
UrE	Udorthents-Urban land complex, 15 to 35 percent slopes	20.6	<1%
HeF	Helechawa-Varilla-Jefferson complex, 35 to 75 percent slopes, very rocky	13.1	<1%
Ud	Udorthents-Urban land complex, occasionally flooded	3.1	<1%
Cr	Craigsville-Philo complex, occasionally flooded	2.8	<1%
	Total	6,231.8	

Source: USDA NRCS 2022

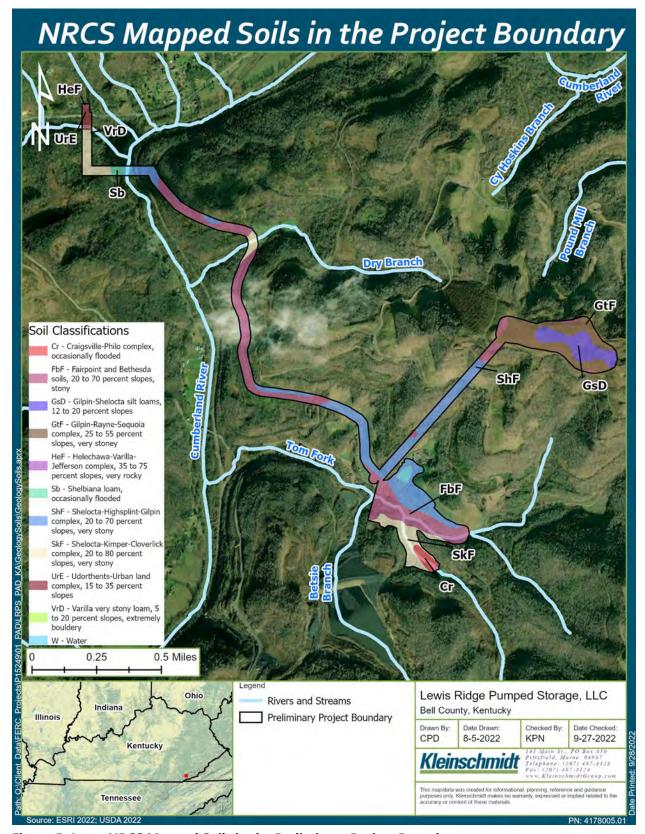


Figure 5-4: NRCS Mapped Soils in the Preliminary Project Boundary

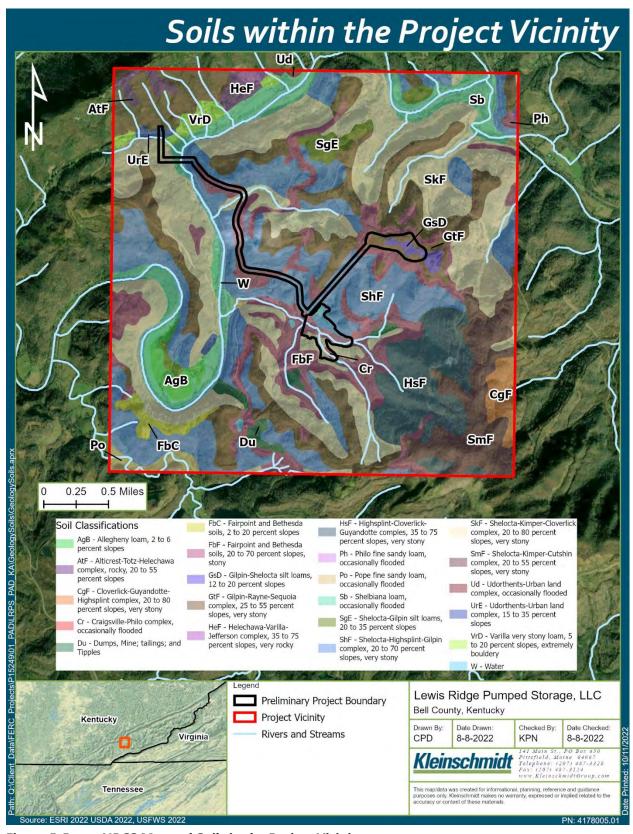


Figure 5-5: NRCS Mapped Soils in the Project Vicinity

5.1.5 Seismic Hazards

Per the USGS Earthquake Hazards Map 2014, the Project is located in a seismic area with a ground peak acceleration of approximately 0.25g, with a 2 percent probability of exceedance in 50 years (2,475-year recurrence interval). Using the U.S. Geological Survey - Earthquake Hazards Program Search Earthquake Catalog, there were no results for earthquakes greater than 2.5 in magnitude within 500 kilometers of the Project location since 1900.

5.1.6 Mining Activities

The Project is located on a property that has historically been used for coal mining. Appendix C contains a map that shows documented mined areas in the Project Boundary. There are active mining permits in the Project Vicinity and many areas have been reclaimed. All historically mined areas on which Project features will be located will be reclaimed.

There are six identified coal seams in the Project Vicinity. From highest to lowest elevation, the seams are Darby, Kellioka, Harlan, Upper Path Fork, Hance, and Mason.

Besides the mining activities in the Project Vicinity, LRPS is not aware of any existing erosion, mass soil movement, slumping, or other forms of instability at the Project location.

5.1.7 References

- Albert J. Froelich and James F. Tazelaar. 1973. Geologic Map of the Balkan Quadrangle, Bell, and Harlan Counties, Kentucky.³
- Chabot Kilburn, W.E. Price, Jr., and D.S. Mull. 1962. Availability of Groundwater in Bell, Clay, Jackson, Knox, Laurel, Leslie, McCreary, Owsley, Rockcastle, and Whitley Counties, Kentucky. Published by the U.S. Geological Survey.
- McGrain, P., and Currens, J.C. 1978. Topography of Kentucky: Kentucky Geological Survey, ser. 11, Special Publication 25, 76 p.
- Nally & Hamilton Enterprises, Inc., 2007, Permit 807-0333 Application.
- RESPEC Company, LLC (RESPEC). 2022. Lewis Ridge Project Status Report, External Memorandum.
- United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). 2022. Web Soil Survey. Available online: https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx Accessed: August 2022.

³ Available as Figure B-2 in Appendix B.

- U.S. Geologic Survey (USGS). 1991. Quaternary Geologic Map of the Blue Ridge 4° x 6° Quadrangle, United States.⁴
- U.S. Geologic Survey (USGS) and the Kentucky Geologic Survey. 1988. Geologic Map of Kentucky, Sesquicentennial Edition of the Kentucky Geologic Survey. 5
- U.S. Geologic Survey (USGS). N.d. A Geologic Map of a Part of the Cumberland Gap Coal Field, Western Sheet.⁶
- Woods, A.J., J.M. Omernik, W.H. Martin, G.J. Pond, W.M. Andrews, S.M. Call, J.A. Comstock, and D.D. Taylor. 2002. Ecoregions of Kentucky (color poster with map, descriptive text, summary tables, and photographs): Reston, VA, U.S. Geological Survey (map scales 1:1,000,000).

⁴ Available as Figure B-3 in Appendix B.

⁵ Available as Figure B-1 in Appendix B.

⁶ Available as Figure B-4 in Appendix B.

5.2 Water Resources

18 CFR 5.6(d)(3)(iii) requires "A description of the water resources of the proposed project and surrounding area. This must address the quantity and quality (chemical/physical parameters) of all waters affected by the project, including but not limited to the project reservoir(s) and tributaries thereto, bypassed reach, and tailrace. Components of the description must include: A) Drainage area; (B) The monthly minimum, mean, and maximum recorded flows in cubic feet per second of the stream or other body of water at the powerplant intake or point of diversion, specifying any adjustments made for evaporation, leakage, minimum flow releases, or other reductions in available flow; (C) A monthly flow duration curve indicating the period of record and the location of gauging station(s), including identification number(s), used in deriving the curve; and a specification of the critical streamflow used to determine the project's dependable capacity; (D) Existing and proposed uses of project waters for irrigation, domestic water supply, industrial and other purposes, including any upstream or downstream requirements or constraints to accommodate those purposes; (E) Existing instream flow uses of streams in the project area that would be affected by project construction and operation; information on existing water rights and water rights applications potentially affecting or affected by the project; (F) Any federally-approved water quality standards applicable to project waters; (G) Seasonal variation of existing water quality data for any stream, lake, or reservoir that would be affected by the proposed project, including information on: (1) Water temperature and dissolved oxygen, including seasonal vertical profiles in the reservoir; (2) Other physical and chemical parameters to include, as appropriate for the project; total dissolved gas, pH, total hardness, specific conductance, chlorophyll a, suspended sediment concentrations, total nitrogen (mg/L as N), total phosphorus (mg/L as P), and fecal coliform (E. Coli) concentrations; (H) The following data with respect to any existing or proposed lake or reservoir associated with the proposed project; surface area, volume, maximum depth, mean depth, flushing rate, shoreline length, substrate composition; and (I) Gradient for downstream reaches directly affected by the proposed project."

5.2.1 Overview

Within the preliminary Project Boundary are the Cumberland River and two known tributaries, Tom Fork and Dry Branch (Figure 5-6). Tom Fork is located at the preliminary Lower Reservoir location. Tom Fork flows from east-to-west to its confluence with the Cumberland River. The preliminary interconnection line crosses Dry Branch in a single span. Dry Branch flows from east-to-west across the preliminary interconnection line to its confluence with the Cumberland River. The preliminary interconnection line also crosses the Cumberland River in a single span.

Water resources in the Project Vicinity are also discussed below. This includes a discussion of the Cumberland River, which is in the Project Vicinity and crossed by the interconnection line.

Figure 5-6 depicts the National Hydrography Dataset (NHD) mapped features within the Project Vicinity. The Cumberland River is mapped on the NHD as a stream/river, Dry Branch is mapped as an intermittent stream, and Tom Fork is mapped as a perennial stream below the preliminary Lower Reservoir location and as an intermittent stream above the Lower Reservoir location.

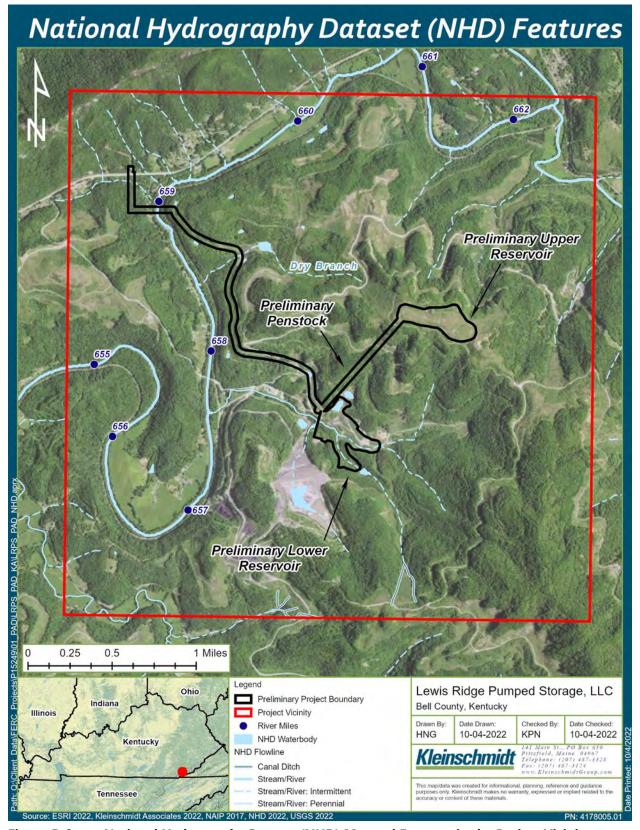


Figure 5-6: National Hydrography Dataset (NHD) Mapped Features in the Project Vicinity

5.2.2 Drainage Area

The drainage area of the Cumberland River near the Project is approximately 468 square miles, and the drainage area of the river basin is described in Section 3.1.

At the Project, the drainage area of the Upper Reservoir is simply the size of the proposed reservoir, which is approximately 24 acres.

The drainage area of the Lower Reservoir is approximately 1.82 square miles (Kleinschmidt 2022). This drainage area of the Lower Reservoir is shown in Figure 5-7. To calculate this drainage area and develop the figure, USACE HEC-HMS v4.10 software was used to delineate the drainage area of the basin containing the Lower Reservoir. The terrain data used to delineate the watershed was KyFromAbove's 5-foot digital elevation model, which was obtained from the Kentucky Division of Geographic Information's website.



Figure 5-7: Drainage Area of Preliminary Lower Reservoir

5.2.3 Streamflow, Gage Data, and Flow Statistics

The following information pertains to the Cumberland River⁷, which is located in the Project Vicinity. Table 5-3 provides information about two USGS gage sites on the Cumberland River located in close proximity to the Project Vicinity. USGS gage number 03401000 (Harlan gage) is located approximately 20 miles upstream of the Project Vicinity and USGS gage number 03402900 (Pineville gage) is located approximately 15 miles downstream of the Project Vicinity. Streamflows are highest in the winter months of January through March and lowest in the summer and early fall between August and October. Monthly average and median streamflows at the Harlan gage are provided in Table 5-4.

There is no historical gauged streamflow data available for the two small tributaries that are in the preliminary Project Boundary, Tom Fork and Dry Branch. LRPS conducted preliminary hydrologic assessment of the drainage basin at the Lower Reservoir, which is on Tom Fork (Kleinschmidt 2022). As described in Section 4.6, the Project recharge water will be sourced from the drainage basin in which the Lower Reservoir is located. This preliminary hydrologic assessment estimated that the average annual inflow rate into the Lower Reservoir's drainage basin is 3.3 cfs (or 8,553,600 cubic feet per month) (Kleinschmidt 2022).

Table 5-3: Cumberland River USGS Gage Sites near the Project Vicinity

USGS Gage Number	Description	Drainage Area Square Miles (mi²)	Period of Record
03401000	Cumberland River near Harlan, Kentucky (approximately 20 miles upstream of Project Vicinity)	374	April 1940- Present
03402900	Cumberland River at Pine St Bridge at Pineville, Kentucky (approximately 15 miles downstream of Project Vicinity)	770	1991-Present

Sources: USGS 2022a, USGS 2022b

Pre-Application Document Lewis Ridge Pumped Storage Project (P-15249)

⁷ As described in Section 4.5, the Project is still in the initial design phase and the source for the initial fill of water at the Project has not yet been determined.

Table 5-4: Monthly Minimum, Average, Median, and Maximum Flows for the Cumberland River at the Harlan Gage (USGS Gage 03401000) for Water Years 1941-2021

Month	Minimum Flow (cfs)	Average Flow (cfs)	Median Flow (cfs)	Maximum Flow (cfs)
January	64	1,143	722	2,767
February	105	1,374	863	3,692
March	334	1,453	960	4,148
April	211	1,099	728	2,986
May	119	758	486	2,003
June	76	390	242	1,224
July	21	312	170	1,414
August	40	246	134	1,202
September	14	153	82	1,018
October	9	201	92	1,129
November	26	466	224	2,004
December	44	944	573	2,704

Source: USGS 2022a

5.2.4 Flow Duration Curves

Provided in Figure 5-8 and Figure 5-9 are monthly flow duration curves for the Cumberland River, using flow data obtained from the Harlan gage (USGS gage 03401000) for the period October 1, 1940 to September 30, 2021 (i.e., water years 1941-2021). Peak flows typically occur in January through May and have historically exceeded 20,000 cfs. Low flows typically occur during the late summer and fall months and are frequently less than 100 cfs. Flow duration curves are not included for Tom Fork or Dry Branch as these data do not exist.

As the unconstructed Project is a closed loop pumped storage facility, streamflow does not impact the Project's dependable capacity.

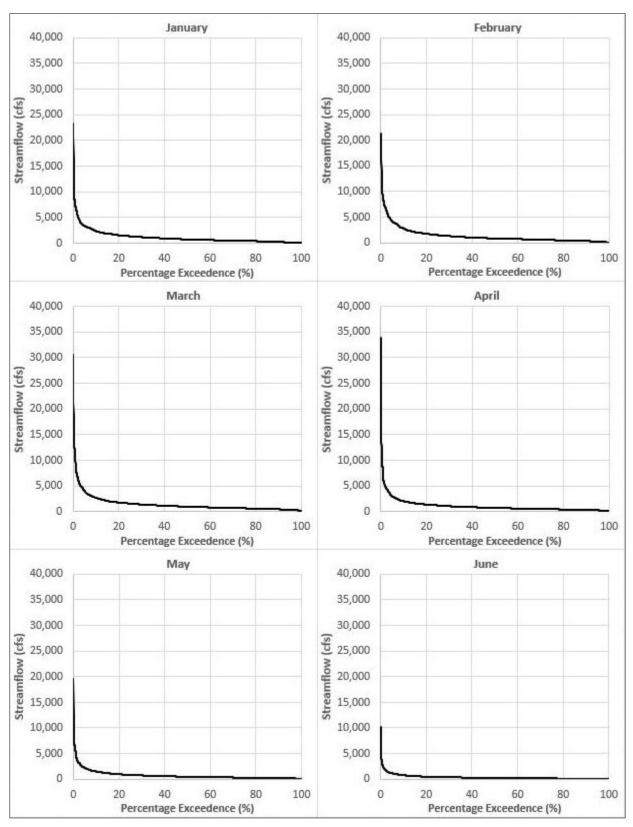


Figure 5-8: January through June Flow Duration Curves for the Cumberland River at the Harlan Gage

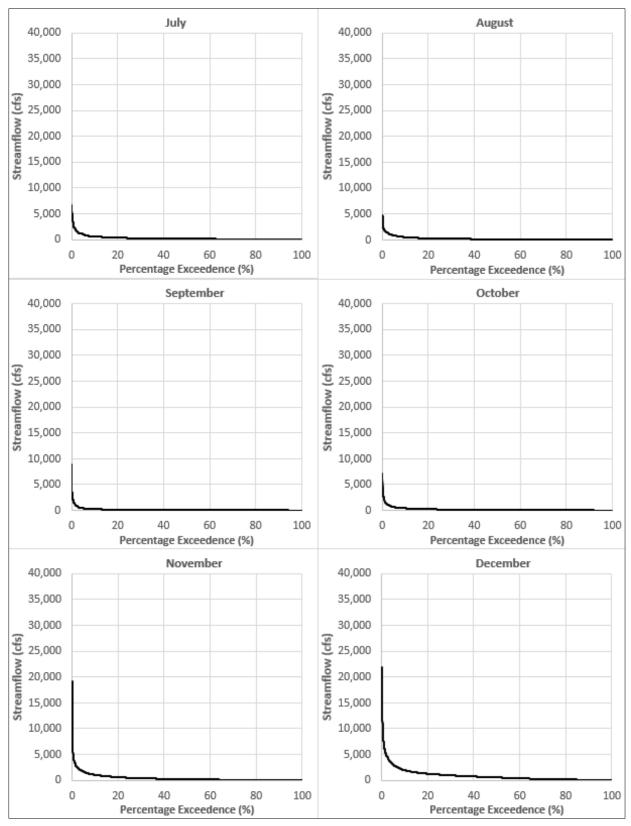


Figure 5-9: July through December Flow Duration Curves for the Cumberland River at the Harlan Gage

5.2.5 Existing and Proposed Uses of Waters

The proposed Project consists of construction of an upper and lower reservoir to store water for the purpose of electric power generation. Reservoir recharge water will be sourced from Tom Fork to account for evaporative water loss and minimal quantities of seepage.

5.2.6 Existing Instream Flow Uses

The Cumberland River in the Project Vicinity is designated for both warm water aquatic habitat and primary contact recreation (KAR 2020). Per the Kentucky Division of Water, Water Maps Portal Source Water Protection Viewer (Kentucky Division of Water 2022), there are no permitted water withdrawals from the Cumberland River or its tributaries within the Project Vicinity.

5.2.7 Federally-Approved Water Quality Standards

Applicable water quality standards for the Cumberland River and its tributaries (i.e., Tom Fork and Dry Branch) in the Project Vicinity are summarized in Table 5-5. This table outlines the warm water aquatic habitat water quality standards.

Primary Contact Recreation standards are also applicable to the Cumberland River in the Project Vicinity between May 1st through October 31st. These standards state that the *E. coli* content shall not exceed 130 colonies per 100 milliliters (ml) as a geometric mean based on not less than five samples taken during a thirty-day period. The *E. coli* content also shall not exceed 240 colonies per 100 ml in twenty percent or more of all samples taken during a thirty-day period. Fecal coliform criteria applies during the remainder of the year and shall not exceed 1,000 colonies per 100 ml as a thirty-day geometric mean based on not less than five samples nor exceed 2,000 colonies per 100 ml in twenty percent or more of all samples taken during a thirty-day period. pH shall be between six to nine and shall not change more than one pH unit within this range over a period of 24 hours.

Table 5-5: Summary of the Warm Water Aquatic Habitat Water Quality Standards Applicable to the Cumberland River in the Project Vicinity

Parameter	Warm Water Aquatic Habitat Water Quality Standard
рН	6-9
Temperature Celsius (°C)	<31.7
Dissolved Oxygen (DO) milligrams per liter (mg/L)	5
Total Dissolved Solids or Specific Conductance	Shall not be changed to the extent that the indigenous aquatic community is adversely affected
Settleable Solids	The addition of settleable solids that may alter the stream bottom so as to adversely affect productive aquatic communities shall be prohibited
Ammonia Un-ionized (mg/L)	<0.05 mg/L

Source: KAR 2020

5.2.8 Water Quality Data

The Cumberland River in the Project Vicinity is not listed on the 303d list for impaired water bodies. Two reaches of the Cumberland River upstream of the Project are listed on the 303d list for impaired water bodies. The stretch from RM 677 to 688.9 is listed for *E. coli* as Category 5, which means the parameter does not meet water quality standard(s), and that parameter is a pollutant with a total maximum daily load (TMDL) required. This listed stretch and parameter have been identified as a high priority. (Kentucky EEC 2022). The stretch from RM 668.3 to 675.80 is listed for specific conductivity as Category 5, with a TMDL required. This listed stretch and parameter have been identified as a low priority. (Kentucky EEC 2022).

Water quality data for the Cumberland River near the Project area are available about 20 miles upstream of the Project Vicinity at the town of Harlan (21KY_WQX-CRW022) and about 8 miles downstream at the State Highway 1344 Bridge (21KY_WQX-PRI086). The ranges of water quality data collected for select parameters are summarized in Table 5-6. Water quality data are not available for Tom Fork or Dry Branch.

Table 5-6: Water Quality Data for Select Parameters at Two Locations in the Cumberland River

Parameter	Cumberland River at Harlan (21KY_WQX-CRW022)	Cumberland River at 1344 Bridge (21KY_WQX-PRI086)
Period of Record Range	2010-2016	2008-2016
Dissolved Oxygen	4.9-15.3 mg/L	4.8-14.8
Conductivity	176-615 microsiemens per centimeter (μS/cm)	50-811 uS/cm
рН	6.78-8.24	6.95-8.75
Temperature	0.6-24.1 degrees °C	2.4-27.9 °C
Total suspended solids	4-1,110 mg/L	2-890 mg/L
Turbidity	2.9-24.1 Nephelometric Turbidity Units (NTU)	0.1-260 NTU
E. coli	69.7-416 colony-forming unit (CFU)	4-1,986 CFU

Source: National Water Quality Monitoring Council 2022

5.2.9 Proposed Project Reservoirs

The preliminary specifications of the Project reservoirs are provided in Section 4.3.

5.2.10 Gradient of Downstream Reaches

The gradient of the Cumberland River in the Project Vicinity is approximately 0.057% between river mile 674 and 675 and approximately 0.076% between river mile 675 and 676. The average gradient of Tom Fork downstream of the preliminary Lower Reservoir to the confluence with the Cumberland River is approximately 5%.

5.2.11 Groundwater

The Breathitt Formation (previously described in Section 5.1) in Bell County yields more than 500 gallons per day to more than three-quarters of the wells drilled in valley bottoms, more than 500 gallons per day to about three-quarters of the wells on hillsides, and more than 100 gallons per day to nearly all wells on ridges. Sandstones yield water to most wells. Shales also yield water to many wells, and coal yields water to few. Near-vertical joints and openings along bedding planes yield most of the water to wells. (Kilburn et al. 1962).

Groundwater flow in the Project region occurs primarily through fractures and openings along bedding planes, which permits more rapid movement of water than water flowing through the pore spaces of predominantly sandstone bedrock. The sandstone zones are sometimes associated with impermeable claystone units that occur near coal seams and shales that limit the vertical

movement of water. These strata cause the water being transmitted by the sandstone and/or fractures to move laterally to the hillsides where the water flows to the surface or until it can move vertically downward again when it encounters a fracture penetrating a confining bed. Mining activities break up the strata over and under the coal seams by blasting operations and increase the permeability of the material, allowing for faster movement of groundwater. Groundwater movement is characterized by stepping movement from the ridge tops to the valley bottoms. Also, wells are generally recharged by direct connection to infiltration from the surface areas directly above and near the wells. (Nally & Hamilton Enterprises, Inc. 2007).

Surface and ground water quality sampling results indicated that there were no adverse effects to the water quality of surface and groundwater systems prior to the permit 807-0372 mining operation and that there had been no adverse effects from previous surface or deep mining. (Nally & Hamilton Enterprises, Inc. 2010).

5.2.12 References

Chabot Kilburn, W.E. Price, Jr., and D.S. Mull, 1962, Availability of Groundwater in Bell, Clay, Jackson, Knox, Laurel, Leslie, McCreary, Owsley, Rockcastle, and Whitley Counties, Kentucky. Published by the U.S. Geological Survey.

Kentucky Administrative Code (KAR), 2020, Title 401 KAR Chapter 10 Regulations.

- Kentucky Division of Water. 2022. Kentucky Source Water Protection Viewer. Available online: https://kygis.maps.arcgis.com/apps/webappviewer/index.html?id=c2324b998e78433aaf9 e6a3d7ad9f86a Accessed: August 2022.
- Kentucky Energy and Environment Cabinet (Kentucky EEC). 2022. 2018-2020 305(b) workbook. Available online: https://eec.ky.gov/Environmental-
 https://eec.ky.gov/Environmental-
 Protection/Water/Monitor/Pages/IntegratedReportDownload.aspx Accessed: August 2022.
- Kleinschmidt Associates (Kleinschmidt). 2022, September 22. Lewis Ridge Lower Reservoir Hydrology Memorandum. Document No. 4178005.01_004ME.
- Martin, G.R., and Arihood, L.D., 2010, Methods for estimating selected low-flow frequency statistics for unregulated streams in Kentucky: U.S. Geological Survey Scientific Investigations Report 2010–5217, 83 p.
- Nally & Hamilton Enterprises, Inc., 2007, Permit 807-0333 Application.
- Nally & Hamilton Enterprises, Inc., 2010, Permit 807-0372 Application.
- National Water Quality Monitoring Council. 2022. Water Quality Portal. Available online: https://doi.org/10.5066/P9QRKUVJ Accessed: July 2022.

U.S. Geological Survey (USGS). 2022a. USGS 03401000 Cumberland River near Harlan, KY. Available online:

https://waterdata.usgs.gov/nwis/inventory/?site_no=03401000&agency_cd=USGS Accessed: August 2022.

U.S. Geological Survey (USGS). 2022b. USGS 03402900 Cumberland River at Pine Street at Pineville, KY. Available online:

https://waterdata.usgs.gov/nwis/inventory/?site_no=03402900&agency_cd=USGS Accessed: August 2022.

5.3 Fish and Aquatic Resources

18 CFR 5.6(d)(3)(iv) requires "A description of the fish and other aquatic resources, including invasive species, in the project vicinity. This section must discuss the existing fish and macroinvertebrate communities, including the presence or absence of anadromous, catadromous, or migratory fish, and any known or potential upstream or downstream impacts of the project on the aquatic community. Components of the description must include: (A) Identification of existing fish and aquatic communities; (B) Identification of any essential fish habitat as defined under the Magnuson-Stevens Fishery Conservation and Management Act and established by the National Marine Fisheries Service; and (C) Temporal and spatial distribution of fish and aquatic communities and any associated trends with respect to: (1) Species and life stage composition; (2) Standing crop; (3) Age and growth data; (4) Spawning run timing; and (5) The extent and location of spawning, rearing, feeding, and wintering habitat."

5.3.1 Existing Fish and Aquatic Communities

The Project Vicinity includes the Upper Cumberland River, approximately 659 river miles upstream of its confluence with the Ohio River. Habitat in this Upper Cumberland River consists mainly of riffles and runs with cobble, boulder, and bedrock substrates (Kentucky Department of Fish and Wildlife Resources [Kentucky DFWR] 2022b).

Within the Upper Cumberland River Basin, 58 species of fish currently or historically occur (Table 5-7). No information describing the fish community within the Project Vicinity (including Cumberland River/Tom Fork) was available. However, in 2017, Kentucky DFWR conducted an electrofishing survey in the Cumberland River approximately 37 miles downstream of the proposed Project location. The survey, which targeted sportfish species, yield 66 fish during 1.5 hours of effort. Overall catch per unit effort (CPUE) was 44 fish/hour. The most abundant species captured were channel catfish, flathead catfish, and spotted bass (Kentucky DFWR 2018). Table 5-8 presents the results of the 2017 survey (Kentucky DFWR 2018). Due to its proximity, the sportfish community in the Cumberland River within the Project Vicinity is expected to be relatively similar to that which Kentucky DFWR found in its survey downstream.

The Kentucky DFWR established a conservation and management plan to conserve and enhance existing native walleye populations in Kentucky (Kentucky DFWR 2014). Between 2014 and 2020, Kentucky DFWR has stocked an average of approximately 26,000 fingerling native strain walleye in the Upper Cumberland River as part of these conservation and management efforts (Kentucky DFWR 2014, 2015, 2016, 2017, 2018, 2019, 2020).

Table 5-7: List of Fish Occurring in the Upper Cumberland River Basin

Family	Common Name	Scientific Name
Petromyzontidae	least brook lamprey	Lampetra aepyptera
Acipenseridae	lake sturgeon	Acipenser fulvescens
Atherinopsidae	brook silverside	Labidesthes sicculus
Clupeidae	gizzard shad	Dorosoma cepedianum
Cyprinidae	blackside dace	Chrosomus cumberlandensis
	bluntnose minnow	Pimephales notatus
	creek chub	Semotilus atromaculatus
	central stoneroller	Campostoma anomalum
	fathead minnow	Pimephales promelas
	flame chub	Hemitremia flammea
	highland shiner	Notropis micropteryx
	mimic shiner	Notropis volucellus
	river chub	Nocomis micropogon
	rosyface shiner	Notropis rubellus
	sawfin shiner	Notropis sp. 4
	scarlet shiner	Lythrurus fasciolaris
	silverjaw minnow	Notropis buccatus
	southern redbelly dace	Chrosomus erythrogaster
	spotfin shiner	Cyprinella spiloptera
	steelcolor shiner	Cyprinella whipplei
	striped shiner	Luxilus chrysocephalus
	warpaint shiner	Luxilus coccogenis
	western blacknose dace	Rhinichthys obtusus
	whitetail shiner	Cyprinella galactura
Catostomidae	black redhorse	Moxostoma duquesnei
	golden redhorse	Moxostoma erythrurum
	northern hog sucker	Hypentelium nigricans
	white sucker	Catostomus commersonii
Ictaluridae	black bullhead	Ameiurus melas
	brindled madtom	Noturus miurus
	yellow bullhead	Ameiurus natalis
	channel catfish	Ictalurus punctatus
	flathead catfish	Pylodictis olivaris
Poeciliidae	western mosquitofish	Gambusia affinis
Cottidae	banded sculpin	Cottus carolinae
Moronidae	white bass	Morone chrysops
Centrarchidae	bluegill	Lepomis macrochirus
	green sunfish	Lepomis cyanellus
	largemouth bass	Micropterus salmoides

Family	Common Name	Scientific Name
	longear sunfish	Lepomis megalotis
	redear sunfish	Lepomis microlophus
	rock bass	Ambloplites rupestris
	smallmouth bass	Micropterus dolomieu
	spotted bass	Micropterus punctulatus
	warmouth	Lepomis gulosus
	white crappie	Pomoxis annularis
Percidae	arrow darter	Etheostoma sagitta
	blackside darter	Percina maculata
	Cumberland darter	Etheostoma susanae
	emerald darter	Etheostoma baileyi
	greenside darter	Etheostoma blennioides
	logperch	Percina caprodes
	olive darter	Percina squamata
	rainbow darter	Etheostoma caeruleum
	redline darter	Etheostoma rufilineatum
	snubnose darter	Etheostoma simoterum
	stripetail darter	Etheostoma kennicotti
	walleye	Sander vitreus

Source: Natureserve 2010

Table 5-8: Fish Captured During 2017 Survey on the Upper Cumberland River at Barbourville, Kentucky

Common Name	Number Captured	CPUE (fish/hr)
smallmouth bass	3	2.0
spotted bass	11	7.3
bluegill	1	0.7
longear sunfish	4	2.7
redbreast sunfish	1	0.7
green sunfish	1	0.7
black crappie	1	0.7
walleye	6	4.0
channel catfish	27	18.0
flathead catfish	11	7.3
Total	66	44.1

Source: Kentucky DFWR 2018

5.3.2 Temporal and Spatial Distribution of Aquatic Communities

Most seasonal movement of fish are associated with spawning activities and correlations with water temperatures and available seasonal refugia. Although there are no diadromous fish species present in the upper Cumberland River, some fish species present may exhibit seasonal movements or migrations within the river to locate foraging or spawning habitat. Examples of such species include white sucker and walleye (Jenkins and Burkhead 1993, Etnier and Starnes 1993).

Cumberland River habitat near the proposed Project appears to be relatively homogenous (i.e., shallow, flowing riffles/runs over cobble, boulder, and bedrock) (Kentucky DFWR 2022b). Accordingly, the fish assemblage present would be expected to consist of smaller individuals and lotic species that prefer those habitats, such as minnows, suckers, and darters. Further downstream of the Project Vicinity on the Cumberland River, as habitat becomes more diverse with deeper water and the presence of pools, a more diverse range of fish species and sizes would be expected, including an increased prevalence of habitat generalist and more lentic species (Jenkins and Burkhead 1993).

5.3.3 Invasive and Nonindigenous Fish and Aquatic Species

The nonindigenous aquatic species known to occur in Upper Cumberland River Basin (HUC6 051301) are listed in Table 5-9. Nonindigenous aquatic species are defined as an aquatic species that has entered a body of water or aquatic ecosystem outside of its historic or native range. Invasive carp are known to occur in the Cumberland River downstream of the Project (Kentucky DFWR 2022a).

Table 5-9: Nonindigenous Aquatic Species known to occur in Upper Cumberland River Basin

Scientific Name	Common Name	Species Origin ¹	Native Habitat
Coelenterates-Hydrozoans	·		·
Craspedacusta sowerbyi	freshwater jellyfish	Exotic	Freshwater
Crustaceans-Crayfish			
Cambarellus shufeldtii	Cajun dwarf crayfish	Native	Freshwater
Cambarus cumberlandensis	Cumberland crayfish	Native	Freshwater
Faxonius rusticus	rusty crayfish	Native	Freshwater
Fishes			
Alosa chrysochloris	skipjack herring	Native	Freshwater-Marine
Alosa pseudoharengus	alewife	Native	Freshwater-Marine
Carassius auratus	goldfish	Exotic	Freshwater
Culaea inconstans	brook Stickleback	Native	Freshwater
Cyprinus carpio	common carp	Exotic	Freshwater
Dorosoma cepedianum	gizzard shad	Native	Freshwater-Marine
Dorosoma petenense	threadfin shad	Native	Freshwater-Marine
Esox masquinongy	muskellunge	Native	Freshwater

Scientific Name	Common Name	Species Origin ¹	Native Habitat
Fundulus catenatus	northern studfish	Native	Freshwater
Gambusia affinis	western mosquitofish	Native	Freshwater
Lepomis auritus	redbreast sunfish	Native	Freshwater
Lepomis gibbosus	pumpkinseed	Native	Freshwater
Lepomis gulosus	warmouth	Native	Freshwater
Lepomis microlophus	redear sunfish	Native	Freshwater
Lepomis miniatus	redspotted sunfish	Native	Freshwater
Micropterus coosae	redeye bass (sensu lato)	Native	Freshwater
Micropterus dolomieu	smallmouth bass	Native	Freshwater
Micropterus punctulatus	spotted bass	Native	Freshwater
Micropterus salmoides	largemouth bass	Native	Freshwater
Morone saxatilis	striped bass	Native	Freshwater-Marine
Moxostoma lachneri	greater jumprock	Native	Freshwater
Notemigonus crysoleucas	golden shiner	Native	Freshwater
Oncorhynchus clarkii	cutthroat trout	Native	Freshwater
Oncorhynchus kisutch	coho salmon	Native	Freshwater-Marine
Oncorhynchus mykiss	rainbow trout	Native	Freshwater-Marine
Perca flavescens	yellow perch	Native	Freshwater
Piaractus brachypomus	pirapitinga, red-bellied pacu	Exotic	Freshwater
Pimephales promelas	fathead minnow	Native	Freshwater
Pomoxis annularis	white crappie	Native	Freshwater
Pomoxis nigromaculatus	black crappie	Native	Freshwater
Salmo trutta	brown trout	Exotic	Freshwater
Salvelinus fontinalis	brook trout	Native	Freshwater
Salvelinus namaycush	lake trout	Native	Freshwater
Sander canadensis × vitreus	saugeye	Native Hybrid	Freshwater
Sander vitreus	walleye	Native	Freshwater
Tinca tinca	tench	Exotic	Freshwater
Mollusks-Bivalves			
Corbicula fluminea	Asian clam	Exotic	Freshwater
Dreissena polymorpha	zebra mussel	Exotic	Freshwater
Plants			
Acorus calamus	single-vein sweetflag	Exotic	Freshwater
Alternanthera philoxeroides	alligatorweed	Exotic	Freshwater
Egeria densa	Brazilian waterweed	Exotic	Freshwater
Lythrum salicaria	purple loosestrife	Exotic	Freshwater
Murdannia keisak	marsh dewflower	Exotic	Freshwater
Myriophyllum aquaticum	parrot feather	Exotic	Freshwater
Myriophyllum spicatum	Eurasian watermilfoil	Exotic	Freshwater-Brackish
Najas minor	brittle waternymph	Exotic	Freshwater
Nasturtium officinale	water-cress	Exotic	Freshwater
Potamogeton crispus	curly-leaf pondweed	Exotic	Freshwater
Reptiles			
Alligator mississippiensis	American alligator	Native	Freshwater
Trachemys scripta troostii	Cumberland Slider	Native	Freshwater

Source: USGS 2022

Exotic = not native to the United States.

Native Hybrid = hybrid of two species native to the United States.

¹ Native = native to the United States

5.3.4 Benthic Macroinvertebrates and Freshwater Mussels

A distribution checklist of Kentucky mussels (Cicerello et al. 1991) indicated that 11 mussel species have been documented within the Upper Cumberland River Basin upstream of Cumberland Falls. Cumberland Falls is located at approximately RM 548 of the Cumberland River, or approximately 111 river miles below the Project. Table 5-10 provides a list of these species.

The Kentucky Department of Environmental Protection (Kentucky DEP) Division of Water monitors physical, chemical and biological elements of waterbodies to assess the quality of the aquatic environment of waterbodies across the state. Kentucky DEP uses combinations of algal, macroinvertebrate and fish community structure as indicators of waterbody health. Macroinvertebrate assemblages have proven to be useful in detecting even subtle changes in habitat and water quality. Table 5-11 presents the top 15 genera collected from reference wadeable streams in the mountain bioregion. (Pond et al. 2003).

Table 5-10: Mussel Species Known to Occur in the Upper Cumberland River Basin Upstream of Cumberland Falls

Scientific Name	Common Name
Alasmidonta atropurpurea	Cumberland elktoe
Alasmidonta marginata	elktoe
Alasmidonta viridis	slippershell mussel
Anodontoides ferussacianius	cylindrical papershell
Elliptio dilatate	spike
Lampsilis cardium	plain pocketbook
Lampsilis fasciola	wavy-rayed lampmussel
Lampsilis ovata	pocketbook
Ortmanniana pectorosa	pheasantshell
Strophitus undulatus	squawfoot
Toxolasma parvum	lilliput

Source: Cicerello et al. 1991

Table 5-11: Top 15 Genera Collected from Reference Wadeable Streams in the Mountain Bioregion

Genus	Relative Abundance	Relative Frequency	Relative Importance*
Stenonema (5 spp.)	9.3	97.3	106.6
Isonychia sp.	10.7	89.2	99.9
Cheumatopsyche sp.	7.5	91.9	99.4
Acroneuria (3 spp.)	4.4	83.8	88.2
Optioservus (2 spp.)	4.0	81.1	85.1
Nigronia (2 spp.)	3.5	75.7	79.2
Ceratopsyche (3 spp.)	4.8	73.0	77.8
Baetis (4 spp.)	2.6	67.6	70.2
Leuctra sp.	2.4	62.2	64.6
Polypedilum (4 spp.)	2.2	62.2	64.4
Psephenus herricki	3.2	59.5	62.6
Chimarra (2 spp.)	5.5	56.8	62.2
Atherix sp.	2.5	54.1	56.5
Acentrella (spp.)	1.1	51.4	52.5
Hydropsyche (3 spp.)	1.7	43.2	44.9

Source: Pond et al. 2003

5.3.5 Essential Fish Habitat

There are no federal fishery management plans for diadromous fish species that occupy the freshwater, inland regions of Kentucky/Tennessee; therefore, there is no designated Essential Fish Habitat (EFH) near the proposed Project.

5.3.6 References

Cicerello, Ronald R., M. L. Warren, and G. A. Schuster. 1991. A Distributional Checklist of the Freshwater Unionids (Bivalvia: Unionidae) of Kentucky. American Malacological Bulletin, Vol 8(2): 113-129. American Malacological Society.

Etnier, David A. and Wayne C. Starnes. 1993. The Fishes of Tennessee. University of Tennessee Press, Knoxville, Tennessee.

Jenkins, R. E., and N. M. Burkhead. 1993. Freshwater Fishes of Virginia. American Fisheries Society, Bethesda, Maryland.

Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR). 2014. Conservation and Management Plan for the Native Walleye of Kentucky. Fisheries Division, Kentucky DFWR.

^{*} Mean relative abundance + relative frequency = relative importance

- Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR). 2015. Annual Performance Report District Fisheries Management.
- Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR). 2016. Annual Performance Report District Fisheries Management.
- Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR). 2017. Annual Performance Report District Fisheries Management.
- Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR). 2018. Annual Performance Report District Fisheries Management.
- Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR). 2019. Annual Performance Report District Fisheries Management.
- Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR). 2020. Annual Performance Report District Fisheries Management.
- Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR). 2022a. Invasive Carp Information. Available online: https://fw.ky.gov/Fish/Pages/Invasive-Carp-Information.aspx Accessed: August 2022.
- Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR). 2022b. Upper Cumberland River. Available online: https://fw.ky.gov/Fish/Pages/Upper Cumberland.aspx. Accessed: July 2022.
- NatureServe. 2010. Digital Distribution Maps of the Freshwater Fishes in the Conterminous United States. Version 3.0. Arlington, VA. U.S.A.
- Pond, G.J., S.M. Call, J.F. Brumley and M.C. Compton. 2003. The Kentucky macroinvertebrate bioassessment index: derivation of regional narrative ratings for wadeable and headwater streams. Kentucky Department for Environmental Protection, Division of Water, Frankfort, Ky.

Available online: https://eec.ky.gov/Environmental-
https://eec.ky.gov/Environmental-
https://eec.ky.gov/Environmental-
https://eec.ky.gov/Environmental-
https://eec.ky.gov/Environmental-
https://eec.ky.gov/Environmental-
<a href="https://eec.ky.gov/Envi

United States Geological Survey (USGS). 2022. Nonindigenous Aquatic Species Database. Available online: https://nas.er.usgs.gov/default.aspx. Accessed August 2022.

5.4 Terrestrial Wildlife and Botanical Resources

18 CFR 5.6(d)(3)(v) requires "A description of the wildlife and botanical resources, including invasive species, in the project vicinity. Components of this description must include: (A) Upland habitat(s) in the project vicinity, including the project's transmission line corridor or right-of-way and a listing of plant and animal species that use the habitat(s); and (B) Temporal or spatial distribution of species considered important because of their commercial, recreational, or cultural value."

5.4.1 Terrestrial Habitats in the Project Vicinity

The Project is located in the Cumberland Mountain Thrust Block (Level IV ecoregion 69e) within the Central Appalachians ecoregion (Level III ecoregion 69), which consists of primarily forested high, steep ridges, hills, coves, narrow valleys, and the Pine Mountain Overthrust Fault (Woods et al. 2002). In general, maximum elevations are greater in this ecoregion than elsewhere in Kentucky. Forest composition is highly variable and is influenced by local aspect, slope position and gradient, topographic shading, soil moisture, and past land usage.

Because of this variation in local landscapes and variety of land uses throughout the area (i.e., extensive surface and underground coal mining, logging, and conversion to pastureland), the composition of vegetative communities is highly variable on a broad scale. In general, the ecoregion was formerly dominated by American chestnut on drier sites. Following logging and the disappearance of chestnut, second-growth forest typically contain white oak (Quercus alba), black oak (Quercus velutina), sugar maple (Acer saccharum), red maple (Acer rubrum), yellow poplar (Liriodendron tulipifera), black walnut (Juglans nigra), black locust (Robinia pseudoacacia), hickory (Carya spp), white ash (Fraxinus americana), American beech (Fagus grandifolia), black cherry (Prunus serotina), buckeye (Aesculus spp), Eastern hemlock (Tsuga canadensis), and American basswood (Tilia americana) (Woods et al. 2002). On mesic sites, forests are mixed; dominated by American beech, yellow poplar, sugar maple, and white oak, with co-dominants of ash, black walnut, buckeye, basswood, northern red oak (Quercus rubra), and others. On drier sites, white oak and hickories dominate the landscape. Pines (Pinus spp) tend to dominate areas with shallow, sandy soils on steep-dipping sandstone. Species composition within shady gorges feature eastern hemlock and various magnolias (Magnolia spp) with an understory of rhododendrons (*Rhododendron spp*) (Woods et al. 2002).

Conversely, areas heavily impacted by anthropogenic disturbances (i.e., mining), are often dominated by invasive shrubs, forbs, grasses, and early-successional tree species (Kentucky EEC 2022). Invasive species are discussed in Section 5.4.3. Common forbs on previously disturbed sites include narrow-leaf pinweed (*Lechea tenuifolia*), Ozark tickseed sunflower (*bidens polylepis*), and Pennsylvania smartweed (polygonum pensylvanicum). Common grasses include fescues (*Festuca spp.*) and oatgrass (*Danthonia spp*). Common early-successional tree species include Virginia pine (*Pinus virginiana*) and black tupelo (*Nyssa sylvatica*). (Reiss 1986)

Botanical species observed during a site visit in May 2022, are included in Table 5-12 below.

Table 5-12: Botanical Species Observed in Project Vicinity

Scientific Name	Common Name	Native and/or Invasive
Acer negundo	box elder	Native
Ailanthus altissima	tree-of-heaven	Non-native
Arctium minus	burdock	Non-native
Catalpa speciosa	northern catalpa	Native
Cercis canadensis	redbud	Native
Dactylis glomerata	orchardgrass	Non-native
Elaeagnus umbellata	autumn olive	Non-native
Festuca spp.	Festuca	Both
Juniperus virginiana	eastern red cedar	Native
Lespedeza spp.	Lespedeza	Both
Leucanthemum vulgare	oxeye daisy	Non-native
Liquidambar styraciflua	sweetgum	Native
Lonicera spp.	Honeysuckle	Both
Melilotus officinalis	yellow sweet clover	Non-native
Penstemon spp.	Penstemon	Both
Platanus occidentalis	American sycamore	Native
Pueraria lobata	kudzu	Non-native
Quercus alba	white oak	Native
Robinia pseudoacacia	black locust	Native
Rosa multiflora	multiflora rose	Non-native
Trifolium pratense	red clover	Non-native
Toxicodendron radicans	poison ivy	Native

Source: Kleinschmidt Associates 2022. This list is based on observations from a May 2022 site visit, not a formal botanical survey.

5.4.2 Terrestrial Wildlife Resources in the Project Vicinity

According to the Kentucky DFWR, wildlife with known occurrences within Bell County includes 178 birds, 47 mammals, 31 reptiles, and 33 amphibians. Similar to vegetative communities, wildlife occurrence and distribution varies by habitat, local aspect, and elevation. Reptile species occurring within Bell County include various turtles, snakes, skinks, and lizards. Amphibians include a variety of frogs, toads, and salamanders. Mammal species within Bell County include small mammals such as shrews, voles, mice, rabbits and bats; medium mammals such as red fox, gray fox, river otter, and beaver; and large mammals such as black bear, white-tailed deer, and elk. (Kentucky DWFR 2022).

Bell County is within the Kentucky Elk Restoration Zone, which encompasses 16 counties in the Cumberland Plateau physiographic ecoregion (Kentucky DFWR 2015). Initial research following the elk reintroduction in Kentucky demonstrated that elk favored the food resources on recently

reclaimed mines sites and used the adjacent forests for cover and refuge (Larkin et al. 2001, Wichrowski et al. 2005, Schneider et al. 2006, Olsson et al. 2007). However, as grassland reclamation progresses, forage quality generally degrades over time as the newly planted wheat, rye, and clover transition to less-nutritious, competitive, or invasive species like lespedeza or fescue (Kentucky DFWR 2015).

Wild pigs (*Sus scrofa*) are a non-native invasive species known to Kentucky and have the potential to occur in the Project Vicinity. Wild pigs in Kentucky are the result of released domestic pigs and hybrids of domestic and Eurasian boar. They are highly adaptable to a variety of habitats and have a high reproductive potential, making population control difficult (Kentucky DFWR 2022).

5.4.3 Invasive Plants Species

Lands in the Central Appalachians ecoregion have been subject to disturbance by activities such as mining, logging, and fire, loss of American chestnut, and invasion of southern pine beetles, which have allowed for the spread of invasive species. These previously-disturbed landscapes exhibit altered vegetative communities, which are dominated by introduced species, like multiflora rose (*Rosa multiflora*), autumn olive (*Elaeagnus umbellata*), princess tree (*Paulownia tomentosa*), and early-successional native species such as black locust and red maple (Kentucky EEC 2022).

In 2008, the Kentucky DFWR developed a Terrestrial Nuisance Species Management Plan. As described in the plan, terrestrial nuisance species (TNS) are non-native species that threaten the diversity or abundance of native terrestrial species or the ecological stability of ecosystems, or commercial, agricultural, or recreational activities dependent on such ecosystems. Kentucky DFWR produced a list of the most problematic TNS in Kentucky, which included six microorganisms, four insects, two birds, one mammal, and 39 plant species (Kentucky DFWR 2008).

In 2000, the Kentucky Invasive Plant Council was established as a state chapter of the Southeast Exotic Pest Plant Council and works to serve as a technical support resource on invasive species in Kentucky, facilitate the exchange of information concerning the management and control of exotic invasive plant species, and support research and monitoring of those species (Kentucky IPC 2019). A list of exotic invasive plant species of Kentucky and associated threat category is provided in Table 5-13.

Table 5-13: Threat Category¹ of Exotic Invasive Plants Species Known to Occur in Kentucky

Scientific Name	Common Name	Terrestrial Nuisance Species?
Category 1 – Severe Threat	_	
Achyranthes japonica	Japanese chaff flower	
Ailanthus altissima	tree-of-heaven	Yes
Alliaria petiolata	garlic mustard	Yes
Ampelopsis brevipedunculata	Porcelain berry	
Arthraxon hispidus	hairy jointgrass	
Carduus nutans	musk thistle	Yes
Celastrus orbiculatus	oriental bittersweet	Yes
Cirsium arvense	Canada thistle	
Clematis terniflora	leatherleaf clematis	
Conium maculatum	poison hemlock	Yes
Coronilla varia	crown vetch	Yes
Dioscorea oppositifolia	Chinese yam	Yes
Elaeagnus umbellata	autumn olive	Yes
Euonymus alatus	winged euonymus, burning bush	Yes
Euonymus fortunei	winter creeper	Yes
Festuca arundinacea (=Lolium arundinaceum)	Kentucky 31 fescue	Yes
Glechoma hederacea	ground ivy	
Lespedeza cuneata	sericea lespedeza	Yes
Lespedeza stipulacea (=Kummerowia)	Korean lespedeza	Yes
Ligustrum sinense, L. vulgare	Chinese privet, European privet	Yes
Lonicera japonica	Japanese honeysuckle	Yes
Lonicera maackii, L. fragrantissima, L. standishii	bush honeysuckles	Yes
Lysimachia nummularia	moneywort	
Lythrum salicaria	purple loosestrife	
Melilotus alba	white sweet clover	Yes
Melilotus officinalis	yellow sweet clover	Yes
Microstegium vimineum	Japanese stiltgrass	
Miscanthus sinensis	Chinese silver grass	Yes
Paulownia tomentosa	Princess tree	Yes
Phragmites australis	common reed	
Polygonum cuspidatum	Japanese knotweed	
Pueraria lobata	kudzu	Yes
Pyrus calleryana	callery pear	Yes
Ranunculus ficaria	lesser celandine	Yes
Rhamnus cathartica	European buckthorn	

Scientific Name	Common Name	Terrestrial Nuisance Species?
Rosa multiflora	multiflora rose	Yes
Sorghum halepense	Johnson grass	Yes
Stellaria media	chickweed	Yes
Category 2 – Significant Threat		
Agrostis stolonifera	weeping love grass	
Akebia quinata	akebia	
Albizia julibrissin	mimosa	
Alternanthera philoxeroides	alligatorweed	
Berberis thunbergii	Japanese barberry	
Bromus inermis	smooth bromegrass	Yes
Bromus tectorum, B. japonicus	cheatgrass	Yes
Cardiospermum halicacabum	balloon vine	
Centaurea biebersteinii	spotted knapweed	Yes
Chrysanthemum leucanthemum	ox-eye daisy	
Cirsium vulgare	bull thistle	
Daucus carota	Queen Anne's lace	Yes
Dipsacus sylvestris, D. laciniata	common teasel, cutleaf teasel	
Echinochloa crus-galli	barnyard grass	
Eleusine indica	goose grass	
Galium pedemontanum	cleavers	
Hedera helix	English ivy	
Hemerocallis fulva	day lily	
Humulus japonicus	Japanese hops	
Hydrilla verticillata	hydrilla	
Lespedeza bicolor, L. thunbergii	bicolor lespedeza, shrubby lespedeza	Yes
Lespedeza striata (= Kummerowia)	Japanese clover/Kobe lespedeza	Yes
Medicago lupulina	black medic	
Mentha x piperata	peppermint	
Morus alba	white mulberry	
Mosla dianthera	miniature beefsteak	
Najas minor	water nymph	
Ornithogalum umbellatum	star-of-Bethlehem	
Pastinaca sativa	wild parsnip	
Perilla frutescens	beefsteak	
Poa compressa	Canada bluegrass	
Poa pratensis	Kentucky bluegrass	
Polygonum cespitosum	bunchy knotweed	

Scientific Name	Common Name	Terrestrial Nuisance Species?
Polygonum persicaria	lady's thumb	
Populus alba	white poplar	
Potamogeton crispus	curlyleaf pondweed	
Rhodotyps scandens	Jetbead	
Rorrippa nasturtium-aquaticum	water-cress	
Rubus phoenicolasius	wineberry	
Schedonorus pratensis	meadow fescue	
Setaria faberi	giant foxtail	
Setaria viridis	green foxtail	
Spiraea japonica	Japanese spiraea	
Thlaspi alliaceum	garlic peppergrass	
Tussilago farfara	coltsfoot	
Typha xglacua	cattail	
Ulmus pumila	Siberian elm	
Verbascum thapsus	common mullein	
Vinca minor	lesser periwinkle	
Category 3 – Moderate Threat		
Argopyron repens	quack grass	
Allium vineale	field garlic	
Arctium minus	common burdock	
Arenaria serpyllifolia	thyme-leaf sandwort	
Barbarea vulgaris	yellow rocket	
Bromus arvensis, B. catharcticus, B. hordeaceus, B. racemosus	field bromes	
Buddleja davidii	orange-eye butterfly bush	
Carduus acathoides	spiny plumeless thistle	
Chenopodium album	lamb's quarters	
Cichorium intybus	chicory	
Commelina communis	dayflower	
Convolvulus arvensis	field bindweed	
Duchesnea indica	Indian strawberry	
Duetzia scabra	fuzzy deutzia	
Elaeagnus angustifolia	Russian olive	
Eleusine indica	goose grass	
Fatoua villosa	hairy crabweed	
Hesperis matronalis	dame's rocket	
Holcus lanatus	velvet grass	
Hypericum perforatum	common St. John's-wort	

Scientific Name	Common Name	Terrestrial Nuisance Species?
Ipomoea hederacea	ivy-leafed morning-glory	
Ipomoea purpurea	purple morning-glory	
Iris pseudoacorus	pale yellow iris	
Lamium purpureum	purple deadnettle	
Lamium amplexicaule	henbit	
Lithospermum arvense	corn-gromwell	
Lolium multiflorum	Italian rye	
Lonicera x bella, L. morrowii, L. tartarica	bush honeysuckles	Yes
Lotus corniculatus	birdsfoot trefoil	
Mohonia bealei	leatherleaf mahonia	
Mentha spicata	spearmint	
Nepeta cataria	catnip	
Oxalis stricta (= O. europea)	common yellow wood-sorrel	
Paspalum dilatatum	dallisgrass	
Phyllostachys aura	golden bamboo	
Poa annua	speargrass	
Potentilla recta	sulphur five-fingers	
Prunus mahalab	mahalab cherry	
Ranunculus bulbosus	bulbous buttercup	
Rumex acetosella	dock, sheep sorrel	
Solanum dulcamara	bitter nightshade	
Thlaspi perfoliatum	field cress	
Torillis arvensis, T. japonica	hedge parsley	
Wisteria sinensis, W. floribunda, W. x formosa	exotic wisterias	

¹ Threat Categories and Descriptions (Kentucky EPPC 2013)

- Category 1 Severe Threat: Exotic plant species which possess characteristics of invasive species and spread
 easily into native plant communities and displace native vegetation; includes species which are or could
 become widespread in Kentucky.
- Category 2 Significant Threat: Exotic plant species which possess some invasive characteristics but have
 less impact of native plant communities; may have the capacity to invade natural communities along
 disturbance corridors, or to spread from stands in disturbed sites in undisturbed areas but have fewer
 characteristics of invasive species than Category 1.
- Category 3 Moderate Threat: Exotic plant species which seem to principally spread and remain in disturbed corridors, not readily invading natural areas; also some agronomic weeds.

5.4.4 References

- Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR). 2008. Kentucky Terrestrial Nuisance Species Management Plan. Available online: https://fw.ky.gov/More/Documents/KYTerrestrialNuisanceSpeciesPlan.pdf Accessed: August 2022.
- Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR). 2015. 2015-2030 Kentucky Elk Management Plan. Frankfurt, Kentucky.
- Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR). 2022. Invasive Species. Available online: https://fw.ky.gov/InvasiveSpecies/Pages/default.aspx Accessed: August 2022.
- Kentucky Energy and Environment Cabinet (Kentucky EEC). 2022. Description of Kentucky Ridge State Forest and Wildlife Management Area. Commonwealth of Kentucky. Available at: https://eec.ky.gov/Nature-Preserves/Locations/Pages/Kentucky-Ridge.aspx. Accessed: July 14, 2022.
- Kentucky Invasive Plant Council (Kentucky IPC). 2019. Kentucky Invasive Plant Council. Available at: https://www.se-eppc.org/ky/. Accessed August 2022.
- Kentucky Exotic Pest Plant Council (Kentucky EPPC). 2013. Exotic Invasive Plants of Kentucky. Available at: https://www.se-eppc.org/ky/KYEPPC 2013list.pdf. Accessed August 2022.
- Larkin, J.L., R. Grimes, L. Cornicelli, J.J. Cox, and D.S. Maehr. 2001. Returning elk to Kentucky: foiling Murphy's Law. Pages 101-107 in D.S. Maehr, R. Noss, and J.L. Larkin, editors: Large mammal restoration: ecological and sociological challenges in the 21st century. Island Press, Washington D.C., USA.
- Olsson, P.M.O., J.J. Cox, J.L. Larkin, D.S. Maehr, P. Widen, M.W. Wichrowski. 2007. Movement and activity patterns of translocated elk (Cervus elaphus 5-39odali) on an active coal mine in Kentucky. Wildlife Biology in Practive 3:1-8.
- Reiss, Ralph. 1986. Early Successional Plant Communities on an Abandoned Strip Mine in Butler County, Kentucky. Masters Theses & Specialist Projects. Paper 2764. Available at: https://digitalcommons.wku.edu/theses/2764.
- Schneider, J., D.S. Maehr, K.J. Alexy, J.J. Cox, J.L. Larkin, B.C. Reeder. 2006. Food habitats of reintroduced elk in southeastern Kentucky. Southeastern Naturalist 5: 535-546.
- Wichrowski, M.W., D.S. Maehr, J.L. Larkin, J.J. Cox, M.P.O. Olsson. 2005. Activity and movements of reintroduced elk in southeastern Kentucky. Southeastern Naturalist 4: 365-374.
- Woods, A.J., J.M. Omernik, W.H. Martin, G.J. Pond, W.M. Andrews, S.M. Call, J.A. Comstock, and D.D. Taylor. 2002. Ecoregions of Kentucky (color poster with map, descriptive text, summary tables, and photographs): Reston, VA, U.S. Geological Survey (map scales 1:1,000,000).

5.5 Wetlands, Riparian, and Littoral Habitat

18 CFR 5.6(d)(3)(vi) requires "Description of floodplains, wetlands, riparian, and littoral habitat (1) List of plant and animal species using the habitat (2) Map of wetlands, riparian and littoral habitat (3) Acreage estimate for each type of land including variability connected to project operations."

5.5.1 Overview

The U.S. Fish and Wildlife Service (USFWS) classification scheme for wetlands serves as the national standard for wetland classification and has been used to classify wetlands appearing in the National Wetlands Inventory (NWI) (USFWS 2022). The NWI coverage is developed from aerial photography. USFWS defines wetlands as: "...lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water. For the purpose of the classification, wetlands must have one or more of these three attributes: (1) at least periodically, the land must support predominantly wetland plants; (2) the substrate is predominantly undrained hydric soil; and (3) rocky, gravelly, or sandy areas that are saturated with or covered by shallow water at some time during the growing season."

Information regarding the location and spatial extent of wetland resources in the Project Vicinity and Preliminary Project Boundary was obtained from the NWI. The mapped NWI features in the Project Vicinity are presented in Figure 5-10 and are listed in Table 5-14. Information regarding floodplains in the Project Vicinity was obtained using Federal Emergency Management Agency (FEMA) flood mapping, as shown in Figure 5-11. As shown, FEMA mapped floodways in the Project Vicinity are primarily associated with the Cumberland River. At the preliminary Lower Reservoir, there is a narrow section closely along Tom Fork that is mapped as a 1% annual chance flood hazard.

Table 5-14: USFWS NWI Mapped Wetlands in the Project Vicinity and Preliminary Project Boundary

NWI Wetland Type	Acres in the Project Vicinity	Acres in the Preliminary Project Boundary
Freshwater Emergent Wetland	3.9	0
Freshwater Forested/Shrub Wetland	30.5	0
Freshwater Pond	19.7	1.8
Riverine	139.3	2.5

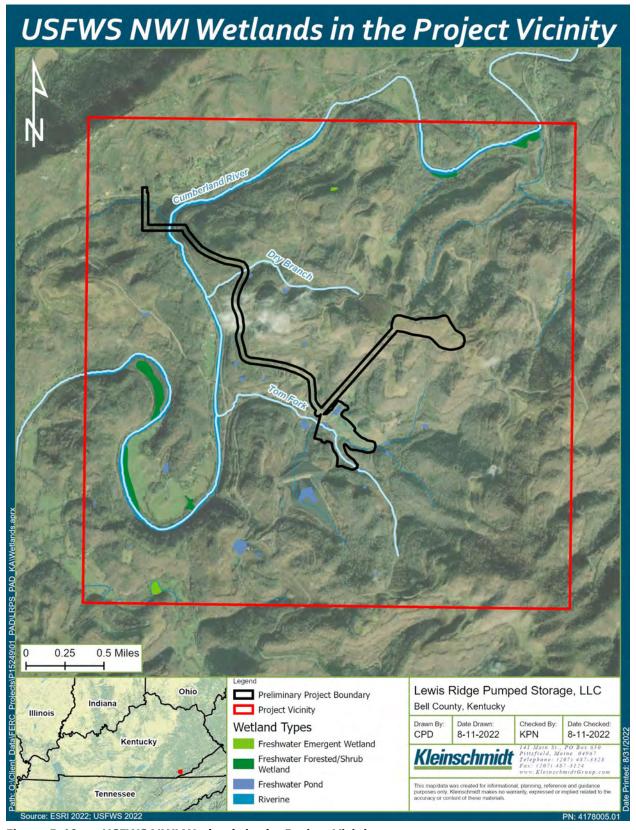


Figure 5-10: USFWS NWI Wetlands in the Project Vicinity

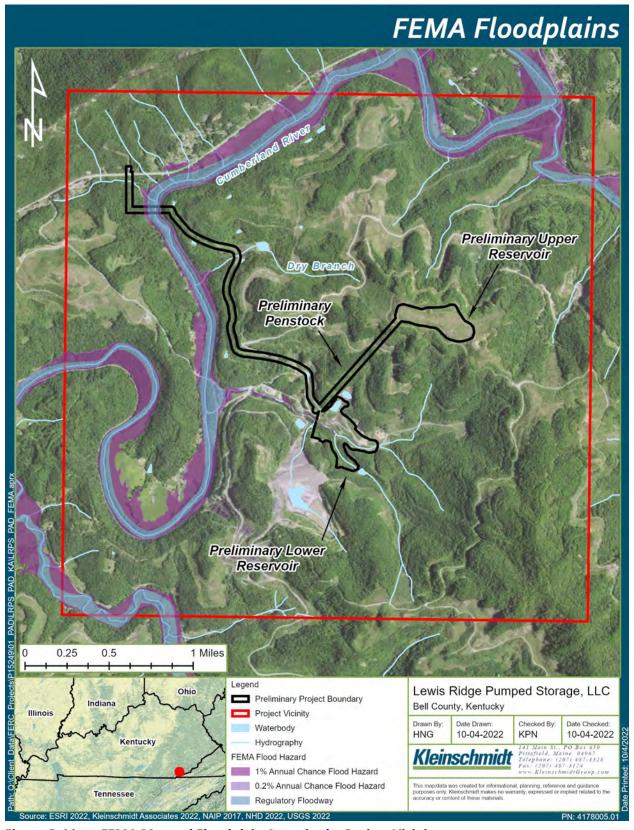


Figure 5-11: FEMA Mapped Floodplain Areas in the Project Vicinity

5.5.2 Riparian and Littoral Habitat

Riparian habitat is located along streams, rivers, and lakes, and provides important ecosystem functions related to hydrology and flooding, nutrient cycling, and plant and wildlife habitat (Mitsch and Gosselink 2000). The littoral zone acts as an interface between the open water aquatic environment and the terrestrial environment (Wetzel 2001). The size and extent of the littoral zone within a waterbody varies depending upon geomorphology and sedimentation within the aquatic system (Wetzel 2001). Riparian habitat in the Project Vicinity includes land adjacent to the Cumberland River as well as several associated tributaries. These riparian habitats are found in the floodplains of the river and associated tributaries. There are two tributaries in the Preliminary Project Boundary that are mapped on the NWI. At the preliminary Lower Reservoir location, there is one tributary named Tom Fork. Additionally, the preliminary interconnection line crosses Dry Branch. Dry Branch flows from east-to-west across the preliminary interconnection line to its confluence with the Cumberland River. Both Dry Branch and Tom Fork are classified on the NWI as R4SBC, which indicates that the system is riverine, subsystem is intermittent, class is streambed, and water regime is seasonally flooded.

5.5.3 Wetland Habitat

Wetlands have the potential to provide a variety of ecological functions including groundwater discharge and recharge, floodflow alteration, fish and shellfish habitat, sediment, toxicant, and pathogen retention, nutrient removal, retention, and transformation, production export, sediment and shoreline stabilization, and wildlife habitat. Wetlands also support human-defined values such as recreation, educational and scientific use, uniqueness and heritage, visual quality, and threatened and endangered species habitat (USACE 1999). Understanding the distribution and characteristics of wetlands on the landscape is therefore useful for land use planning and management. Within the Project Vicinity, there are approximately 3.9 acres mapped on the NWI as freshwater emergent wetland, 30.5 acres mapped as freshwater forested/shrub wetland, and 19.7 mapped as freshwater pond. Within the Preliminary Project Boundary, there are no areas mapped as freshwater wetland and approximately 1.8 acres mapped on the NWI as freshwater pond. This 1.8 acres includes two areas classified on the NWI as PUBHh located in the Preliminary Lower Reservoir location. These areas are both classified as a permanently flooded and diked/impounded.

5.5.4 Wetland, Riparian, and Littoral Plant and Animal Species

LRPS is conducting a wetland and waterway delineation, which will provide detail on plant species within the Project Boundary. See Section 6 for more detail. It is anticipated that a variety of animal species, including birds, insects, mammals, snakes, turtles, and amphibians such as frogs, toads, and salamanders may use the wetland, riparian, and littoral habitat.

5.5.5 References

- Mitsch, W.J. and J.G. Gosselink. 2000. Wetlands. John Wiley & Sons, Inc, New York, New York. 920 pp.
- U.S. Army Corps of Engineers (USACE) New England District. 1999. The Highway Methodology Workbook Supplement. 32 pp.
- U.S. Fish and Wildlife Service (USFWS). 2022. National Wetlands Inventory (NWI) Mapper Surface Waters and Wetlands. Available online: https://fws.gov/program/national-wetlands-inventory. Accessed: July 2022.

Wetzel, R.G. 2001. Limnology: Lake and River Ecosystems. Academic Press.

5.6 Rare, Threatened, and Endangered Species

18 CFR 5.6(d)(3)(vii) requires "A description of any listed rare, threatened and endangered, candidate, or special status species that may be present in the project vicinity. Components of this description must include: (A) A list of Federal- and state-listed, or proposed to be listed, threatened and endangered species known to be present in the project vicinity; (B) Identification of habitat requirements; (C) References to any known biological opinion, status reports, or recovery plan pertaining to a listed species; (D) Extent and location of any federally- designated critical habitat, or other habitat for listed species in the project area; and I Temporal and spatial distribution of the listed species within the project vicinity."

5.6.1 Overview

Information on rare, threatened, and endangered (RTE) species potentially occurring in Bell County, Kentucky was obtained from rare species databases maintained by the USFWS Information, Planning, and Conservation (IPaC), the Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR) list of State Threatened, Endangered, and Special Concern Species, and the Office of Kentucky Nature Preserves (OKNP) Kentucky Rare Plant Database.

5.6.2 Rare, Threatened, and Endangered Wildlife Resources

According to the USFWS IPaC list and letter from USFWS dated August 23, 2022 (Appendix E), four federally listed species potentially occur within the Project Vicinity: gray bat (*Myotis grisescens*, endangered), Indiana bat (*Myotis sodalist*, endangered), northern long-eared bat (*Myotis septentrionalis*, threatened), and monarch butterfly (*Danaus plexippus*, candidate) (USFWS 2022a). The Kentucky DFWR list of species classified as state endangered, threatened, or species of concern in Bell County, Kentucky includes insects, crayfish, mussels, reptiles, amphibians, fish, and mammals (Table 5-15, Kentucky DFWR 2022a). This list includes two species of fish with federal protection status, blackside dace (*Chrosomus cumberlandensis*; threatened) and Cumberland arrow darter (*Etheostoma sagitta*; candidate), which were not included in the USFWS list (Kentucky DFWR 2022a, USFWS 2022a). In August 2022, the yellow-spotted woodland salamander (*Plethodon pauleyi*) was petitioned to be listed under the ESA as an endangered or threatened species and to concurrently designate critical habitat (Center for Biological Diversity 2022). The federally listed and petitioned species are discussed in detail below. There is no proposed or designated Critical Habitat for any protected species within the Project Vicinity.

Table 5-15: Rare, Threatened, and Endangered Wildlife Species with Known Records of Occurrence in Bell County, Kentucky^a

Scientific Name	Common Name	Federal Status ^b	KY Status ^c	Global & State Rank ^d
Insects				
Callophrys irus	frosted elfin	=	Е	G3; S1
Callophrys dimidiata	sparkling jewelwing	-	E	G5; S1S2
Cheumatopsyche helma	helma's net-spinning caddisfly	-	Н	G3; SH
Danaus plexippus	monarch butterfly	С	-	G4; S4
Lytrosis permagnaria	a geometrid moth	-	E	G3G4; S1S2
Manoplylax butleri	bottle cap caddisfly	-	S	G2; S2
Polygonia faunus	green comma	-	Н	G5; SH
Pseudanophthalmus frigidus	icebox cave beetle	-	E	G1; S1
Stylurus notatus	elusive clubtail	-	E	G3; S1
Mussels				,
Anodontoides denigrata	Cumberland papershell	-	Е	G1; S1
Fumonelix wetherbyi	clifty covert	-	S	G2G3; S2
Lampsilis ovata	pocketbook	_	E	G5; S1
Crayfish	politica		_	33, 3.
Cambarus buntingi	longclaw crayfish	-	Т	G4Q; S2S3
Cambarus quenteri	redbird crayfish	=	S	GNR; S3
Cambarus parvoculus	mountain midget crayfish	=	S	G5; S2
Fish				
Chrosomus cumberlandensis	blackside dace	LT	Т	G2; S2
Etheostoma sagitta	Cumberland arrow darter	С	S	G3; S3
Amphibians			L	_
Cryptobranchus alleganienses alleganienses	east hellbender	-	S	G3T2; S2S3
Reptiles				
Cemophora coccinea	scarletsnake	-	S	G5; S3
Ophisaurus 5-46odalist5-46s longicaudus	Eastern slender glass lizard	-	Т	G5T5; S2
Plestiodon anthracinus	coal skink	-	E	G5; S1
Plestiodon inexpectatus	Southeastern five-lined skink	-	S	G5; S2S3
Birds				
Accipiter striatus	sharp-shinned hawk	-	S	G5; S3B, S4N
Cardellina canadensis	Canada warbler	-	S	G5; S3B
Centronyx henslowii	Henslow's sparrow	-	S	G4; S3B
Certhia americana	brown creeper	-	T	G5; S1S2B, S4N
Circus hudsonius Corvus corax	Northern harrier	-	T T	G5; S1S2B, S4N
Empidonax minimus	common raven least flycatcher	<u>-</u>	E	G5; S1S2 G5; S1B
Falco peregrinus	peregrine falcon		E	G4; S1B
Haliaeetus leucocaphalus	bald eagle	-	S	G5; S3B, S3S4N
Junco hyemalis	dark-eyed junco	-	S	G5; S2S3B, S5N
Peucaea aestivalis	Bachman's sparrow	-	Е	G3; S1B

Scientific Name	Common Name	Federal Status ^b	KY Status ^c	Global & State Rank ^d
Phalacrocorax auratus	double-crested cormorant	-	S	G5; S2B
Podilymbus Podiceps	rose-breasted grosbeak	-	S	G5; S3S4B
Polygonia faunus	pied-billed grebe	-	Е	G5; S1B, S4N
Setophaga fusca	blackburnian warbler	-	T	G5; S1S2B
Sitta canadensis	red-breasted nuthatch	-	Е	G5; S1B
Spatula discors	blue-winged teal	-	T	G5; S1S2B
Tyto alba	barn owl	-	S	G5; S3
Vermivora chrysoptera	golden-winged warbler	-	Е	G4; S1B
Mammals				
Myodes gapperi maurus	Kentucky red-backed vole	-	S	G5T3T4; S3
Myotis grisescens	gray bat	LE	Е	G4
Myotis leibii	Eastern small-footed bat	-	Т	G4; S2
Myotis lucifugus	little brown bat	-	Т	G3; S2
Myotis sodalis	Indiana bat	LE	E	G2; S1S2
Myotis septentrionalis	northern long-eared bat	LT	E	G1G2
Perimyotis subflavus	tricolored bat	-	Т	G2G3; S2
Sorex cinereus	cinereus shrew	-	S	G5; S3
Spilogale putorius	Eastern spotted skunk	-	S	G4; S2S3

^a Source: Kentucky DFWR 2022a

State ranks: S1 = critically imperiled, at very high risk of extinction due to extreme rarity; S2 = imperiled, at high risk of extinction due to very restricted range; S3 = vulnerable, at moderate risk of extinction due to restricted range; S4 = apparently secure, uncommon but not rare; S5 = secure – common, widespread, abundant.

Gray Bat

The gray bat is a highly colonial species in eastern North America distinguished from other species of the genus *Myotis* by its larger size and the uniformly gray fur on its back. The primary range of the species is centered on the cave regions of Alabama, Missouri, Arkansas, Kentucky, and Tennessee, with smaller populations found in adjacent states (USFWS 2009, Ozier et al. 2020). Gray bats inhabit caves year-round, occupying cold hibernating caves or mines in winter and dispersing to warmer maternity and bachelor caves during summer. Mating occurs in the fall prior to hibernation, and females deliver a single pup after arriving at the maternity cave in late May or early June. The summer caves are almost always near a river or reservoir, where gray bats feed on night-flying aquatic and terrestrial insects. Most foraging occurs over open water near a forested shoreline, and bats forage up to 12 miles or more from roost sites. A primary threat to the gray bat is anthropogenic disturbance to their caves. Infection of gray bats by the fungus causing

b Federal status: LE = listed endangered; LT = listed threatened; C = candidate species, not yet listed or proposed for listing.

^c Kentucky state status: E = endangered; T = threatened; S = special concern; H=historic.

d Global ranks: G1 = critically imperiled, at very high risk of extinction due to extreme rarity; G2 = imperiled, at high risk of extinction due to very restricted range; G3 = vulnerable, at moderate risk of extinction due to restricted range; G4 = apparently secure, uncommon but not rare; G5 = secure – common, widespread, abundant.

white-nose syndrome, a disease that infects the skin of hibernating bats and has devastated populations of other bat species, is also a possible threat. (Ozier et al. 2020). The gray bat has an approved recovery plan from 1982 (USFWS 1982).

Indiana Bat

The Indiana bat is a nocturnal insectivore, emerging from roosts shortly after sunset, and feeding almost exclusively on flying insects, but will consume terrestrial prey on occasion (USFWS 2007). Summer roost habitats are underneath exfoliating bark in mature trees that receive direct sunlight for more than half a day. Foraging typically occurs in semi-open to closed forested habitats with an open understory, forested edges, or riparian or wetland areas. During the winter, Indiana bats are restricted to suitable underground hibernacula. Hibernacula are predominantly caves but can include other cave-like structures such as mines and shafts. Typical hibernacula are high in volume and complexity, where variable vertical relief provides a range of temperatures and microclimates during the winter months (USFWS 2007). Threats to Indiana bat include human disturbance of hibernating bats, loss of summer habitat, pesticides and other contaminants, and white-nose syndrome (USFWS 2022b). The Indiana bat has a draft recovery plan from 2007 (USFWS 2007).

In association with the mining facility's permitting process, mist netting, acoustic monitoring, and habitat assessments were performed for the Indiana bat near the preliminary Lower Reservoir location in 2010. The report concluded that the Indiana bats were not using the then proposed permit area as summer roost or forage habitat and no portals were located that would provide potential winter habitat to bats (Biological Systems 2010).

Northern Long-eared Bat

The northern long-eared bat, distinguished from other species of *Myotis* by its long ears, is a wideranging species found in a variety of forested habitats in summer and hibernates in caves in winter (USFWS 2016). The species is found across eastern and north-central U.S. and southern Canada and is generally associated with old-growth forests (NatureServe 2021). Northern long-eared bats overwinter in hibernacula that include caves and abandoned mines (USFWS 2016). Rarely are there more than 100 individuals per hibernation colony (NatureServe 2021). Mating occurs in late summer or fall prior to hibernation, and each female delivers a single pup in June or early July. In summer, the bats generally are colonial but tend to be more solitary than other *Myotis* species, often roosting alone in deep cracks and crevices, under bark, or in hollows of live and dead trees. Foraging occurs within forests, along forest edges and clearings, and occasionally over ponds. Principal threats to the species include human disturbance of hibernating bats and mortality due to white-nose syndrome (USFWS 2016).

Monarch Butterfly

Monarch butterfly is a candidate species not yet proposed for listing under the Endangered Species Act of 1973 (USFWS 2020). The species is a large and conspicuous butterfly that exhibits long-distance migration and overwinters as adults at forested locations in Mexico and California. Adult monarch butterflies feed on nectar from a wide variety of flowers. Reproduction is dependent on the presence of milkweed, the sole food source for larvae. Larvae develop and feed on the milkweed plant, sequestering chemicals as a defense against predators. Adults live up to six to nine months, and multiple generations are produced over the course of the breeding season. Monarch butterflies occur across the continental U.S., but populations have been declining over the past 20 years. Primary threats to the species include the loss and degradation of habitat from conversion of grasslands to agriculture, widespread use of herbicides, exposure to insecticides, land-clearing activities in overwintering sites, urban development, and general loss of milkweed and nectar sources across the species' range from various land development activities (USFWS 2020).

Blackside Dace

Reaching a maximum length of three inches, the blackside dace is a small minnow endemic to the upper Cumberland River drainage in southeastern Kentucky and northeastern Tennessee. The blackside dace has a pointed snout, a wide, black lateral stripe on its side, with an olive to gold-colored back. The blackside dace is found in small, cool, upland streams with moderate flows and minimal silt. Habitat consists of streams with good canopy and instream cover such as submerged root wads, undercut banks, woody debris, and large rocks. (Floyd 2016). The spawning period is from April to July, with the most observations of spawning activity occurring from May to June (USFWS 2015). Spawning males are brightly colored, with bright yellow dorsal fins and scarlet on the lower head, nape, and belly (NatureServe 2022a). Principal threats to the species include siltation related to coal mining, silviculture, agriculture, and road construction (National Geographic 2022). The blackside dace has an approved recovery plan from 1988 (USFWS 1988).

Cumberland Arrow Darter

The Cumberland arrow darter occurs in the upper Kentucky and Cumberland River drainages. The species is currently stable in the Cumberland drainage and considered of conservation concern in the Kentucky River drainage. Habitat includes rocky riffles and pools of headwaters, creeks, and small rivers. Juveniles and sometimes adults are found in larger streams such as the main channel of Cumberland River in Kentucky. Spawning occurs in riffles in water approximately 5-15 centimeters deep or under or near rocks. Spawning peaks in April and the age range of breeding females is 2-4 years. (Nature Serve 2022b). Principal threats are point and non-point source pollution related to acid mine drainage and siltation related to coal mining (Kentucky DFWR 2022b).

Yellow-spotted Woodland Salamander

The petitioned yellow-spotted woodland salamander occurs on shale and sandstone outcrops from West Virginia to east Tennessee. Yellow-spotted woodland salamanders are large and slender, with gray-brown bodies and two rows of yellow spots along their dorsum. Adults range from 100-170 millimeters from head to tail with males being slightly smaller than females. Forage for prey occurs during the day on rock outcrops, trees, and the forest floor. The salamanders hibernate from October to March, with higher elevation individuals hibernating from September to April. Females reach sexual maturity at age five and nest in underground cavities or rock outcrop crevices. Principal threats are the present or threatened loss or modification of habitat related to mining, logging, and deforestation. (Center for Biological Diversity 2022).

5.6.3 Rare, Threatened, and Endangered Botanical Resources

There are no federally listed plant species that potentially occur within the Project Vicinity according to the USFWS IPaC list and letter from USFWS dated August 23, 2022 (Appendix E) (USFWS 2022a). According to the OKNP Rare Plant Database, and Endangered, Threatened, and Special Concern Plants, Animals and Natural Communities of Kentucky (OKNP 2019), there are 29 rare plant species with known occurrences within Bell County (Table 5-16).

Table 5-16: Rare, Threatened, and Endangered Plant Species with Known Records of Occurrence in Bell County, Kentucky

Scientific Name	Common Name	Federal Status ^a	KY Status ^b	Global Rank, State Rank ^c	Habitat ^d
Adlumia fungosa	Allegheny-vine	-	Н	G4, SH	Cliffs, talus, rocky slopes, rich stream-bottom forests, cool rocky forests; well-drained sunny openings, rocky and sandy slopes. Can invade following fire and logging.
Amianthium muscitoxicum	Fly poison	-	Т	G4G5, S1	Sandy soil, lowlands, bogs, and open woods. Reported from pine-oak woods and sandstone outcrops.
Baptisia tinctoria	Yellow wild indigo	-	Т	G5, S1S2	Sandhills, pine flatwoods, xeric woodlands, ridges, woodland edges, and road banks.
Boykinia aconitifolia	Brook saxifrage	-	Т	G4, S2	Streambanks, riverbanks, crevices in spray cliffs around waterfalls, seepages.
Calamagrostis odali ssp. Porteri	Porter's reedgrass	-	Т	G4T4, S2S3	Dry, rocky woods on mountain summits.
Calopogon tuberosus var. tuberosus	Tuberosus grass pink	-	E	G5T5, S1	Sphagnum bogs, fens, savannas, and wet shores. Dry, sandy pine and pine-oak woods and swamps.
Capnoides/Corydalis sempervirens	Rock harlequin	-	S	G5, S3?	Dry rocky woods. Usually associated with rock outcrops and ridge summits.
Carex austrocaroliniana	Tarheel sedge	-	S	G4, S3	Mesophytic ravine forests.
Castanea pumila	Allegheny chinkapin	-	Т	G5, S2	Xeric forests and woodlands. Generally, in fire-maintained habitats. Dry or moist acidic soils.
Chelone obliqua var. obliqua	Red turtlehead	ı	E	G4T3T4Q, S1	Streambanks, swamp forests. Alluvial swamps and wet woods.
Chrysosplenium americanum	American golden-saxifrage	-	Т	G5, S2?	Springs or muddy soils; springheads, open wooded seeps, seepage banks of spring-fed streams, seasonally wet sandstone rocks, rills, cool wet areas. Usually in shade.
Convallaria montana	American lily-of- the-valley	-	E	G4?, S1	Rocky or dry-mesic mixed hardwood forested slopes.
Deschampsia/Avenella flexuosa	Crinkled hairgrass	-	Т	G5, S2	Dry, open or partially shaded sandy or rocky soil in mesic forests. Cracks in sandstone cliffs and cliff bases.
Gentiana decora	Showy gentian	-	S	G4?, S3	Moist woods and openings in canopy on mountain summits.
Houstonia serpyllifolia	Michaux's bluets	-	E	G4?, S1	Streambanks, grassy balds, moist forests, seepy rock outcrops, spray cliffs, and moist disturbed areas. Moist soils in the mountains.
Lathyrus venosus	Smooth veiny peavine	-	S	G5, S2S3	Dry to mesic slopes, especially in basic soils.
Liparis loeselii	Loesel's twaybay	-	Т	G5, S2S3	Bogs, peaty meadows, and damp or seeping thickets or mesic slopes. Has been found on abandoned strip mines.

Scientific Name	Common Name	Federal Status ^a	KY Status ^b	Global Rank, State Rank ^c	Habitat ^d
Listera smallii	Kidney-leaf twaybay	-	Т	G4, S2	Humus of damp woods and tickets, bogs or shaded weed-free humus below rhododendron on mountain slopes and stream heads.
Melampyrum lineare var. latifolium	American cowwheat	-	Т	G5T5, S2	Dry, open sandstone ridgetops, including dry to dry-mesic second growth woods, road edges, and rock outcrops.
Monotropsis odorata	Sweet pinesap	-	Т	G3, S2	Sandstone ridgetops. Chiefly pine woods but also mesophytic woods.
Polytrichum pallidisetum	A hair cap moss	-	Т	G5, S2?	Soil humus and rocks in moist conditions or hardwood forests.
Prosartes maculata	Nodding mandarin	-	S	G4, S3?	Rich mesic forests.
Salvia urticifolia	Nettle-leaf sedge	-	Е	G5, S1	Woods, thickets, and glades.
Silene ovata	Ovate catchyfly	-	E	G3, S1	Dry, mesic forests and mountain summits. Has been found in calcareous sandstone woods and exposures on the side slopes below a cap of sandstone.
Solidago curtisii	Curtis' goldenrod	-	T	GNR, S3	Mountain woods.
Solidago puberula	Downy goldenrod	-	S	G5, S2	Dry woods.
Solidago roanensis	Roan Mountain goldenrod	-	Т	G4G5, S1S2	Forests on mountain summits and openings, including roadbanks.
Trillium undulatum	Painted trillium		Т	G5, S2	Mesic ravine forests, upper elevation mesic hemlock forests. Seeps in mesic forests and oak-chestnut forests.
Veratrum parviflorum	Appalachian bunchflower	-	E	G4?, S1	Moist wooded slopes in the mountains.

^a Federal status: LE = listed endangered; LT = listed threatened; C = candidate species, not yet listed or proposed for listing; SOMC = Species of Management Concern.

State ranks: S1 = critically imperiled, at very high risk of extinction due to extreme rarity; S2 = imperiled, at high risk of extinction due to very restricted range; S3 = vulnerable, at moderate risk of extinction due to restricted range; S4 = apparently secure, uncommon but not rare; S5 = secure – common, widespread, abundant; S#? = denotes inexact numeric rank; S#B = refers to breeding population in Kentucky; S#N = refers to non-breeding population in Kentucky.

Source: OKNP 2019

^b Kentucky state status: E = endangered; T = threatened; S = special concern; H=historic.

c Global ranks: G1 = critically imperiled, at very high risk of extinction due to extreme rarity; G2 = imperiled, at high risk of extinction due to very restricted range; G3 = vulnerable, at moderate risk of extinction due to restricted range; G4 = apparently secure, uncommon but not rare; G5 = secure – common, widespread, abundant; G#? = denotes inexact numeric rank; GNR = unranked, conservation status not yet assessed; G#Q = questionable taxonomy that may reduce conservation priority; G#T# = T denotes rarity of a subspecies.

^d Habitat descriptions for plants from OKNP Rare Plant Database (OKNP 2019).

5.6.4 References

- Biological Systems Consultants, Inc. (Biological Systems). 2010. Nally and Hamilton Enterprises, Inc. Permit # 807-0353 Indiana Bat (*Myotis sodalist*) Mist Netting And Winter Habitat Assessment BSC # 21073 / Final Report.
- Center for Biological Diversity. 2022. Petition to list the yellow-spotted woodland salamander (*Plethodon pauleyi*) under the Endangered Species Act as an endangered or threatened species and to concurrently designate critical habitat. Available at: https://www.biologicaldiversity.org/species/amphibians/pdfs/Yellow-spotted-woodland-salamander-Plethodon-pauleyi-petition.pdf. Accessed September 2022.
- Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR). 2022a. Species observations for select counties: Bell County. Available at: app.fw.ky.gov/speciesinfo/speciesinfo.asp. Accessed: May 2022.
- Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR). 2022b. Wildlife Action Plan; Fish. Available at: https://fw.ky.gov/WAP/Pages/Fish.aspx#844. Accessed August 2022.
- Floyd, Michael A., PhD. 2016. Kentucky's Threatened and Endangered Fishes Blackside Dace (*Chrosomus cumberlandensis*). Kentucky Ecological Services Field Office, U.S. Fish and Wildlife Service. Available at: https://www.nanfa.org/ac/blackside-dace-status.pdf. Accessed August 2022.
- National Geographic. 2022. Vulnerable Blackside Dace Fish. Available at: https://www.nationalgeographic.org/projects/photo-ark/animal/chrosomus-cumberlandensis/. Accessed August 2022.
- Nature Serve. 2021. Northern Long-eared Bat. Available at:
 https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.102615/Myotis_septentrionallis. Assessed August 2022.
- Nature Serve. 2022a. Blackside Dace. Available at:
 https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.106572/Chrosomus cumberlandensis. Accessed August 2022.
- Nature Serve. 2022b. Arrow Darter. Available at: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.104554/Etheostoma_sagitta. Accessed August 2022.
- Office of Kentucky Nature Preserves (OKNP). 2019. Endangered, Threatened, and Special Concern Plants, Animals, and Natural Communities of Kentucky. Office of Kentucky Nature Preserves, Kentucky Energy and Environment Cabinet, Frankfort, KY. Available online at: http://eppcapp.ky.gov/nprareplants/search.aspx?county=Bell. Accessed: May 2022.

- Ozier, J., K. Owers, K. Torrey, P. Sirajuddin, S. Kreuger. 2020. Species profile for *Myotis griscens*. Original 2008 account by Ozier and updates. Georgia Biodiversity Portal, Wildlife Resources Division, Wildlife Conservation Section, Social Circle.
- U.S. Fish and Wildlife Service (USFWS). 1982. Gray Bat Recovery Plan. Available online at: https://ecos.fws.gov/docs/recovery_plan/820701.pdf. Accessed August 2022.
- U.S. Fish and Wildlife Service (USFWS). 1988. Blackside Dace Recovery Plan. Available at: https://ecos.fws.gov/docs/recovery_plan/880817.pdf. Accessed August 2022.
- U.S. Fish and Wildlife Service (USFWS). 2007. Indiana bat (*Myotis sodalist*) Draft Recovery Plan: first revision. U.S Fish and Wildlife Service, Fort Snelling, MN. 258 pp.
- U.S. Fish and Wildlife Service (USFWS). 2009. Gray bat (*Myotis grisescens*) 5-year review: summary and evaluation. Midwest Region, Columbia, Missouri Ecological Services Field Office.
- U.S. Fish and Wildlife Service (USFWS). 2016. Species Profile: Northern long-eared bat (*Myotis septentrionalis*).
- U.S. Fish and Wildlife Service (USFWS). 2015. 5-Year Review: Summary and Evaluation. Available at: https://ecos.fws.gov/docs/five_year_review/doc4641.pdf. Accessed August 2022.
- U.S. Fish and Wildlife Service (USFWS). 2020. Endangered and threatened wildlife and plants; 12-month finding for the monarch butterfly. Federal Register 85(23):81813-81822.
- U.S. Fish and Wildlife Service (USFWS). 2022a. Information, Planning, and Consultation. Available online: https://ecos.fws.gov/ipac/ Accessed: June 2022.
- U.S. Fish and Wildlife Service (USFWS). 2022b. Indiana Bat. Available online: https://www.fws.gov/species/indiana-bat-myotis-sodalis.

5.7 Recreation and Land Use

18 CFR 5.6(d)(3)(viii) requires "A description of the existing recreational and land uses and opportunities within the project boundary. The components of this description include: (A) Text description illustrated by maps of existing recreational facilities, type of activity supported, location, capacity, ownership and management; (B) Current recreational use of project lands and waters compared to facility or resource capacity; (C) Existing shoreline buffer zones within the project boundary; (D) Current and future recreation needs identified in current State Comprehensive Outdoor Recreation Plans, other applicable plans on file with the Commission, or other relevant local, state, or regional conservation and recreation plans; I If the potential applicant is an existing licensee, its current shoreline management plan or policy, if any, with regard to permitting development of piers, boat docks and landings, bulkheads, and other shoreline facilities on project lands and waters; (F) A discussion of whether the project is located within or adjacent to a: (1) River segment that is designated as part of, or under study for inclusion in, the National Wild and Scenic River System; or (2) State-protected river segment; (G) Whether any project lands are under study for inclusion in the National Trails System or designated as, or under study for inclusion as, a Wilderness Area. (H) Any regionally or nationally important recreation areas in the project vicinity; (I) Non-recreational land use and management within the project boundary; and (J) Recreational and non-recreational land use and management adjacent to the project boundary."

5.7.1 Recreation

5.7.1.1 Recreation in the Preliminary Project Boundary and Project Vicinity

The preliminary Project Boundary and much of the Project Vicinity includes land used historically for mining. Recreation is not permitted on the private property with active and reclaimed mining operations; due to the industrial nature of this land, public access is restricted for public safety. There are no existing recreation sites in the preliminary Project Boundary and there are no public recreation sites in the Project Vicinity.

The Upper Cumberland River supports recreational water activities including fishing, canoeing, and kayaking. There is an Upper Cumberland River public access site called the Varilla Ramp located just downstream from the Project Vicinity, approximately 3 miles from the Project. The Varilla Ramp includes a boat ramp and a small, gravel parking area for approximately 8 vehicles. The Varilla Ramp is used for bank anglers, wade fishing, and as a put-in for canoes and kayaks. The Varilla Ramp is managed by the Kentucky DFWR. The Kentucky DFWR lists a river mile stretch of 13.8 miles of the Upper Cumberland River with the Varilla Ramp being the put-in access point, and the 4 Mile Ramp located just north of Pineville being the take-out location. The Kentucky DFWR does not list any boating sections on the Upper Cumberland River further upstream of the Project Vicinity. The Varilla Ramp is shown in Figure 5-12. (Kentucky DFWR 2022).



Figure 5-12: Varilla Ramp

Source: Kentucky DFWR 2022

5.7.1.2 Regional Recreation Opportunities

There are numerous recreational opportunities in Eastern Kentucky in the region surrounding the Project. Key regional parks include Cumberland Gap National Historic Park, Kentucky Ridge State Forest and Wildlife Management Area, Daniel Boone National Forest, and Cumberland Falls State Resort Park.

Cumberland Gap National Historic Park is located approximately 10 miles from the Project. The park is at the borders of Kentucky, Tennessee, and Virginia. The park consists of approximately 24,000 acres and offers 85 miles of hiking trails, camping, scenic views, unique geologic sandstone formations, and underground caverns. Cumberland Gap National Historic Park is managed by the National Park Service (NPS). (NPS 2022a).

Kentucky Ridge State Forest, located approximately 15 miles from the Project, consists of over 15,000 acres and contains the Pine Mountain State Resort Park. Kentucky Ridge State Forest is located on the south side of Pine Mountain and the north side of Log Mountain, encompassing Little Clear Creek Valley as well as Chenoa Lake. The forest is open to public hunting fishing, primitive camping, and hiking, and is managed by the state. (Kentucky EEC 2022a).

Daniel Boone National Forest, located approximately 40 miles from the Project, consists of more than 708,000 acres of national forest system lands across 21 counties in eastern Kentucky. Daniel Boone National Forest has over 600 miles of trails and is home to two federally recognized wildernesses and more than 250 recreation sites. Recreation activities include hiking, hunting, camping, picnicking, off-highway vehicle riding, and fishing. Daniel Boone National Forest is managed by the USDA United States Forest Service (USFS). (USDA USFS 2022).

Cumberland Falls State Resort Park is located approximately 45 miles from the Project in Corbin, Kentucky. The park is managed by Kentucky State Parks. Within the park is Cumberland Falls, a 125-foot-wide waterfall on the Cumberland River. In addition to camping, there is lodging available at the park. The park provides opportunities for recreation including hiking, fishing, canoeing, and picnicking. (Kentucky State Parks 2022).

5.7.1.3 Recreation Needs Identified in Management Plans

Kentucky has a Statewide Comprehensive Outdoor Recreation Plan (SCORP), which was prepared by the Kentucky Department for Local Government (2019). This is a five-year plan which covers 2020-2025 and outlines strategies and recommendations for addressing outdoor recreation in the state. The SCORP permits the state to remain eligible to receive federal Land and Water Conservation Funds for outdoor recreational projects. The SCORP was developed with extensive input from Kentucky's fifteen area development districts, several federal, state and local government agencies, and community recreational-user groups. (Kentucky Department for Local Government 2019).

The Kentucky SCORP contained ten strategic goals to work on through 2025:

- Goal 1: Expand and improve the quantity and variety of outdoor recreation opportunities, with emphasis on areas and population segments where these are most lacking.
- Goal 2: Develop and promote the recreational opportunities that are associated with tourism.
- Goal 3: Implement an integrated strategy of trail development utilizing the funding resources and selection criteria of the Recreational Trails Program Fund, Land and Water Conservation Fund, Transportation Enhancement funds, and other sources.
- Goal 4: Facilitate the public's awareness and Statewide Outdoor Recreation Goals/use of Kentucky's outdoor recreation resources, facilities, programs, and promote the social and health benefits of their use.
- Goal 5: Preserve the state's natural, environmental, historical, and cultural assets.
- Goal 6: Establish and maintain a strong element of public participation in the planning, development, and management of outdoor recreation facilities and programs.

- Goal 7: Increase and promote coordination and definition of roles among the various federal, state, regional, local, and private agencies that are responsible for the planning, programming, and implementation of recreation facilities and opportunities.
- Goal 8: Make the most efficient use of existing recreation facilities and resources.
- Goal 9: Fully exploit all existing funding resources for recreation and seek to develop other funding possibilities.
- Goal 10: Promote the use of SCORP as a planning tool and the progressive implementation of its identified objectives

Regarding current and future recreation needs, Strategic Goal 1 of the Kentucky 2020-2025 SCORP is further detailed. An objective under Strategic Goal 1 is, to "Develop additional local park and recreation facilities that are based on a careful assessment of community needs. Through technical assistance and planning incentives from state and regional agencies, educate and encourage local park departments of techniques for conducting needs surveys, developing community recreation plans, and incorporating public input into the need assessment." (Kentucky Department for Local Government 2019).

A quantitative statewide survey regarding the demand for recreation facilities and resources was completed and detailed in the SCORP (2019). In the survey, most respondents said that parks somewhat met their needs while approximately one third of participants indicated that parks completely met their needs. Less than 10% of respondents said that their needs were not at all met. The SCORP concluded that although there is room for improvement, the survey indicates that Kentuckians are largely satisfied with their parks. It was also stated that paved trails were reported as the most urgent need facing recreational facilities (19.2%) with playgrounds (17.2%), and picnic shelters (15.8%) following. (Kentucky Department for Local Government 2019).

5.7.2 Land Use

The area within the preliminary Project Boundary has historically been used for coal mining and is considered an industrial site. The area within the preliminary Project Boundary is privately owned and managed. There are still active mining permits in the Project Vicinity. The preliminary Upper and Lower Reservoirs are located at reclaimed mine sites and the preliminary interconnection line runs along existing roads. Photos of the Project Vicinity are provided in Section 5.8. Overall, the Project Vicinity includes lands generally considered as rural lands. The Project Vicinity includes lands which have been used historically for mining. Additionally, the Project Vicinity includes forested lands and low-density residential areas.

The major land use categories as mapped by the National Land Cover Database (NLCD) for the preliminary Project Boundary and Project Vicinity are presented in Table 5-17 and depicted on

Figure 5-13. As shown, the major land use identified in the NLCD for the preliminary Project Boundary and Project Vicinity include undeveloped land, largely consisting of deciduous forest, shrub/scrub, and herbaceous land.

Table 5-17: Major Land Use Categories in the Preliminary Project Boundary and Vicinity

Major Land Use	Project Boundary Acres	Project Vicinity Acres		
Deciduous Forest	73.4	4,230.1		
Shrub/Scrub	40.2	787.9		
Herbaceous	19.5	323.8		
Developed, Open Space	10.1	134.1		
Developed, Low Intensity	9.4	88.3		
Developed, Medium Intensity	2.0	49.1		
Open Water	1.3	108.7		
Hay/Pasture	0.7	183.5		
Developed, High Intensity	0.7	10.7		
Mixed Forest	0.4	218.4		
Barren Land	0.1	87.0		
Emergent Herbaceous Wetlands	-	6.4		
Evergreen Forest	-	2.0		
Woody Wetlands	-	1.3		
Total*	157.6	6,231.4		

^{*} Due to rounding, the sum of the addends may not equal the total.

Source: Dewitz 2021, USGS 2021

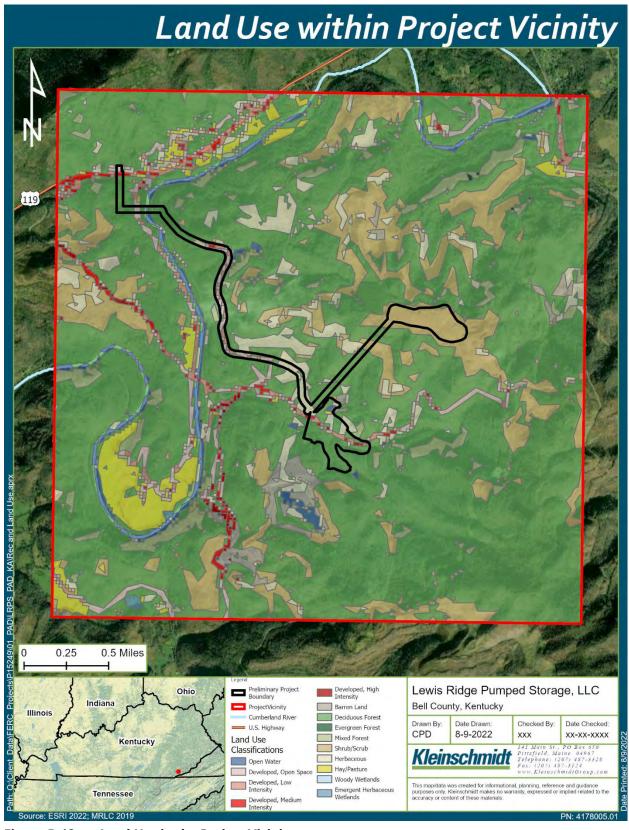


Figure 5-13: Land Use in the Project Vicinity

5.7.3 Protected River Segments

There are no rivers within the Project Vicinity that have been designated for inclusion in the National Wild and Scenic River System (NPS 2022b).

Kentucky has a Wild Rivers Program which was established by the Kentucky Wild Rivers Act of 1972 and is administered by the Office of Kentucky Nature Preserves. Located approximately 84 miles downstream from the Project, the Cumberland River has been designated a Wild River from Summer Shoals to the backwaters of Lake Cumberland (Kentucky EEC 2022b). This segment is 16.1 miles long and is over 40 miles from the Project Vicinity (Kentucky EEC 2022b). There are no state-protected river segments in the Project Vicinity.

5.7.4 National Trails System and Wilderness Areas

In the Project Vicinity, there are no lands included in the National Trails System, nor are there lands designated as, or under study for inclusion as, a Wilderness Area (NPS 2022c, Southern Appalachian Wilderness Stewards 2022).

5.7.5 References

- Dewitz, J., and U.S. Geological Survey (USGS). 2021. National Land Cover Database (NLCD) 2019 Products (ver. 2.0, June 2021): U.S. Geological Survey data release, https://doi.org/10.5066/P9KZCM54 Accessed: June 2022.
- Kentucky Department for Local Government. 2019, October. Kentucky Outdoor Recreation Plan 2020 2025. Available online: https://kydlgweb.ky.gov/Documents/LWCF/Kentucky%20SCORP.pdf. Accessed: June 2022.
- Kentucky Department of Fish and Wildlife Resources (Kentucky DFWR). 2022. Upper Cumberland River. Available online: https://fw.ky.gov/Fish/Pages/Upper Cumberland.aspx Accessed: August 2022.
- Kentucky Energy and Environment Cabinet (Kentucky EEC). 2022a. Kentucky Ridge State Forest. Available online: https://eec.ky.gov/Natural-Resources/Forestry/ky-state-forests/Pages/Kentucky-Ridge-State-Forest.aspx Accessed: August 2022.
- Kentucky Energy and Environment Cabinet (Kentucky EEC). 2022b. Kentucky Wild Rivers Program. Available online: https://eec.ky.gov/Nature-
 https://eec.ky.gov/Nature-
 Preserves/conserving natural areas/wild-rivers/Pages/default.aspx. Accessed: July 2022.
- Kentucky State Parks. 2022. Cumberland Falls State Resort Park. Available online: https://parks.ky.gov/corbin/parks/resort/cumberland-falls-state-resort-park. Accessed: August 2022.

- National Park Service (NPS). 2022a. Cumberland Gap National Historical Park. Available online: https://www.nps.gov/cuga/index.htm. Accessed: June 2022.
- National Park Service (NPS). 2022b. National Wild and Scenic Rivers System. Available online: https://www.rivers.gov/kentucky.php Accessed: August 2022.
- National Park Service (NPS). 2022c. National Trails System. Available online:

 https://www.nps.gov/subjects/nationaltrailssystem/national-scenic-trails.htm Accessed:

 August 2022.
- Southern Appalachian Wilderness Stewards. 2022. Available online: https://www.wildernessstewards.org/kentucky Accessed: August 2022.
- U.S. Department of Agriculture (USDA) United States Forest Service (USFS). 2022. Daniel Boone National Forest. Available online: https://www.fs.usda.gov/dbnf. Accessed: June 2022.

5.8 Aesthetic Resources

18 CFR 5.6(d)(3)(ix) requires "A description of the visual characteristics of the lands and waters affected by the project. Components of this description include a description of the dam, natural water features, and other scenic attractions of the project and surrounding vicinity. Potential applicants are encouraged to supplement the text description with visual aids."

5.8.1 Bell County, Kentucky

Bell County's 361-acres include two scenic Appalachian Mountain ridges, the Pine and Cumberland Mountains, which are densely forested with picturesque streams flowing through deep valleys (Commonwealth 2017). The Pine Mountain ridge extends west/east over 120 miles from Tennessee to Elkhorn City, Kentucky and is approximately 3 miles north of the Project Vicinity (Commonwealth 2022). The Cumberland Mountain ridge extends west/east and is approximately 6 miles south of the Project Vicinity. Bell County is home to Kentucky's first state park (Pine Mountain State Resort Park) and the country's largest national historical park (Cumberland Gap National Historical Park). Chained Rock on Pine Mountain provides views of the city of Pineville and its surrounding mountain forests. (KY Dept of Tourism 2022).

The Pine Mountain State Scenic Trail is currently being developed and once completed, will traverse 120-miles from the Breaks Interstate Park to the Cumberland Gap National Historical Park. The nearby Cumberland Gap National Historical Park offers diverse views of mountain scenery and includes scenic vistas of the Appalachian Mountains, waterfalls, unique rock formations, and lush forests as depicted in Figure 5-14 through Figure 5-16 (NPS 2021a; NPS 2021b). The Pine Mountain State Scenic Trail will pass through several scenic nature preserves, including one containing the largest old growth forest in Kentucky. (Commonwealth 2022).



Figure 5-14: Gap Greek at Cumberland National Historical Park

Source: NPS 2021b



Figure 5-15: Poor Valley Ridge and Cumberland Mountain

Source: NPS 2021b



Figure 5-16: The Cumberland Gap

Source: NPS 2021b

5.8.2 Lewis Ridge Project Site

Aesthetics in the Project Vicinity consists of previously disturbed lands (including previous and active mining facilities) and surrounding forests. Photos taken within the Project Vicinity are provided as Figure 5-17 through Figure 5-24.



Figure 5-17: Preliminary Upper Reservoir Site

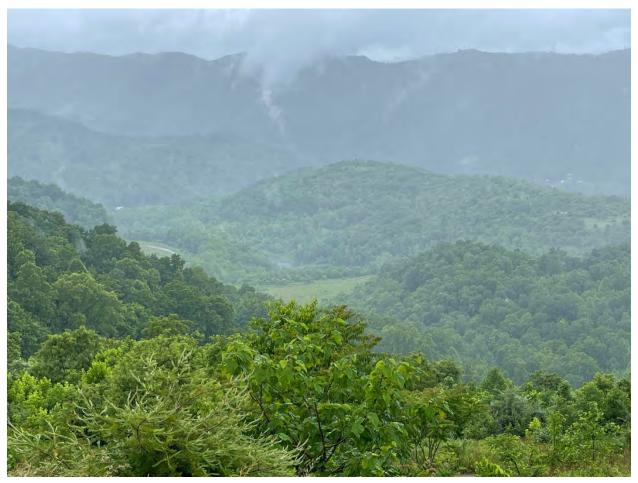


Figure 5-18: View from the Preliminary Upper Reservoir Site, facing northwest



Figure 5-19: Preliminary Lower Reservoir Site



Figure 5-20: View of Tom Fork Downstream of Preliminary Lower Reservoir Site



Figure 5-21: View of Dry Branch near Preliminary Interconnection Line Crossing



Figure 5-22: View of Reclaimed Mining Area in Project Vicinity



Figure 5-23: View of Pond in Project Vicinity



Figure 5-24: Closed High Wall Mining Operation in Project Vicinity

5.8.3 References

Commonwealth of Kentucky. 2017. Bell County, Kentucky. Available online:

https://bellcounty.ky.gov/Pages/index.aspx#:~:text=Bell%20County%20is%20located%20in%20the%20southeastern%20corner,forested%20with%20picturesque%20streams%20cutting%20through%20deep%20valleys. Accessed: July 2022.

Commonwealth of Kentucky. 2022. Pine Mountain State Scenic Trail. Available online:

https://eec.ky.gov/Nature-

<u>Preserves/Locations/Pages/Pine%20Mountain%20State%20Scenic%20Trail.aspx#:~:text=The%20Pine%20Mountain%20State%20Scenic%20Trail%20%28PMSST%29%20is,natural%20areas%20including%3A%20Bad%20Branch%20State%20Nature%20Preserve%2C.</u>
Accessed July 2022.

Kentucky Department of Tourism (KY Dept of Tourism). 2022. Chained Rock. Available online: https://www.kentuckytourism.com/pineville/attractions/guided-tours/chained-rock. Accessed: July 2022.

National Park Service (NPS). 2021a. Cumberland Gap National Historical Park. Available online: https://www.nps.gov/cuga/planyourvisit/things2do.htm Accessed: July 2022.

National Park Service (NPS). 2021b. Cumberland Gap National Historical Park. Photo Gallery of Landforms and Features. Available online:

https://www.nps.gov/media/photo/gallery.htm?pg=923649&id=22EF783A-1DD8-B71C-070227187909C696. Accessed: July 2022.

5.9 Cultural Resources

18 CFR 5.6(d)(3)(x) requires "A description of the known cultural or historical resources of the proposed project and surrounding area. Components of this description include: (A) Identification of any historic or archaeological site in the proposed project vicinity, with particular emphasis on sites or properties either listed in, or recommended by the State Historic Preservation Officer or Tribal Historic Preservation Officer for inclusion in, the National Register of Historic Places; (B) Existing discovery measures, such as surveys, inventories, and limited subsurface testing work, for the purpose of locating, identifying, and assessing the significance of historic and archaeological resources that have been undertaken within or adjacent to the project boundary; and (C) Identification of Indian tribes that may attach religious and cultural significance to historic properties within the project boundary or in the project vicinity; as well as available information on Indian traditional cultural and religious properties, whether on or off of any federally-recognized Indian reservation (A potential applicant must delete from any information made available under this section specific site or property locations, the disclosure of which would create a risk of harm, theft, or destruction of archaeological or Native American cultural resources or to the site at which the resources are located, or would violate any Federal law, including the Archaeological Resources Protection Act of 1979, 16 U.S.C. 470w-3, and the National Historic Preservation Act of 1966, 16 U.S.C. 470hh)."

5.9.1 Prehistoric Context

The Project is situated in southeast Kentucky near the borders of Tennessee and Virginia. Archaeological evidence suggests that humans have occupied the region for more than 12,000 years (KY Heritage Council 2022a).

The earliest evidence of human occupation in the southeastern United States is identified as the Paleoindian Stage, which began approximately 12,000 B.C. and continued to approximately 8,000 B.C. The climate in Kentucky was much colder and wetter upon the estimated first arrival at the end of the last ice age at least 12,000 years ago. Mammoth, mastodon, and bison provided meat and hides were used for temporary shelters and clothing. In this time frame, people lived in small groups and migrated frequently. The Paleoindian toolkit consisted of well-crafted spear points of stone. It is likely Paleoindians also made tools from wood and animal bones (KY Heritage Council 2022a).

During the Archaic period (8,000 to 1,000 B.C.), the region's climate gradually trended toward that of modern weather patterns, which led to the extinction of large animals such as the mastodon and giant bison. Hunting shifted to smaller game animals such as deer, turkey, and rabbit. Archaic groups collected wild plants for food and medicine and made baskets for collecting, transporting, and storing their food. Sedentism increased during this period compared to the Paleoindian period, but groups still migrated every few months. Archaic hunters used notched and stemmed (not fluted) stone spearpoints and used a spearthrower (atlatl) to improve velocity and accuracy. By 1,000 B.C., some Archaic groups began experimenting with growing food (KY Heritage Council 2022a).

The Woodland period (1,000 B.C. to A.D. 1,000) is marked by the introduction of pottery, which was used for cooking and food storage. During this period, gardening and cultivating plants increased and groups tended to live in larger communities. Large earthen enclosures were used in religious ceremonies and burial mounds were constructed over decades. Evidence from this period suggests that long-distance exchange networks appeared and people began to explore caves (such as Mammoth Cave in Kentucky). The bow and arrow were invented late in this period and spearpoints were replaced with arrowheads. The use of groundstone tools continued and were used for processing corn. (KY Heritage Council 2022a).

The Late Prehistoric period (A.D. 1000-1750) represents the last pre-contact cultural traditions prior to the introduction of European settlers and the introduction of diseases that decimated native populations. Late Prehistoric groups focused on planting, growing, and harvesting corn and beans. The toolkit was expanded to include the hoe for agricultural fields. New forms of pottery such as jars, bowls, plates, bottles, and colanders were developed. People lived in large year-round settlements and constructed rectangular houses. Communities were ruled by hereditary chiefs who lived on larger mounds near the center of the settlement. Religious and ceremonial life is depicted by the figures engraved on shell gorgets (necklace pendants) and placement of ceramic vessels with shell spoons, pipes, and shell necklaces with the deceased. (KY Heritage Council 2022a).

Several Native American tribes once called Kentucky home, including the Cherokee, the Chickasaw, and the Shawnee (VisitLex 2022). From around 1650 to 1750, Native American wars ensued over control of Kentucky, or the "Great Meadow," between the Shawnee tribes located north of the Ohio River and the Cherokee and Chickasaw tribes located south of the Cumberland River (KY Dept of Tourism 2022). By the 1680s or 1690s, the Shawnee had one or more villages on the upper Cumberland River; however, the Cherokee claimed the upper Cumberland River as their hunting grounds (Henderson and Pollack 2012). The Cherokee forced the Shawnee out of the area around 1714 (Henderson and Pollack 2012).

5.9.2 Historic Context

Dr. Thomas Walker and Christopher Gist first explored Kentucky in 1750 and 1751, but outbreaks of conflict between the British and Native Americans delayed further exploration for over a decade (KY Dept of Tourism 2022). By the late 1700s the newly formed United States began to put settlement pressure on the region (KY Dept of Tourism 2022). European settlement in the area was slower than along the East Coast of the modern United States due to the barrier of the Appalachian Mountains (VisitLex 2022). After 1775, Kentucky experienced rapid growth as the first settlements west of the Appalachian Mountains were founded with settlers primarily from Virginia, North Carolina, and Pennsylvania (accessing the area by the Cumberland and Ohio Rivers). Daniel Boone first explored Kentucky in 1767 and returned in 1769 for a two-year exploration of the area

(KY Dept of Tourism 2022). In 1772, the Cherokee surrendered their claim to Kentucky to the colony of Virginia (VisitLex 2022). During the American Revolutionary War, indigenous Native American tribes fought with the British against American colonists. Several conflicts took place in Kentucky, including the siege of Boonesboro, attacks on Martin's and Ruddle's Station, and the Battle of Blue Licks in 1782 (VisitLex 2022). The Battle of Blue Licks was one of the last Native American battles in Kentucky, although smaller conflicts occurred until 1813 (KY Dept of Tourism 2022). Kentucky became a state in 1792 and the westernmost region was annexed following its purchase from the Chickasaw Indians in 1818 (KY Dept of Tourism 2022). With passage of the "Indian Removal Act" in 1830, American Indians living east of the Mississippi River were required to move west to Indian Territory. However, Kentucky's Indian removal had taken place much earlier, first in response to the events of the French and Indian War, then the American Revolution, and finally, the War of 1812 (Henderson and Pollack 2012). In addition to aiding in immigration to the area, the Cumberland Gap had strategic value during the Civil War as whoever occupied the pass controlled the railroad from Virginia to Tennessee.

The logging Industry in Bell County began after the Civil War ended in 1865, with its most active years continuing until around 1900. The coal industry in Bell County started around 1888, after the Louisville and Nashville Railroad Company built a railroad along the Cumberland River (Fusan 1939). The coal fields in eastern Kentucky peaked in 1928-1930 and maintained those production levels until the second World War (Kentucky Foundation 2007).

5.9.3 Architectural Review

A Phase I archaeological reconnaissance was performed in 2007 in association with the permit submitted to the Division of Mines for a mining facility in the area of the preliminary Lower Reservoir location. The survey identified four previously unrecorded sites: two historic cemeteries (further discussed in Section 5.9.4), remains of a coal camp house, and remains of a historic coal mining operation (McGraw 2007). Although not eligible for the NRHP individually, the Kentucky State Historic Preservation Office (SHPO) and the Division of Mines recommended Phase II investigations of the sites in the form of archival research to determine if they were eligible as a district. Due to extensive disturbance from coal mining operations and surface mining, the district was found ineligible for the NRHP.

A preliminary historic resources site check of the Project Vicinity was submitted to the Kentucky Heritage Council to identify previously recorded sites and any properties or sites already listed on or determined eligible for the National Register of Historic Places (NRHP). The site check identified 10 historic houses along public roadways (1 of which meets NRHP criteria) and the Balkan School (meets NRHP criteria) (Figure 5-25) within the Project Vicinity (Kentucky Heritage Council 2022b).



Figure 5-25: Balkan School

5.9.4 Archaeological Review

A preliminary records review for archaeological sites was submitted to the University of Kentucky to determine whether there are previously recorded archaeological sites near the Project, and if present, their NRHP status. The review identified 5 sites within a 30-meter buffer of the Project Boundary and includes the two cemeteries identified in the 2007 Phase 1 reconnaissance. Three of the sites do not meet NRHP eligibility criteria and the two cemeteries' NRHP status have not been assessed (University of Kentucky 2022). The previous mining facility did not impact the cemeteries by providing a 100-foot buffer zone.

5.9.5 References

- Fuson, Henry Harvey. 1939. History of Bell County, Kentucky. Available online at: http://www.bellcpl.org/uploads/4/2/6/7/42679073/history of bell county kentucky.pdf. Accessed July 2022.
- Kentucky Department of Tourism (KY Dept of Tourism). 2022. About Kentucky: History. Available online at: https://www.kentuckytourism.com/get-inspired-ky/about-kentucky/history. Accessed: July 2022.
- Kentucky Foundation. 2007. Kentucky Coal Education. Kentucky Coal Heritage Coal Camps and Communities. Available online at:

 http://coaleducation.org/coalhistory/coaltowns/historic_context.htm. Accessed: September 2022.
- Kentucky Heritage Council (KY Heritage Council). 2022a. State Historic Preservation Office. Prehistoric Archaeology of Kentucky. Available online at https://heritage.ky.gov/archaeology/prehistoric/Pages/overview.aspx. Accessed: July 2022.
- Kentucky Heritage Council (KY Heritage Council). 2022b. Preliminary Site Check. Site Identification Program. 410 High Street, Frankfort, KY 40601.
- Henderson, A and D. Pollack. 2012. Native America: A State-by-State Historical Encyclopedia edited by Daniel S. Murphree Volume 1, pages 393-440 Greenwood Press, Santa Barbara, CA. 2012. Available online at: https://heritage.ky.gov/Documents/Native History KyTeachers.pdf. Accessed: July 2022.
- Lexington Visitors Center (VisitLex). 2022. Indigenous Americans in Kentucky. Available online at: https://www.visitlex.com/guides/post/indigenous-americans-in-kentucky. Accessed: July 2022.
- McGraw, Betty J. 2007. Phase I Archaeological Survey of the Nally & Hamilton Enterprises, Inc. Balkan Coal Permit Area, Bell County, Kentucky.
- University of Kentucky. 2022. Kentucky Office of State Archaeology. Preliminary Records Review. 1020A Export Street, Lexington, KY 40506.

5.10 Socioeconomic Resources and Environmental Justice

18 CFR 5.6(d)(3)(xi) requires "A general description of socio-economic conditions in the vicinity of the project. Components of this description include general land use patterns (e.g., urban, agricultural, forested), population patterns, and sources of employment in the project vicinity."

5.10.1 Overview

The unconstructed Project is located in Bell County, near the communities of Blackmont, Tejay, Balkan, and Callaway in southeast Kentucky. The following sections describe socioeconomic conditions in the Project region, including Bell County and the Commonwealth of Kentucky, to provide context.

5.10.2 General Land Use Patterns

Compared to other counties in Kentucky, Bell County, Kentucky has a high number of mining, quarrying, oil & gas extraction, utilities, and agriculture, forestry, fishing & hunting industries (Data USA 2019). Bell County, Kentucky produced 302 million tons of coal from 1879 to 2004, with 108 million tons extracted by surface mining (Carey 2007). General land use in the Project Vicinity is further described in Section 5.7.

5.10.3 Population Patterns

Figure 5-18 summarizes the population estimates for Bell County, Kentucky and the Commonwealth of Kentucky as reported in the 2010 and 2020 U.S. Census, and as estimated by the United States Census Bureau for 2021.

Table 5-18: Estimated Population of Bell County, Kentucky and the Commonwealth of Kentucky

County/State	2010 Census	2020 Census	Percent Change 2010-2020	2021 Estimates	Percent Change 2020-2021
Bell County, Kentucky	28,691	24,097	-16.01%	23,858	-0.99%
Kentucky	4,339,367	4,505,836	3.84%	4,509,394	0.08%

Source: U.S. Census Bureau 2022

Census tract 9604 (Figure 5-26) is approximately 53 square-miles and includes the communities of Tejay, Balkan, and Callaway. The tract had an estimated population of 1,292 with a population density of 24.4 people per square-mile (U.S. Census 2020). Based on 2020 data, Bell County is approximately 359 square-miles and had a population density of 67.1 people per square-mile; both of which are lower than the state average density of 114.1 people per square-mile. (U.S. Census Bureau 2022).

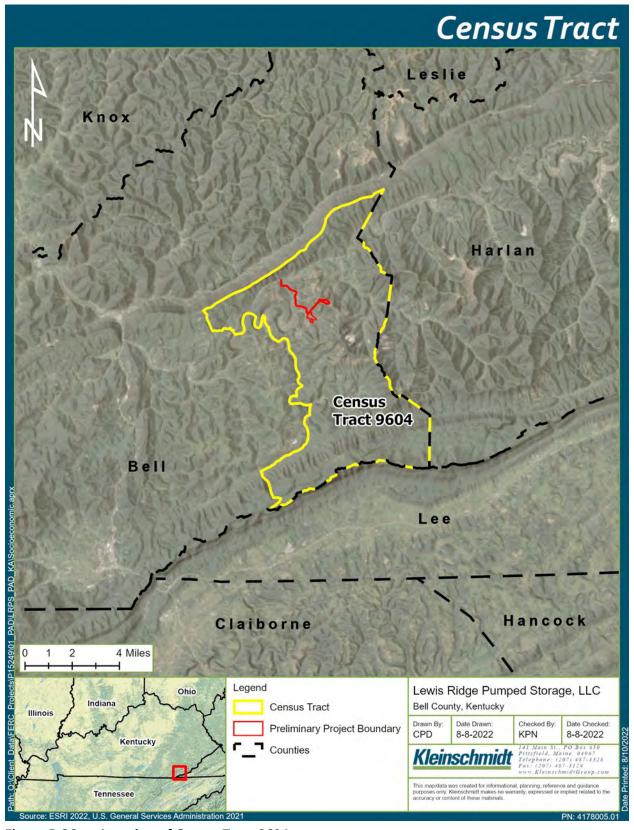


Figure 5-26: Location of Census Tract 9604

5.10.4 Economic Indicators and Employment

The 2016-2020 estimated median household income for Bell County was \$28,442 in 2020 dollars with a poverty rate of 29.8 percent, compared to 14.9 percent in Kentucky (U.S. Census Bureau 2022). Table 5-19 provides the household and family distribution and income for Bell County, Kentucky. In 2019, Census tract 9604 had an estimated median household income of \$30,978, the second highest median household income of the census tracts in Bell County, Kentucky (Data USA 2019).

Table 5-19: Household Incomes and Distributions for Bell County, Kentucky

	Bell County
2016-2020 Households	10,504
2016-2020 Approximate Number of Persons per Household	2.43
2016-2020 Percentage of Population in Civilian Labor Force	38.4%
2020 Population Below Poverty Level	29.8%

Source: U.S. Census Bureau 2022

The largest industries in Bell County, Kentucky in 2019 were Health Care & Social Assistance, Manufacturing, and Retail Trade. The highest paying industries were Mining, Quarrying, & Oil & Gas Extraction (\$62,604), Agriculture, Forestry, Fishing & Hunting, & Mining (\$46,513), and Wholesale Trade (\$45,472). (Data USA 2019).

5.10.5 Environmental Justice

Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, and Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, as amended, require federal agencies to consider if impacts on human health or the environment would be disproportionately high and adverse for minority and low-income populations in the surrounding community resulting from the programs, policies, or activities of federal agencies. The thresholds used for populations meeting environmental justice (EJ) status are as follows:

- For minority populations, the meaningfully greater analysis method was used, where the minority population in a block group is at least 10 percent greater than that of the same population for the county:
 - o (County population) x (1.10) = threshold above which a minority population must be for inclusion as an environmental justice community
- The "low-income threshold criteria" was used to identify environmental justice communities based on income level, where the block group must have a higher percentage of low-income households than the county.

Figure 5-27 depicts the census blocks groups screened for environmental justice within census tract 9604. Table 5-20 provides associated race and ethnicity data, as well as data on households in poverty. Ethnicity data did not identify any EJ communities within the census tract, however, both block groups within the census tract meet EJ status due to income levels below the poverty level.

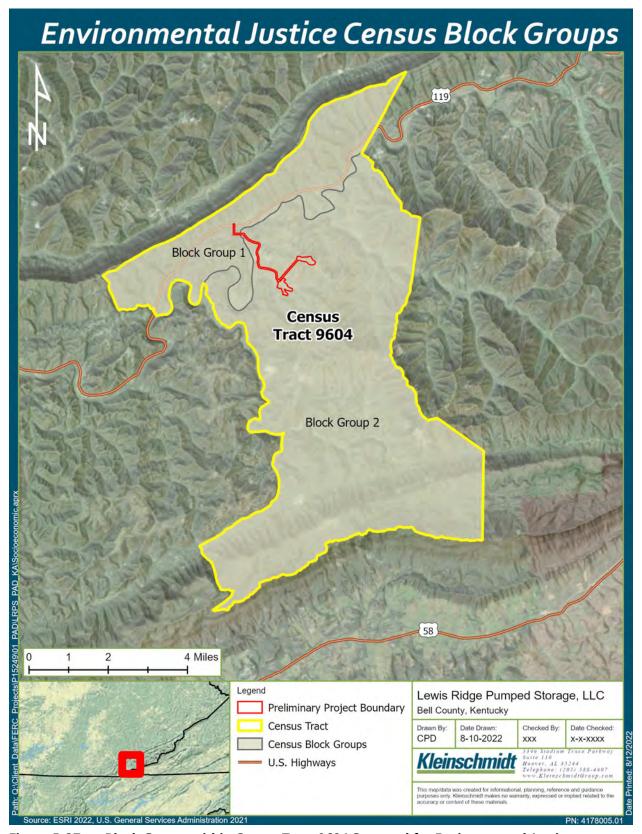


Figure 5-27: Block Groups within Census Tract 9604 Screened for Environmental Justice

Table 5-20: Environmental Justice Data

	Race and Ethnicity Data						Low-Income Data			
Geography	Total Population (count)	White Alone Not Hispanic (count)	African American (count)	Native American/ Alaska Native (count)	Asian (count)	Native Hawaiian & Other Pacific Islander (count)	Some Other Race (count)	Two or More Races (count)	Total Minority (%)*	Households in Poverty (%)
Kentucky	4,449,052	3,868,479	358,928	9,386	65,191	3,182	43,601	100,285	13	16.7
Bell County, Kentucky	26,791	25,531	742	60	45	-	36	377	4.7	31.7
Census Tract 9604, Block Group 1	856	856	-	-	-	-	-	-	0	52.1
Census Tract 9604, Block Group 2	1060	1060	-	-	-	-	-	-	0	34

^{*}Calculated the percent total minority population by subtracting the percentage of "White Alone Not Hispanic" from 100 percent for any given area.

Source: American Community Survey 2019, 2020

^{*}Blue shaded cells indicate EJ community

The EPA's Environmental Justice Screening and Mapping Tool (EJScreen) (Version 2.0) was used to review environmental and demographic indicators of Block Group 1 and 2 of Census Tract 9604. Block Group 1 had an approximate population of 856 and covered approximately 11 square-miles, and Block Group 2 had an approximate population of 1,060 and covered approximately 42 square-miles. The percentiles in Table 5-21 (Block Group 1) and in Table 5-22 (Block Group 2) provide perspective on how the block groups compare to the entire Commonwealth of Kentucky, the EPA region (4), and the United States for each EJ index. EJScreen is not used by EPA to identify EJ communities or to quantify specific risk values for a selected area. Instead, the tool is a screening level for identifying geographic areas that may warrant further consideration, analysis, or outreach. The complete EJScreen Reports (Version 2.0) for Block Groups 1 and 2 of Census Tract 9604 are provided in Appendix F.

Table 5-21: Pollution and Sources and Socioeconomic Indicators for Block Group 1 of Census
Tract 9604

a		Sta	te	EPA Region		USA	
Selected Variables	Value	Avg.	%tile	Avg.	%tile	Avg.	%tile
Pollution and Sources							
Particulate Matter 2.5 (µg/m³)	7.64	8.9	5	8.18	27	8.74	24
Ozone (ppb)	40.3	42.4	16	37.9	59	42.6	33
2017 Diesel Particulate Matter* (µg/m³)	0.0706	0.226	0	0.261	<50	0.295	<50
2017 Air Toxics Cancer Risk* (lifetime risk per million)	30	29	99	31	80-90	29	80-90
2017 Air Toxics Respiratory HI*	0.3	0.36	46	0.4	<50	0.36	<50
Traffic Proximity (daily traffic count/distance to road)	43	380	30	430	28	710	21
Lead Paint (% Pre-1960 Housing)	0.25	0.23	69	0.15	81	0.28	59
Superfund Proximity (site count/km distance)	0.052	0.039	80	0.083	60	0.13	43
RMP Facility Proximity (facility count/km distance)	0.043	0.67	6	0.6	3	0.75	3
Hazardous Waste Proximity (facility count/km distance)	0.03	0.77	11	0.62	3	2.2	3
Underground Storage Tanks (count/km²)	0	1.1	16	3.5	10	3.9	16
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.00025	1.3	45	0.45	50	12	38
Socioeconomic Indicators							
Demographic Index	33%	26%	73	37%	50	36%	54
People of Color	0%	15%	8	39%	1	40%	1
Low Income	65%	37%	90	35%	91	31%	92
Unemployment Rate	11%	6%	85	6%	86	5%	87
Linguistically Isolated	0%	1%	73	3%	51	5%	45
Less Than High School Education	32%	14%	94	13%	94	12%	92
Under Age 5	7%	6%	68	6%	71	6%	68
Over Age 64	14%	16%	43	17%	46	16%	50

Source: EPA 2022a

Table 5-22: Pollution and Sources and Socioeconomic Indicators for Block Group 2 of Census
Tract 9604

a		Sta	te	EPA Region		USA	
Selected Variables	Value	Avg.	%tile	Avg.	%tile	Avg.	%tile
Pollution and Sources							
Particulate Matter 2.5 (µg/m³)	7.64	8.9	5	8.18	27	8.74	24
Ozone (ppb)	40.3	42.4	16	37.9	59	42.6	33
2017 Diesel Particulate Matter* (µg/m³)	0.0706	0.226	0	0.261	<50	0.295	<50
2017 Air Toxics Cancer Risk* (lifetime risk per million)	30	29	99	31	80-90	29	80-90
2017 Air Toxics Respiratory HI*	0.3	0.36	46	0.4	<50	0.36	<50
Traffic Proximity (daily traffic count/distance to road)	6.2	380	11	430	8	710	5
Lead Paint (% Pre-1960 Housing)	0.35	0.23	80	0.15	87	0.28	67
Superfund Proximity (site count/km distance)	0.059	0.039	84	0.083	64	0.13	48
RMP Facility Proximity (facility count/km distance)	0.043	0.67	6	0.6	3	0.75	3
Hazardous Waste Proximity (facility count/km distance)	0.035	0.77	13	0.62	5	2.2	4
Underground Storage Tanks (count/km²)	0	1.1	16	3.5	10	3.9	16
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.00016	1.3	41	0.45	46	12	34
Socioeconomic Indicators							
Demographic Index	34%	26%	75	37%	52	36%	55
People of Color	1%	15%	14	39%	3	40%	3
Low Income	66%	37%	90	35%	92	31%	92
Unemployment Rate	2%	6%	31	6%	28	5%	30
Linguistically Isolated	2%	1%	80	3%	62	5%	55
Less Than High School Education	24%	14%	85	13%	86	12%	85
Under Age 5	2%	6%	11	6%	14	6%	13
Over Age 64	15%	16%	44	17%	48	16%	51

Source: EPA 2022b

5.10.6 References

- American Community Survey. 2019. 5-Year Estimates. Available online:

 https://data.mansfieldnewsjournal.com/american-community-survey/bell-county-kentucky/population/total-population/yty/05000US21013/. Accessed: August 2022.
- American Community Survey. 2020. Percent of Households (Table B17017 Poverty Status in the Past 12 Months by Household Type by Age of Householder. 2020 ACS 5-Year Estimated Detailed Tables. U.S. Census Bureau retrieved from <a href="https://censusreporter.org/data/table/?table=B17017&geo_ids=14000US21013960400,150|14000US21013960400&primary_geo_id=14000US21013960400. Accessed: October 2022.
- Carey, Daniel I. 2007. Generalized Geologic Map for Land-Use Planning: Bell County, Kentucky. Kentucky Geological Survey Map and Chart. 181. Available online: https://uknowledge.uky.edu/cgi/viewcontent.cgi?article=1180&context=kgs_mc. Accessed: June 2022.
- Data USA. 2019. Bell County, Kentucky. Available online: https://datausa.io/profile/geo/bell-county-ky/#economy. Accessed: May 2022.
- Environmental Protection Agency (EPA). 2022a. EJScreen Report for Blockgroup 210139604001. Available online: https://ejscreen.epa.gov/mapper/ejscreen_SOE.aspx Accessed: August 2022.
- Environmental Protection Agency (EPA). 2022b. EJScreen Report for Blockgroup 210139604002. Available online: https://ejscreen.epa.gov/mapper/ejscreen_SOE.aspx Accessed: August 2022.
- U.S. Census Bureau. 2022. Quick Facts: Kentucky; Bell County, Kentucky. Available online: https://www.census.gov/quickfacts/fact/table/KY,bellcountykentucky/PST045221. Accessed: May 2022.
- U.S. Census Bureau. 2020. 2020 Census Demographic Data Map Viewer. Available online:

 https://mtgis-portal.geo.census.gov/arcgis/apps/MapSeries/index.html?appid=2566121a73de463995ed2b2fd7ff6eb7. Accessed: June 2022.

5.11 Tribal Resources

18 CFR 5.6(d)(3)(xii) requires "A description of Indian tribes, tribal lands, and interests that may be affected by the project. Components of this description include: (A) Identification of information on resources specified in paragraphs (d)(2)(ii)-(xi) of this section to the extent that existing project construction and operation affecting those resources may impact tribal cultural or economic interests, e.g., impacts of project-induced soil erosion on tribal cultural sites; and (B) Identification of impacts on Indian tribes of existing project construction and operation that may affect tribal interests not necessarily associated with resources specified in paragraphs (d)(3)(ii)-(xi) of this Section, e.g., tribal fishing practices or agreements between the Indian tribe and other entities other than the potential applicant that have a connection to project construction and operation."

There are no Tribal lands in the Project Vicinity. The Permittee has identified the Native American tribes listed in Table 5-23 as having the potential to have interest in the Project and are included in the Distribution List for the Project licensing process.

Table 5-23: Native American Tribes included in Project Distribution List

Native American Tribe
Southern Cherokee Nation of Kentucky
Eastern Band of Cherokee Indians
Peoria Tribe of Indians of Oklahoma
Delaware Nation
Miami Tribe of Oklahoma

6.0 PRELIMINARY LISTING OF POTENTIAL ISSUES, INFORMATIONAL NEEDS, AND MITIGATION BY RESOURCE

18 CFR 5.6(d)(4) requires "Based on the resource description and impacts discussion required by paragraph (d)(3) of this section; the pre-application document must include with respect to each resource area identified above, a list of: (i) Issues pertaining to the identified resources; (ii) Potential studies or information gathering requirements associated with the identified issues; (iii) Relevant qualifying Federal and state or tribal comprehensive waterway plans; and (iv) Relevant resource management plans."

6.1 Geology and Soils

The Project is located at a site on a property that has historically been used for coal mining. Information regarding baseline conditions of the geology and soils of the Project Vicinity and previously conducted mining activities is readily available. Due to the placement of Project features on reclaimed mining areas, site stability has potential to be an issue that will need to be confirmed throughout the design phase of the Project, in geotechnical evaluations, engineering, and design of the Project. LRPS is committed to public health and safety and will take all necessary steps to ensure that this Project is engineered and designed to ensure a stable, lasting, and safe Project.

LRPS is proposing to conduct a phased geotechnical investigation approach to obtaining the geotechnical data/information needed to support the design as it progresses. LRPS proposes to conduct a preliminary geotechnical investigation which will include a geophysical survey at the Upper and Lower Reservoirs and a limited number of widely spaced geotechnical borings (i.e., one to two at each primary Project feature). The purpose of the proposed preliminary geotechnical investigation is to provide a general characterization of subsurface conditions at the preliminary locations of each primary Project feature, including the thickness of overburden soil, top of bedrock depth/elevation contours, presence of subsurface voids, and ease/difficulty of rock excavation.

As the design progresses, additional phase(s) of geotechnical investigation and evaluation of subsurface conditions may be required. LRPS proposes that the results of the preliminary geotechnical investigation be obtained first, and additional phases of geotechnical investigation are developed based on the results of the preliminary investigation and Project engineering and design needs. Additional phases of geotechnical investigation will be conducted as needed, and may include additional geophysical survey in additional areas, more closely spaced geophysical lines to improve/enhance data resolution, and/or a more rigorous geotechnical drilling plan with several borings at each primary Project feature. During drilling of borings in subsequent investigation phases, a down-hole televiewer (or similar equipment) may be used in some borings

to evaluate the presence of voids or to map fractures at elevations of interest to the Project and/or packer testing may be completed at elevations of interest to estimate the hydraulic conductivity of the rock mass. Additionally, some of the subsequent borings could be converted to temporary observation wells to measure the groundwater elevations and conditions in the Project Vicinity.

6.2 Water Resources

The Project would involve a one-time withdrawal of water for initial fill and routine smaller withdrawals for makeup water due to evaporation and seepage at the reservoirs. At this time, the water source for the initial fill and recharge is anticipated to be Tom Fork, which is located at the Lower Reservoir. It has not yet been determined if supplementation will be required from the Cumberland River for the initial fill. LRPS conducted a preliminary hydrologic assessment to estimate the evaporation rate at the Project, filling time, and the maximum storm inflow in the drainage basin at the preliminary Lower Reservoir. Based on preliminary Project specifications, a drainage area of 1.82 square miles at the preliminary Lower Reservoir, and an average annual inflow rate into that drainage basin of 3.30 cfs (or 8,553,600 ft³ per month), it is anticipated that the Project initial fill duration would be approximately 380 days, if 100% diversion of Tom Fork was used.

It is anticipated that the Project will require routine maintenance recharge fill to make up water lost due to evaporation. In the preliminary hydrologic assessment of the Project, it was estimated that the average percent of diversion of Tom Fork flow required for recharge water would be approximately 8%. Due to the anticipated evaporation rate and inflow anticipated at Tom Fork, it is anticipated that pumping from the Cumberland River will not be necessary for routine maintenance recharge fill.

As the Project is proposed to be closed loop, it is not anticipated that the Project will impact water quality in Tom Fork. The preliminary Project Boundary crosses both Dry Branch and the Cumberland River. These crossings are of the preliminary interconnection line only and no water resource impacts are anticipated at those crossings.

Best management practices will be used during construction for the protection of water resources and will be outlined in an appropriate construction plan which will address erosion and sedimentation associated with construction.

LRPS proposes to conduct baseline water quality sampling in Tom Fork, including parameters such as dissolved oxygen, temperature, and conductivity. As part of the licensing process, LRPS will consult with Kentucky DEP and the appropriate agencies to determine permit application needs and appropriate monitoring and mitigation measures in accordance with the requirements of the CWA and associated regulations.

The objectives and methodology associated with the proposed wetland and waterway delineation and water quality sampling of Tom Fork will be detailed in a Draft Proposed Study Plan, which LRPS will make available to the interested agencies and stakeholders for review and comment.

6.3 Fish and Aquatic Resources

As described in Section 5.3, there is available information about fish and aquatic resources in the Cumberland River, and limited information on fish and aquatic resources in the tributaries in the Project Vicinity, including Tom Fork. The interconnection line will cross the Cumberland River and Dry Branch each in a single span, with no anticipated impacts to aquatic habitat or fisheries.

It is anticipated the Project has the potential to cause temporary and permanent impacts to fish and aquatic resources at Tom Fork. The preliminary Lower Reservoir location is located on Tom Fork and the initial fill would require the diversion at the preliminary Lower Reservoir to obtain water to fill the Project. It has not yet been determined the rate of initial fill, although it was estimated that at 100% diversion, it would take approximately 380 days to fill the Project, based on the preliminary Project specifications and historical regional flow data. The diversion for initial fill is anticipated to temporarily impact water quantity at Tom Fork between the Lower Reservoir and the confluence with the Cumberland River. It was estimated that the average percent of diversion of Tom Fork flow required for recharge water would be approximately 8%. The diversion for recharge fill is anticipated to permanently impact water quantity at Tom Fork between the Lower Reservoir and the confluence with the Cumberland River. These impacts to water resources have the potential to impact fish and aquatic habitat in Tom Fork.

LRPS is proposing two studies that would provide information about fish and aquatic species habitat in Tom Fork. LRPS is proposing to conduct a wetland and waterbody delineation in the preliminary Project Boundary. This will include obtaining some information about the physical habitat in Tom Fork, including substrate. LRPS is also proposing to conduct baseline water quality sampling in Tom Fork which will also inform fish and aquatic species habitat. The collected information will help in understanding the existing conditions in Tom Fork to inform fish and aquatic species habitat.

6.4 Terrestrial Wildlife and Botanical Resources

The Project is located at an existing highly disturbed area historically used for mining. The Project features will primarily be located in this previously disturbed area or along existing access roads. The wildlife and botanical resources in the region are well understood. Both native and non-native vegetation cover the Project Vicinity, and it is expected that common terrestrial wildlife inhabit or use the Project Vicinity, including small and large mammals, birds, reptiles, and amphibians. The Project has the potential to impact the terrestrial wildlife and botanical resources temporarily and

permanently within the limits of disturbance during and after construction. Noise and human presence during construction activities has the potential to temporarily disturb wildlife. The Project will permanently alter the habitat within the Project Boundary and is anticipated to displace terrestrial wildlife and vegetation due to the alteration of habitat within the Project Boundary. Although permanent vegetation disruption is anticipated, it is not anticipated that the Project will have long-term effects on plant communities within the Project Vicinity.

At this time, as terrestrial wildlife and botanical resources are well understood, LRPS is not proposing studies specific to common terrestrial wildlife and botanical resources. LRPS work with the appropriate state and federal resource agencies to develop Project construction and operation plans that address noxious weed control and vegetation management.

6.5 Wetlands, Riparian, and Littoral Habitat

Readily available information on wetlands in the Project Vicinity was obtained from the USFWS NWI. LRPS proposes to conduct a wetland and waterway delineation in and directly adjacent to the preliminary Project Boundary. This will be a field survey to identify and delineate jurisdictional waters of the United States and will determine the extent of waters so that any potential disturbances to those waters are understood and permitted with the USACE, as appropriate. The objectives and methodology associated with the proposed wetland and waterway delineation will be detailed in a Draft Proposed Study Plan, which LRPS will make available to the interested agencies and stakeholders for review and comment.

6.6 Rare, Threatened, and Endangered Species

As described in further detail in Section 5.6, federally-protected (or petitioned to be federally-protected) species with the potential to occur in the Project Vicinity include: gray bat, Indiana bat, northern long-eared bat, monarch butterfly, and the yellow-spotted woodland salamander. Several state-protected species were identified as having known occurrences in Bell County, Kentucky, including two fish species: blackside dace and Cumberland arrow darter.

The proposed Project has the potential to impact fish and aquatic species, including RTE fish species, if present, in Tom Fork, due to the proposed water withdrawal for initial fill and routine recharge. LRPS proposes to conduct baseline water quality sampling in Tom Fork, including parameters such as dissolved oxygen, temperature, and conductivity. LRPS also proposes to conduct a wetland and waterbody delineation in the preliminary Project Boundary which will include obtaining some information about the physical habitat at Tom Fork, including substrate. The information collected in these studies are anticipated to provide information to determine if the existing conditions at Tom Fork provide suitable habitat for blackside dace or Cumberland

arrow darter. Detailed study objectives and methodology will be provided in the Draft Proposed Study Plan.

To avoid potential impacts to tree roosting bats, LRPS proposes to avoid tree-clearing during between June 1 and August 15. If avoidance is not possible, a survey will be conducted.

6.7 Recreation and Land Use

The preliminary Project Boundary and much of the Project Vicinity includes land used historically for mining. There are no existing recreation sites in the preliminary Project Boundary and there are no public recreation sites in the Project Vicinity. Recreation is not permitted in the preliminary Project Boundary as it is private property with active and reclaimed mining operations and public access is restricted for public safety due to the industrial nature of this land. As there is no recreation in the Project Boundary, it is not anticipated that the Project will temporarily or permanently impact recreation resources. Due to the existing and proposed industrial land use of the area, it is also anticipated that there will be no notable changes in land use. As recreation resources and land use in the Project Vicinity are well understood, and no issues have been identified, no studies or protection, mitigation, and enhancement (PME) measures relative to recreation and land use resources are proposed.

6.8 Aesthetic Resources

The Project involves the development of the features described in Section 4.0, including the development of an upper and lower reservoir, penstock, and interconnection line. Project specifications are considered preliminary, as LRPS is still in the initial design phase. At this time, it has not been determined if the penstock will be entirely above-ground or buried. At this time, LRPS anticipates that the interconnection line will run primarily along existing roads, thus minimizing disturbance and alteration of the area. Due to the history of mining in the majority of the area within the preliminary Project Boundary, much of the area has been previously disturbed and the Project is not anticipated to have notable alteration of the use of the land. Additionally, vegetation and topography limits the visibility of the area. No issues have been identified relative to aesthetic resources and no studies or PME measures are proposed.

6.9 Cultural Resources

The Project construction has the potential to impact historic architectural and archaeological resources, if there are any, within the Project area of potential effects, which would likely include the Project Boundary and the Project construction limits of disturbance. As described in Section 5.9, based on preliminary desktop historic architectural review, there are several historic properties in the Project Vicinity. LRPS proposes to consult with Kentucky SHPO to determine if

any historic properties would be in the Project area of potential effects in accordance with Section 106 of the National Historic Preservation Act (NHPA) of 1966. In addition to the preliminary archaeological records review that was completed and discussed in Section 5.9.1.4, LRPS proposes to conduct additional desktop archaeological review of the Project area of potential effects. This additional review will be conducted by a certified archaeologist, as required by Kentucky SHPO, and will result in detailed information on previously recorded sites and survey areas in the specified area. The additional review is intended to meet the Kentucky SHPO's specifications to verify known sites in a project area and provide information that is critical to the review of projects subject to Section 106 consultation. Following the results of the additional archaeological review, LRPS will consult with the Kentucky SHPO, and Native American tribes to determine if field survey is required.

6.10 Socioeconomic Resources and Environmental Justice

The region surrounding the Project support various employment industries including health care and social assistance, manufacturing, and retail trade. Environmental justice communities were identified in the Project Vicinity based on the low-income threshold criteria. LRPS anticipates that the Project would have a positive economic impact on the region and has the potential to benefit the identified EJ communities through the creation of jobs and additional tax revenue. LRPS is proposing to conduct a socioeconomic study that examines the short-term and long-term economic impacts to the Project region.

6.11 Tribal Resources

There are no Tribal lands in the Project Vicinity and LRPS does not anticipate that the Project will impact Tribal resources. LRPS has identified five Native American tribes that could have potential interest in the Project, and have included these Native American tribes on the Project Distribution List.

The Project Boundary primarily includes land previously disturbed due to the historical mining activities and associated access roads. As described in further detail in Section 6.9, LRPS proposes to conduct an additional desktop archaeological review of the Project area of potential effects. This archaeological review will be conducted by a certified archaeologist and will result in detailed information on previously recorded sites and survey areas in the specified area. LRPS will consult with the Kentucky SHPO and the Native American tribes to determine if undisturbed areas within the Project area of potential effects of Project limits of disturbance have a potential for archaeological sites, and if determined necessary, will complete a field survey of the area.

7.1 Relevant Qualifying Federal and State or Comprehensive Waterway Plans

Section 10(a)(2)(A) of the Federal Power Act (FPA), 16 U.S.C § 803(a)(2)(A), requires FERC to consider the extent to which a Project is consistent with Federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways potentially affected by the proposed Project. On April 27, 1988, FERC issued Order No. 481-A revising order No. 481, issued October 26, 1987, establishing that FERC will accord FPA Section 10(a)(2)(A) comprehensive plan status to any Federal or state plan that:

- Is a comprehensive study of one or more of the beneficial uses of a waterway or waterways;
- Specifies the standards, the data, and the methodology used; and
- Is filed with the Secretary of the Commission.

FERC currently lists 18 comprehensive plans for the Commonwealth of Kentucky (FERC 2022). Of these listed plans, seven (7) are potentially relevant to the Project, as listed below (Table 7-1). These plans may be useful in the licensing proceeding for characterizing desired conditions.

Table 7-1: List of Qualifying Comprehensive Plans Potentially Relevant to the Project

Resource	Comprehensive Plan
Recreation Resources	Kentucky Department for Local Government. Kentucky Statewide Comprehensive Outdoor Recreation Plan (SCORP). Frankfort, Kentucky. October 2008.
Water Resources	Kentucky Department for Natural Resources and Environmental Protection. 1979. Kentucky wild rivers statewide management plan. Frankfort, Kentucky. June 1979.
Water Resources	Kentucky Department for Natural Resources and Environmental Protection. 1980. Kentucky wild rivers: Cumberland River management plan. Frankfort, Kentucky. June 1980.
Water Resources	Kentucky Division of Water. National Park Service. 1992. Kentucky rivers assessment. Department of the Interior, Atlanta, Georgia.
Water Resources	Kentucky Department for Natural Resources and Environmental Protection. 1980. Kentucky wild rivers: Martins Fork management plan. Frankfort, Kentucky. June 1980.
Water Resources	National Park Service. 1993. The Nationwide Rivers Inventory. Department of the Interior, Washington, D.C.
Fish and Aquatic Resources	U.S. Fish and Wildlife Service. n.d. Fisheries USA: the recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, D.C.

Source: FERC 2022

7.2 References

Federal Energy Regulatory Commission (FERC). 2022, August. List of Comprehensive Plans. Office of Energy Projects, 20426. Washington, D.C. Available online: https://cms.ferc.gov/media/list-comprehensive-plans Accessed: August 2022.

APPENDIX A

SUMMARY OF CONTACTS AND CORRESPONDENCE MADE IN PREPARING THE PAD 18 CFR § 5.6 (D)(5)

From: Nathan Sandvig
To: Chandler, Kent (PSC)

Cc: Sandy Slayton; Michael Gambrel; Lesley Brotkowski; Michael Ricci; Matt Dunlap; Elizabeth Krchnavek

Subject: Lewis Ridge Pumped Storage Hydropower Project Update

Date: Thursday, July 21, 2022 3:46:45 PM

Attachments: image001.png

Chairman Chandler,

Hope all is well and you stayed tick-free and relatively dry at the Kentucky Mountain Laurel Festival back in May.

Following-up, thanks for taking the time to meet with Rye Development and our team (copied) on site of the proposed 216-MW Lewis Ridge Pumped Storage Project. The project is anticipated to have 8 hours or 2,165 MWh of cost-competitive energy storage.

Rye has initiated site evaluations and is in the process of developing documents required for a license application to FERC. We wanted to let you know that Rye and our consultants Kleinschmidt are initiating consultation and setting up meetings with resource agencies and stakeholders to introduce the proposed Lewis Ridge Project.

Lastly, we plan on submitting a non-conforming proposal letter in response to LG&E/KU's capacity/energy RFP. We are going to suggest opening a dialog to explore interest, conduct due diligence, discuss commercial structuring, etc. in this RFP process or preferably in a separate track given the unique nature of this superior asset class that is on par and competitive Li-ion batteries. We believe this ultra-flexible project is ideal for cost-effective firm peaking, firm dispatchable baseload and/or load-following capacity and energy to optimize the clean energy generation portfolio for the future.

Please reach out if you have any questions, comments, concerns, etc. We look forward to working with you on the proposed Lewis Ridge Project.

Regards,



Nate Sandvig
Vice President
830 NE Holladay St.
Portland, OR 97232
(503) 309-2496
nathan@ryedevelopment.com
www.ryedevelopment.com

From: Nathan Sandvig

To: Stump, Kenya K (EEC); Johnson, Kari (EEC); Slone, Gordon (EEC); Johnson, Carey M (EEC)
Cc: Sandy Slayton; Michael Gambrel; Lesley Brotkowski; Michael Ricci; Elizabeth Krchnavek

Subject: Lewis Ridge Pumped Storage Hydropower Project Update

Date: Thursday, July 21, 2022 3:53:33 PM

Attachments: <u>image001.png</u>

Kenya et al,

Hope all is well. It was great meeting back in May. Very much appreciated your time and initial input.

As you know, Rye Development is proposing to develop the 216-MW Lewis Ridge Pumped Storage Project on reclaimed mine land in Bell County. Rye has initiated site evaluations and is in the process of developing documents required for a license application to the Federal Energy Regulatory Commission (FERC). We wanted to let you know that Rye is initiating consultation and setting up meetings with resource agencies and stakeholders to introduce the proposed Lewis Ridge Project. Copied is our leadership team and consultants who will be involved in this effort.

Please reach out if you have any questions, comments, concerns, etc. We look forward to working with you on the proposed Lewis Ridge Project.

Regards,



Nate Sandvig
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In August 2022, Lewis Ridge Pumped Storage, LLC initiated consultation with the following entities by sending an outreach email and information sheet (both provided below this list):

- Albey Brock, Bell County Judge Executive
- Craig Potts, Kentucky Heritage Council
- Matthew Catron, Kentucky Department of Fish & Wildlife Resources
- Lonis Morgan, Kentucky Division of Mine Reclamation and Enforcement
- Gordon R. Slone, Kentucky Department for Natural Resources
- Robert Miller, Kentucky Department for Environmental Protection, Division of Water, London Regional Office
- Deborah Dotson, Delaware Nation
- Chief Harper, Peoria Tribe of Indians of Oklahoma
- Richard Sneed, Eastern Band of Cherokee Indians, Qualla Boundary
- Tim "Healing Spirit" Jordan, Southern Cherokee Nation of Kentucky
- Douglas Lankford, Miami Tribe of Oklahoma
- Jeff Duncan, U.S. National Park Service, Southeast Region
- Daniel Blackman, U.S. Environmental Protection Agency, Region IV
- Andrew Raddant, U.S. Department of the Interior, Office of Environmental Policy and Compliance
- Leopoldo "Leo" Miranda-Castro, U.S. Fish and Wildlife Service
- Kim Amendola, National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service, Southeast Regional Office
- Tucker Davis, Kentucky Coal Association
- Kentucky Cabinet for Economic Development
- Tom Fitzgerald, Kentucky Resource Council
- Kentucky Chamber of Commerce

From: Sandy Slayton <sandy@ryedevelopment.com>

Sent: Wednesday, August 24, 2022

To: (see list above)

Cc: Nathan Sandvig <Nathan@ryedevelopment.com>; Lesley Brotkowski

<Lesley.Brotkowski@kleinschmidtgroup.com>

Subject: Lewis Ridge Pumped Storage Project, Bell County, KY **Attachment:** Lewis Ridge PSP Preliminary Info Sheet 08172022

Hello,

Rye Development (Rye) is proposing to develop the Lewis Ridge Pumped Storage Project (Lewis Ridge Project) on reclaimed mine land in Bell County, Kentucky. Rye has initiated site evaluations and is in the process of developing documents required for a license application to the Federal Energy Regulatory Commission (FERC). We would like to set up a meeting with you to introduce the proposed Lewis Ridge Project and FERC licensing process. A preliminary description of the proposed project is attached. Rye wants to learn about available resource information and discuss potential resource concerns, information gaps, and proposed studies. If you would like to talk with us to learn more about the project or discuss existing information about the site, please let me know your availability on September 7, 8, or 9 for a virtual meeting.

Thank you for your consideration. We look forward to working with you on the proposed Lewis Ridge Project.

Sincerely, Sandy



Sandy Slayton
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<u>Lewis Ridge Pumped Storage Project, FERC No. P-15249</u> <u>Information Sheet</u>

The Lewis Ridge Pumped Storage Project (Project) (Federal Energy Regulatory Commission [FERC or Commission] Project No. 15249) is an unconstructed closed loop pumped storage hydroelectric generating facility in Bell County, Kentucky. Lewis Ridge Pumped Storage, LLC (Permittee, potential applicant, or LRPS) received a Preliminary Permit for the Project from the FERC on March 3, 2022. LRPS is currently preparing a Notification of Intent (NOI) to file an application for an original FERC license for the Project, as well as a Pre-Application Document (PAD) and a request to use the Traditional Licensing Process (TLP) for FERC licensing of this Project. Under the TLP, the three-stage pre-filing consultation process described in 18 CFR § 4.38 would be completed and documented.

The Project is currently in the initial stages of design, permitting, and licensing and exact Project specifications and site-specific locations of the Project features have not been finalized. Figure 1 depicts the approximate preliminary locations of the Project features. The Project would be located at a site historically used for mining. The Project is anticipated to provide 287 megawatts (MW) of generation capacity. It is anticipated that the Project would use two pump turbine units with power generated through a closed loop pumped storage project. The Project seeks to derive the benefits of traditional pumped storage, essentially increasing off-peak load and increasing generating capacity during peak demand periods, but in an improved manner that reduces and avoids many of the environmental impacts of the traditional pumped storage facility design. The closed loop pumped storage project would utilize the site topography to circulate water between a lower and upper reservoir to store and generate power. The primary drainage basin for the Project is the Cumberland River Basin. The source of water for the initial fill of the Project is dependent on site-specific information not yet available, but preliminary review indicates that the initial fill water source may be the natural flow from the unnamed tributary at which the Lower Reservoir would be located with potential supplementation from the Cumberland River. It is anticipated that recharge water would be sourced from the unnamed tributary at which the Lower Reservoir would be located. A key benefit to the preliminary Project site is that the area at which the Project facilities would be located would be a reclaimed mine site, meaning that the area is largely disturbed.

The preliminary Project features include the following: (1) a 5,450-foot-long, 135-foot-high roller compacted concrete dam for the upper reservoir with an integrated overflow spillway; (2) an upper reservoir with a surface area of 24 acres and a storage capacity of 2,300 acre-feet; (3) a 3,850-foot-long steel penstock with the upper section likely being 16 feet in diameter and the lower extent bifurcating into two 12 foot diameter steel sections; (4) a steel surge tower or set of energy-dissipating pressure relief valves; (5) a 420-foot-long, 80-foot-wide powerhouse containing two 143.5-megawatt (MW) reversible pump-turbines with a total installed capacity of 287 MW; (6) a 830-foot-long, 75-foot-high roller compacted concrete dam at the lower reservoir with an integrated overflow spillway; (7) a 47 acre lower reservoir with a storage capacity of 2,300 acre-feet; and (8) a 2.3-mile-long, 161 kilovolt overhead transmission line. The Project would have an estimated annual generation of 605,000 megawatt-hours (Mwh) and energy storage of 2,165 Mwh. The Project would have a storage time of 8 hours at full discharge capacity.

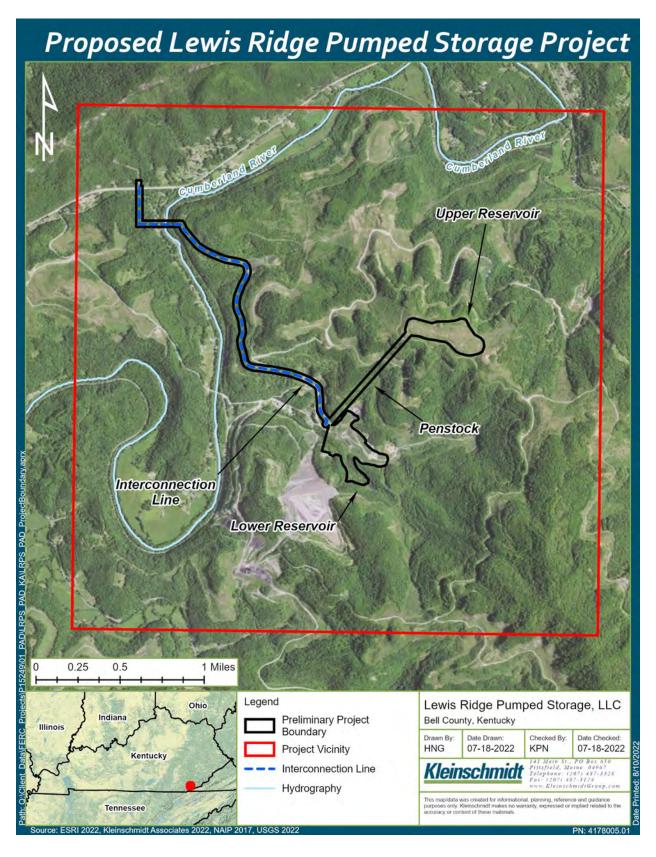


Figure 1. Proposed Lewis Ridge Pumped Storage Project

Lewis Ridge Pumped Storage, LLC conducted meetings with the U.S. Fish and Wildlife Service and the Kentucky Cabinet for Economic Development on September 9th, 2022, and with the Kentucky Resource Council on September 13th, 2022. Meeting summaries and the associated PowerPoint presentation are provided below. Following the meeting summaries and PowerPoint presentation is additional email correspondence associated with the Lewis Ridge Pumped Storage Project licensing.

Lewis Ridge Pumped Storage Project

Meeting Summary

9/9/2022 10:00 AM

Attendees:

John Faustini, U.S. Fish and Wildlife Service (USFWS) Lee Andrews, U.S. Fish and Wildlife Service Jennifer Garland, U.S. Fish and Wildlife Service Sandy Slayton, Lewis Ridge Pumped Storage, LLC (LRPS) Lesley Brotkowski, Kleinschmidt Associates Elizabeth Krchnavek, Kleinschmidt Associates

Purpose:

Initial agency meeting with U.S. Fish and Wildlife Service. Provide an overview of the Lewis Ridge Pumped Storage Project (Project) and request input and available resource information.

Summary:

- Sandy opened the call, and initiated introductions of all on the call.
- Sandy provided the meeting agenda and described meeting purpose.
- Sandy gave an overview of pumped storage and the purpose of the Project.
- Sandy provided an overview of the Project. Sandy described the preliminary Project Boundary
 and Project Vicinity. In response to questions from John and Lee, Sandy described that for the
 initial fill it has not yet been determined if supplementation from the Cumberland River will be
 required.
- Sandy described the preliminary Project specifications.
- Sandy described the current status of the Project in the Federal Energy Regulatory Commission (FERC) Licensing Process
 - o Received Preliminary Permit 3/3/2022.
 - o Requesting to follow the Traditional Licensing Process (TLP).
 - o Planning to file the Pre-Application Document (PAD) in October.
- Sandy asked USFWS for available resource information or resource concerns and described the
 anticipated studies, which include a wetland and waterway delineation, bat survey (if needed),
 cultural resources study, and socioeconomic assessment.
- Lesley described the species that were listed in the USFWS Information for Planning and Consultation (IPaC) report.
- Lee discussed the following resources:
 - o Bats:
 - Stated that it is likely that either LRPS will either need to assume bat presence or conduct a survey. Can either do a survey or assume presence.
 - Stated that it will need to be determined if the Project will impact any caves.
 - Stated that the tri-colored bat is under review to be listed as endangered under the Endangered Species Act (ESA).
 - o Blackside dace

- Stated that records will need to be checked to see if blackside dace occurs in Tom Fork. Added that it is possible that the water quality is not very good and that the conductivity may be too high to provide habitat for blackside dace.
- o Yellow-spotted salamander
 - Stated that the yellow-spotted salamander was recently petitioned for protection under the ESA. It is not currently listed. The species is very rare with very few occurrences.
- Monarch butterfly
 - Stated that there may be opportunities for habitat enhancement.
 - Cumberland arrow darter
 - Not listed federally.
- Sandy closed by thanking USFWS for their participation.
- John noted that Carrie Allison is no longer with USFWS and the distribution list should be updated to reflect that change.

Lewis Ridge Pumped Storage Project

Meeting Summary

9/9/2022 11:00AM

Attendees:

Andy Luttner, Kentucky Cabinet for Economic Development Sandy Slayton, Lewis Ridge Pumped Storage, LLC (LRPS) Lesley Brotkowski, Kleinschmidt Associates Elizabeth Krchnavek, Kleinschmidt Associates

Purpose:

Initial agency meeting with KY Cabinet for Economic Development. Provide an overview of the Lewis Ridge Pumped Storage Project (Project) and request input.

Summary:

- Sandy opened the call, and initiated introductions of all on the call.
- Sandy provided the meeting agenda and described meeting purpose.
- Sandy gave an overview of pumped storage and the purpose of the Project.
- Andy Luttner described the objectives of Kentucky Cabinet for Economic Development and explained that there is a lot of interest in development in Kentucky and need for green energy.
- Andy asked about distribution. Sandy explained that they will be selling independently to the grid LG&E and KU Energy.
- Sandy discussed the Project specifications, benefits of the Project, reasoning behind the site selection.
- Andy asked the economic impact of the Project. Sandy stated that LRPS will be conducting an economic study, but there will be permanent jobs, as well as construction jobs.
- Andy asked about timeline. Sandy explained that the final Federal Energy Regulatory Commission (FERC) application is anticipated to be filed in early 2024, then FERC initiates their National Environmental Policy Act (NEPA) process, and then construction could occur. Soonest operation would be approximately 2030-2031.
- Andy offered support of the Project and stated that if LRPS has any requests, to let him know.
- Sandy closed by thanking Andy for his participation.

Lewis Ridge Pumped Storage Project

Meeting Summary

9/13/2022 2:30PM

Attendees:

Ashley Wilmes, Kentucky Resource Council (KYRC) Tom FitzGerald, KYRC Sandy Slayton, Lewis Ridge Pumped Storage, LLC (LRPS) Lesley Brotkowski, Kleinschmidt Associates Elizabeth Krchnavek, Kleinschmidt Associates

Purpose:

Initial agency meeting with KYRC. Provide an overview of the Lewis Ridge Pumped Storage Project (Project) and request input and available resource information.

Summary:

- Sandy opened the call, and initiated introductions of all on the call.
- Sandy provided the meeting agenda and described meeting purpose.
- Sandy gave an overview of pumped storage and the purpose of the Project.
- Sandy provided an overview of the Project. Sandy described the preliminary Project Boundary and Project Vicinity. Sandy described the preliminary Project specifications.
- Tom FitzGerald initiated discussion. He asked questions about the ownership of the site. Sandy
 responded that Asher Land and Company owns the site. Tom FitzGerald asked about water
 conveyance. Sandy stated that it would be a penstock. Tom FitzGerald asked about Project
 specifications, hazard classifications, and if the Project will be located on fill. Tom Fitzgerald
 expressed concerns of site stability.
- Sandy described the anticipated studies: cultural resources, wetland and waterway delineation, bat survey, and a socioeconomic assessment, along with geotechnical evaluations.
- Tom Fitzgerald provided recommendations regarding Project feature location, as it relates to site stability. Tom Fitzgerald cautioned that the Project not be placed on fill, as he states there are concerns about fill compaction.
- Tom Fitzgerald asked about distribution. Sandy explained that they will be selling independently to the grid LG&E and KU Energy.
- Tom Fitzgerald suggested that additional non-governmental organizations, including Earthjustice, may be interested in the Project. Ashley Wilmes requested that LRPS share the slide deck and a quick introductory email so that they can send to their clients. Sandy replied that the Project website just went live and that she can send the PowerPoint.
- Sandy closed by thanking KYRC for their participation.

Lewis Ridge Pumped Storage Project FERC P-15249



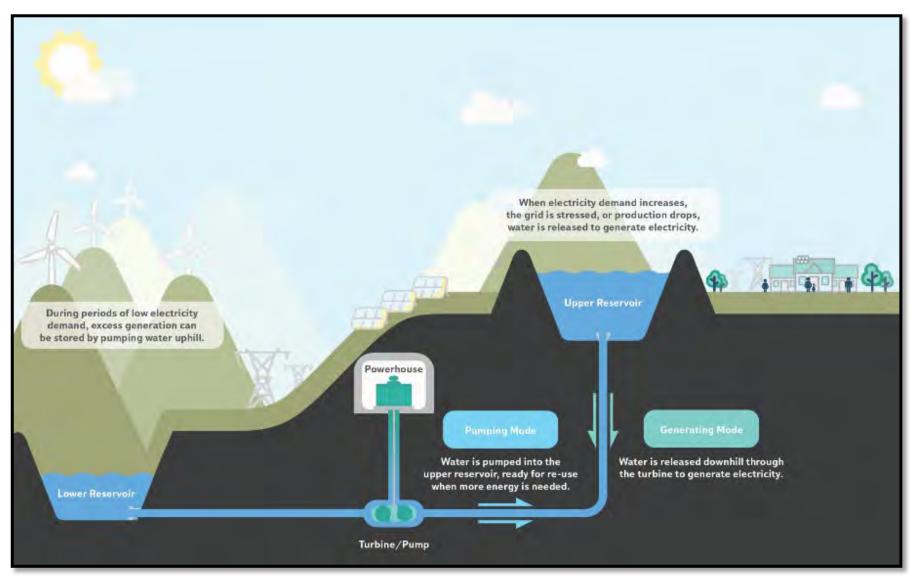
Agenda

- 1) Introductions
- 2) Meeting Purpose
- 3) Pumped Storage Overview
- 4) Project Overview
- 5) FERC Licensing Process
- 6) Resources and Proposed Studies
- 7) Discussion

Meeting Purpose

- 1) Provide an overview of the proposed Lewis Ridge Pumped Storage Project
- 2) Provide information about the FERC licensing process
- 3) Receive input and feedback regarding the information presented

Pumped Storage Overview



Why Pumped Storage in KY?

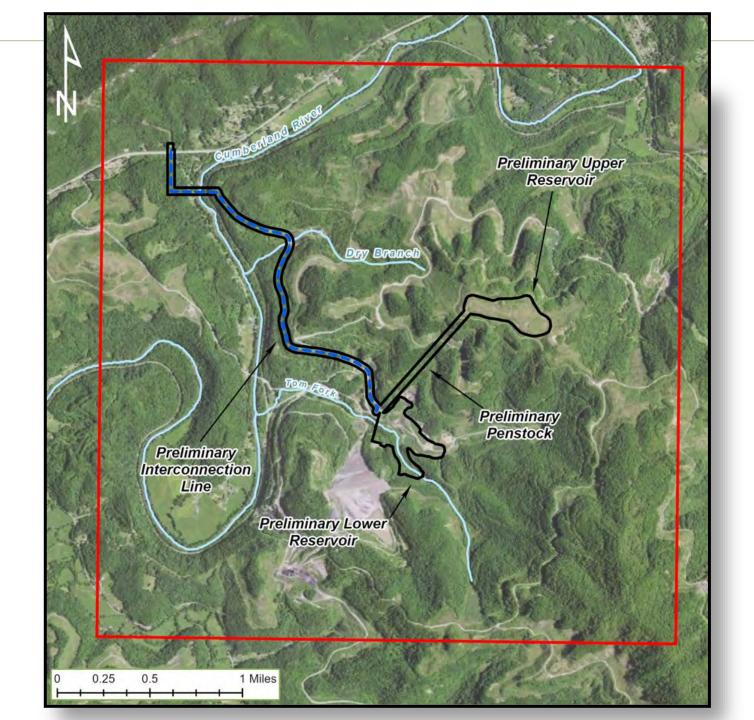
- Pumped storage provides reliable and dependable generation during periods of high energy use.
- Pumped storage projects support a grid in transition, providing energy certainty during weather and blackout events, and capacity for variable generation sources.

Project Overview

- Initial stages of design
- Unconstructed 287 MW closed-loop pumped storage hydroelectric generating facility
- Provide 8 hours or 2,165 MWh (671,700 MWh annually) of cost-competitive energy storage
- Location in Bell County, in Southeastern Kentucky
- Reclaimed coal mine site

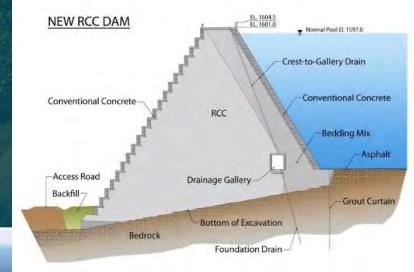


Preliminary Project Boundary and Project Vicinity



Preliminary Project Specifications

- Structure type of Upper and Lower Reservoir – Roller Compacted Concrete
- Two 143.5 MW reversible pump-turbine units
- 3,850-foot-long steel penstock
- ❖ 2.3 mile transmission line





Preliminary Project Operations

- Closed-loop pumped storage project
 - Pump water from the Lower Reservoir to the Upper Reservoir at times when energy is in excess or in low demand. To generate energy, water would be released from the Upper Reservoir through the penstock to the powerhouse.
- Recharge Fill
 - Diversion structure at Tom Fork located at Lower Reservoir.
- Initial Fill
 - TBD. Hydrology evaluation to be conducted to determine if supplementation from the Cumberland River will be needed.

FERC Licensing Process

- FERC Preliminary Permit issued on March 3, 2022.
 - Term of 48 months.
- Requesting to follow the Traditional Licensing Process (TLP).



FERC Application Process



Resources and Proposed Studies

- Environmental Resources
 - Available resource information?
 - Resource concerns?
- Anticipated Studies
 - Wetland and waterway delineation
 - Bat survey
 - Cultural resources study
 - Socioeconomic assessment

Questions and Discussion

Sandy Slayton Vice President, Environmental Rye Development

P: 206-919-3976

E: sandy@ryedevelopment.com

Rye Development Lesley Brotkowski Senior Licensing Coordinator Kleinschmidt Associates

P: 715-318-3729

E: Lesley.Brotkowski@kleinschmidtgroup.com





From: Karla Reece - NOAA Federal < karla.reece@noaa.gov>

Sent: Friday, August 26, 2022 11:15 AM

To: Sandy Slayton <<u>sandy@ryedevelopment.com</u>>

Subject: Re: Lewis Ridge Pumped Storage Project, Bell County, KY

Hello Ms Slayton,

It seems to me that your project is well away from the habitats where NMFS ESA-listed species might be present. You can find information about ESA-listed species under NMFS purview along with a host of other information about the consultation process on our website, here: https://www.fisheries.noaa.gov/southeast/endangered-species-conservation/esa-section-7-interagency-consultation-southeast-united-states

A list of Species and Critical Habitat found in the Southeast Region is provided here: https://www.fisheries.noaa.gov/southeast/endangered-species-conservation/esa-section-7-interagency-consultation-southeast-united-states

Thank you,

Karla

I am 100% Teleworking due to Covid-19. Please email any questions or concerns for the most efficient response.

Karla Reece- (she/her)
Section 7 Team Lead
Interagency Cooperation Branch
Protected Resources
NOAA Fisheries | U.S. Department of Commerce
Southeast Regional Office
National Marine Fisheries Service
email: karla.reece@noaa.gov

Section 7 Guidance Webpage - UPDATED URL Updated Construction Conditions, (May 2021)

This is a U.S. government email account. Your emails to this address may be reviewed or archived. Please do not send inappropriate material. Thank you.

From: Andrews, Lee

To: Sandy Slayton; Garland, Jennifer; Putnam, Christopher; Faustini, John

Cc: <u>Lesley Brotkowski</u>; <u>Elizabeth Krchnavek</u>

Subject: Re: Fw: [EXTERNAL] Lewis Ridge Pumped Storage Project (Rye/FWS)

Date: Friday, September 9, 2022 12:39:19 PM

Attachments: <u>image001.png</u>

You can address anything on this project to me at the address listed below. For anything you send via email, just send it to our office email address, which is:

KentuckyES@fws.gov

Thanks.

Lee Andrews Field Supervisor U.S. Fish and Wildlife Service Kentucky Field Office

Interior Region 2 -- South Atlantic-Gulf 330 West Broadway, Room 265 Frankfort, KY 40601

502/695-0468 x108 502/695-1024 fax 502/229-4616 cell

From: Sandy Slayton <sandy@ryedevelopment.com>

Sent: Friday, September 9, 2022 12:27 PM

To: Garland, Jennifer <jennifer_garland@fws.gov>; Putnam, Christopher <christopher_putnam@fws.gov>; Faustini, John <john_faustini@fws.gov>; Andrews, Lee <lee_andrews@fws.gov>

Cc: Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>; Elizabeth Krchnavek <Elizabeth.Krchnavek@kleinschmidtgroup.com>

Subject: RE: Fw: [EXTERNAL] Lewis Ridge Pumped Storage Project (Rye/FWS)

Hi All,

Thank you for the call this morning. Christopher, I'm sorry we missed you. Attached is the presentation we went through on the call. We are really happy to have you all engaged. Please let us know if any questions or comments come up, and Chris, we'd be happy to talk with you sometime if you'd like.

To update our records, as we had Carrie Allison as the main contact, who from this group should we specifically have on our distribution list in her place?

Have a great weekend.

From: Ashley Wilmes
To: Sandy Slayton

Cc: <u>fitzkrc@aol.com</u>; <u>Lesley Brotkowski</u>; <u>Elizabeth Krchnavek</u>; <u>Nathan Sandvig</u>

Subject: Re: Lewis Ridge Pumped Storage Project (Rye/KYRC)

Date: Tuesday, September 13, 2022 3:12:45 PM

The comments of the Joint Intervenors in the LGE/KU IRP case, and other filings, can be

accessed here: https://psc.ky.gov/Case/ViewCaseFilings/2021-00393

The video of the two days of hearing can be accessed through the PSC website

here: https://psc.ky.gov/Case/ViewCaseFilings/2021-00393/Hearings

--

Ashley Wilmes | Director (*she/her/hers*)

Kentucky Resources Council www.kyrc.org | 502-875-2428

From: <u>Sandy Slayton</u>

To: Ashley Wilmes; fitzkrc@aol.com

 Cc:
 Lesley Brotkowski; Elizabeth Krchnavek; Nathan Sandvig

 Subject:
 RE: Lewis Ridge Pumped Storage Project (Rye/KYRC)

Date: Tuesday, September 13, 2022 3:46:52 PM

Attachments: <u>image001.png</u>

Lewis Ridge PSP Preliminary Info Sheet 08172022.docx Lewis Ridge PSP Preliminary Info Overview (1).pptx

Thank you Ashley. We appreciate talking with you both today, and appreciate you sending that information over. We will definitely review it.

Attached is some project information that we would be happy for you to share with the other NGOs you mentioned. We also just went live with a project website: https://www.lewisridgeproject.com/

If you have other thoughts, ideas, concerns that come up, please let us know. We'll keep you in the loop as we move forward.

Sandy

Rye Development

Sandy Slayton
Vice President, Environmental
(206) 919-3976
sandy@ryedevelopment.com
www.ryedevelopment.com

From: Sandy Slayton
To: Duncan, Jeffrey R

Cc: <u>Nathan Sandvig</u>; <u>Lesley Brotkowski</u>; <u>Elizabeth Krchnavek</u>

Subject: RE: [EXTERNAL] Lewis Ridge Pumped Storage Project, Bell County, KY

Date: Thursday, October 6, 2022 2:22:05 PM

Attachments: <u>image001.png</u>

Hi Jeff,

Sorry we missed you again. Feel free to call me any time if you want to just try and connect that way.

Sandy

Rye Development

Sandy Slayton
Vice President, Environmental
(206) 919-3976
sandy@ryedevelopment.com
www.ryedevelopment.com

From: Duncan, Jeffrey R < Jeff Duncan@nps.gov>

Sent: Tuesday, October 4, 2022 11:41 AM

To: Sandy Slayton <sandy@ryedevelopment.com>

Cc: Nathan Sandvig <Nathan@ryedevelopment.com>; Lesley Brotkowski <Lesley.Brotkowski@kleinschmidtgroup.com>; Elizabeth Krchnavek

<Elizabeth.Krchnavek@kleinschmidtgroup.com>

Subject: Re: [EXTERNAL] Lewis Ridge Pumped Storage Project, Bell County, KY

Let's do 2-230 Thurs. Thanks!

Jeffrey R. Duncan, PhD. Regional Aquatic Ecologist

Science and Natural Resources Management

Wild and Scenic Rivers
Fisheries and Aquatic Resources

National Park Service, Interior Region 2 - South Atlantic Gulf

100 West Martin Luther King, Jr. Blvd. Suite 215

Chattanooga, TN 37402

Ph: (423) 987-6127

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From: Sandy Slayton < <u>sandy@ryedevelopment.com</u>>

Sent: Tuesday, October 4, 2022 11:19 AM **To:** Duncan, Jeffrey R < Jeff Duncan@nps.gov >

Cc: Nathan Sandvig < <u>Nathan@ryedevelopment.com</u>>; Lesley Brotkowski < <u>Lesley.Brotkowski@kleinschmidtgroup.com</u>>; Elizabeth Krchnavek

<<u>Elizabeth.Krchnavek@kleinschmidtgroup.com</u>>

Subject: RE: [EXTERNAL] Lewis Ridge Pumped Storage Project, Bell County, KY

Hi Jeff,

How about Thursday 2-2:30 or 2:30-3 eastern time? Let me know if either works and I'll send us a calendar appointment.

Thanks!

Sandy

From: Duncan, Jeffrey R < <u>Jeff_Duncan@nps.gov</u>>

Sent: Monday, October 3, 2022 10:01 AM

To: Sandy Slayton <<u>sandy@ryedevelopment.com</u>>

Cc: Nathan Sandvig < <u>Nathan@ryedevelopment.com</u>>; Lesley Brotkowski

<<u>Lesley.Brotkowski@kleinschmidtgroup.com</u>>; Elizabeth Krchnavek

<<u>Elizabeth.Krchnavek@kleinschmidtgroup.com</u>>

Subject: Re: [EXTERNAL] Lewis Ridge Pumped Storage Project, Bell County, KY

Hi Sandy-

I'm actually pretty flexible tomorrow (Tues) and Wed. Alternatively, my Thursday afternoon is currently open too.

Thanks, Jeff

Jeffrey R. Duncan, PhD. Regional Aquatic Ecologist

Science and Natural Resources Management

Wild and Scenic Rivers
Fisheries and Aquatic Resources

National Park Service, Interior Region 2 - South Atlantic Gulf

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Chattanooga, TN 37402

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From: Sandy Slayton < <u>sandy@ryedevelopment.com</u>>

Sent: Friday, September 30, 2022 4:31 PM **To:** Duncan, Jeffrey R < <u>Jeff_Duncan@nps.gov</u>>

Cc: Nathan Sandvig < <u>Nathan@ryedevelopment.com</u>>; Lesley Brotkowski < <u>Lesley.Brotkowski@kleinschmidtgroup.com</u>>; Elizabeth Krchnavek

<<u>Elizabeth.Krchnavek@kleinschmidtgroup.com</u>>

Subject: RE: [EXTERNAL] Lewis Ridge Pumped Storage Project, Bell County, KY

Hi Jeff,

I apologize for not getting our rescheduled meeting on our calendars regarding the Lewis Ridge Pumped Storage Project. Is there a time next week (week of Oct 3) that works for you? Thanks! Have a great weekend.

Sandy

From: Duncan, Jeffrey R < Jeff_Duncan@nps.gov Sent: Thursday, September 8, 2022 6:15 PM

To: Sandy Slayton < sandy@rvedevelopment.com>

Cc: Nathan Sandvig < <u>Nathan@ryedevelopment.com</u>>; Lesley Brotkowski < <u>Lesley.Brotkowski@kleinschmidtgroup.com</u>>; Elizabeth Krchnavek

<<u>Elizabeth.Krchnavek@kleinschmidtgroup.com</u>>

Subject: Re: [EXTERNAL] Lewis Ridge Pumped Storage Project, Bell County, KY

I'm not in tomorrow (Friday). Next week Tues or Wed mornings or anytime Friday all look good. Thanks!

Jeffrey R. Duncan, PhD. Regional Aquatic Ecologist

Science and Natural Resources Management

Wild and Scenic Rivers
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National Park Service, Interior Region 2 - South Atlantic Gulf

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From: Sandy Slayton < <u>sandy@ryedevelopment.com</u>>

Sent: Thursday, September 8, 2022 8:02 PM **To:** Duncan, Jeffrey R < Jeff Duncan@nps.gov>

Cc: Nathan Sandvig < <u>Nathan@ryedevelopment.com</u>>; Lesley Brotkowski < <u>Lesley.Brotkowski@kleinschmidtgroup.com</u>>; Elizabeth Krchnavek

< Lesiey. bi otkowski@kieiiisciiiiilidigi oup.com/, Elizabetii kicii

<<u>Elizabeth.Krchnavek@kleinschmidtgroup.com</u>>

Subject: RE: [EXTERNAL] Lewis Ridge Pumped Storage Project, Bell County, KY

No problem, Jeff! I totally understand. If you happen to be available tomorrow, Friday 9/9 between 11-12:30 eastern, I know we have a window then. If that doesn't work, we can find a time next week — maybe let me know which day(s) work best.

Thanks!

Sandy

From: Duncan, Jeffrey R < Jeff_Duncan@nps.gov Sent: Thursday, September 8, 2022 12:13 PM

To: Sandy Slayton < sandy@rvedevelopment.com>

Cc: Nathan Sandvig < <u>Nathan@ryedevelopment.com</u>>; Lesley Brotkowski < <u>Lesley.Brotkowski@kleinschmidtgroup.com</u>>; Elizabeth Krchnavek

<<u>Elizabeth.Krchnavek@kleinschmidtgroup.com</u>>

Subject: Re: [EXTERNAL] Lewis Ridge Pumped Storage Project, Bell County, KY

My sincere apologies. My day has been wall to wall meetings, including one or two that ran over...but that's no excuse. Apparently I neglected to accept the invitation for this one, so it wasn't highlighted on calendar. More than happy to reschedule at your convenience. Just let me know.

Again, my apologies....

Jeffrey R. Duncan, PhD. Regional Aquatic Ecologist

Science and Natural Resources Management

Wild and Scenic Rivers
Fisheries and Aquatic Resources

National Park Service, Interior Region 2 - South Atlantic Gulf

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From: Sandy Slayton < <u>sandy@ryedevelopment.com</u>>

Sent: Thursday, September 8, 2022 2:09 PM **To:** Duncan, Jeffrey R < Jeff Duncan@nps.gov >

Cc: Nathan Sandvig < <u>Nathan@ryedevelopment.com</u>>; Lesley Brotkowski < <u>Lesley.Brotkowski@kleinschmidtgroup.com</u>>; Elizabeth Krchnavek

<<u>Elizabeth.Krchnavek@kleinschmidtgroup.com</u>>

Subject: RE: [EXTERNAL] Lewis Ridge Pumped Storage Project, Bell County, KY

Hi Jeff,

Sorry we missed you today. Please let us know if there is a good time to reschedule.

Thanks!

Sandy

From: Sandy Slayton

Sent: Thursday, August 25, 2022 5:29 PM **To:** 'Duncan, Jeffrey R' < Jeff Duncan@nps.gov>

Cc: Nathan Sandvig < <u>Nathan@ryedevelopment.com</u>>; Lesley Brotkowski

<Lesley.Brotkowski@kleinschmidtgroup.com>

Subject: RE: [EXTERNAL] Lewis Ridge Pumped Storage Project, Bell County, KY

Thanks for the reply, Jeff. We're looking forward to talking with you. I'll send out an invitation for 2pm on 9/8; please feel free to suggest an alternative time.

Sandy

From: Duncan, Jeffrey R < Jeff_Duncan@nps.gov Sent: Wednesday, August 24, 2022 4:51 PM

To: Sandy Slayton < sandy@ryedevelopment.com>

Cc: Nathan Sandvig < <u>Nathan@ryedevelopment.com</u>>; Lesley Brotkowski

<Lesley.Brotkowski@kleinschmidtgroup.com>

Subject: Re: [EXTERNAL] Lewis Ridge Pumped Storage Project, Bell County, KY

Hi Sandy- Thanks for reaching out. I'm currently in the afternoons of 9/7 and 9/8. I look forward to speaking with you and learning about the project.

Best, Jeff

Jeffrey R. Duncan, PhD. Regional Aquatic Ecologist

Science and Natural Resources Management

Wild and Scenic Rivers
Fisheries and Aquatic Resources

National Park Service, Interior Region 2 - South Atlantic Gulf

100 West Martin Luther King, Jr. Blvd. Suite 215

Chattanooga, TN 37402

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From: Sandy Slayton < <u>sandy@ryedevelopment.com</u>>

Sent: Wednesday, August 24, 2022 7:41 PM **To:** Duncan, Jeffrey R < <u>Jeff_Duncan@nps.gov</u>>

Cc: Nathan Sandvig < <u>Nathan@ryedevelopment.com</u>>; Lesley Brotkowski

<Lesley.Brotkowski@kleinschmidtgroup.com>

Subject: [EXTERNAL] Lewis Ridge Pumped Storage Project, Bell County, KY

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

Mr. Duncan,

Rye Development (Rye) is proposing to develop the Lewis Ridge Pumped Storage Project (Lewis Ridge Project) on reclaimed mine land in Bell County, Kentucky. Rye has initiated site evaluations and is in the process of developing documents required for a license application to the Federal Energy Regulatory Commission (FERC). We would like to set up a meeting with you to introduce the proposed Lewis Ridge Project and FERC licensing process. A preliminary description of the proposed project is attached. Rye wants to learn about available resource information and discuss potential resource concerns, information gaps, and proposed studies. If you would like to talk with us to learn more about the project or discuss existing information about the site, please let me know your availability on September 7, 8, or 9 for a virtual meeting.

Thank you for your consideration. We look forward to working with you on the proposed Lewis Ridge Project.

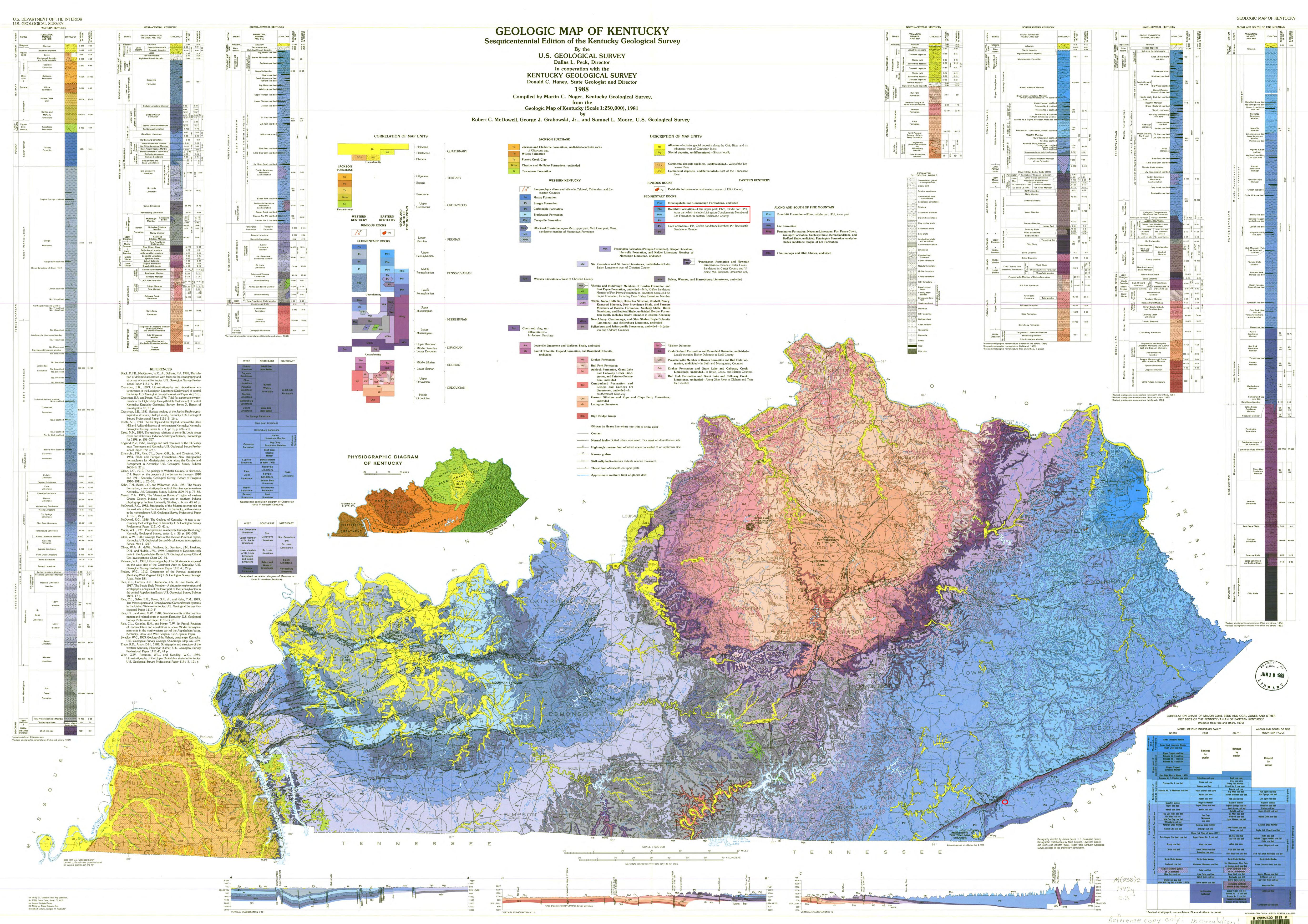
Sincerely, Sandy



Sandy Slayton
Vice President, Environmental
(206) 919-3976
sandy@ryedevelopment.com
www.ryedevelopment.com

APPENDIX B

GEOLOGIC MAPS



Formation

Pennington

Formation

Newman

Limestone

Formation

Chattanooga

†Mapped as uppermost member of Lee Formation in

Varilla quadrangle (Englund, Landis, and Smith, 1963)

V. E. McKELVEY, DIRECTOR AREA NORTH OF PINE MOUNTAIN AND BENEATH OVERTHRUST FAULT DESCRIPTION AND BED Alluvium and colluvium Sand, silt, clay, and gravel. Alluvium consists of gravel overlain by poorly stratified sand, silt, and clay. Colluvium nsists mainly of sandstone blocks and boulders in sandy to clayey matrix; widespread in steep gullies and as talus, fan, or landslide deposits; forms veneer along north slope and foot of Pine Mountain. Hindman coal bed ?-31/2 Sandstone, shale, siltstone, and coal: Sandstone, light- to dark-gray, very fine to fine-grained, generally silty, medium- to thin-bedded; locally medium to coarse grained, thick bedded, crossbedded, and moderately quartzose; sandstone beds are not continuous across the area. Shale and siltstone, olive-gray to gray; shale is locally sandy or silty. A fossiliferous marine zone consisting of about 10 feet of calcareous gray shale and nodular "blue" limestone locally overlies the Hindman coal bed. The Hazard No. 8 coal bed splits in the northeastern part of this quadrangle and forms a zone that commonly consists of two coal beds separated by 5 to 10 feet of shale or siltstone; the zone generally occurs between cliff-forming, medium- to coarse-grained, quartz-Hazard No. 7(?) coal bed Hazard coal zone Sandstone, siltstone, shale, and coal: Sandstone, medium- to light-gray, very fine to medium-grained, silty; interbedded with or gradational to siltstone; poorly exposed. Magoffin Beds of Morse (1931), is a fossiliferous, Magoffin Beds dark-gray, calcareous marine shale several feet thick. A sparsely fossiliferous silty gray marine shale commonly overlies the Fire Clay rider coal bed. The Fire Clay rider coal bed is thickest west of Stoney Fork in northwestern part of map area. The Fire Clay coal bed generally contains a distinctive flint-clay parting as much as 7 inches thick near its base; the flint clay is brownish gray with pearly luster and conchoidal frac-Fire Clay rider coal bed 1-3½ Fire Clay coal bed 1/2-5½ ture, and usually contains fossil plant trash. Shale, siltstone, sandstone, and coal: Shale and siltstone, gray to olive-gray; a thin black shale bed with sparse marine fossils commonly occurs in lowest third of unit. The Kendrick Shale of Jillson (1919) is poorly exposed north of Pine Mountain; sparse fossil fragments were recognized in silty shale only near northwest corner. 0?-11/2 of Jillson (1919) Sandstone, medium-gray, fine- to medium-grained, locally very silty; common in eastern and western parts of area north of Pine Mountain. The upper coal bed in the Rim coal zone is the principal one in the zone; it is also known as the Moss coal bed (Lyons, 1963, p. 140). The Straight Creek coal bed in Bell County has been correlated with the Jellico coal bed (Lyons, 1963, p. 138); however, the Straight Creek bed may be an older one which lies as much as 200 feet below the Jellico equivalent. The Rim and Straight Creek coal beds apparently persist in the subsurface of most of the area north of the Kettle Island fault zone. The higher Rim (Moss) coal zone coal beds are rarely exposed and may be discontinuou Straight Creek coal bed Shale, siltstone, sandstone, and coal: Shale and siltstone, light- to dark-gray, interbedded; some dark-gray shale beds contain rare linguloid brachiopods. Sandstone, medium- to dark-gray, fine-grained, in thin interbeds in siltstone and shale. Coal beds and carbonaceous shale zones occur near top and middle of unit. Most of this unit, which dips steeply, is poorly exposed in structurally deformed belt north of Pine Mountain and in the Kettle Island fault zone; thickness data are mostly from drillers' logs of core holes. Sandstone, shale, and coal: Sandstone, white to light-gray, fine- to coarse-grained, mostly quartzose and wellindurated; medium to thick bedded, crossbedded, generally pebbly, cliff forming. A thin lenticular chertpebble conglomerate and a sheared, lenticular coal bed associated with silty carbonaceous shale between pebbly sandstone beds with coal fragments are exposed near mouth of Kettle Island Branch.

Sandstone, shale, and limestone: Sandstone, light- to medium-gray, very fine to medium-grained, argillaceous,

Limestone and shale: Limestone, blue-gray to gray, fine- to medium-crystalline; basal part contains chert nod-

Shale and siltstone, interbedded, dusky-red to greenish-gray, platy to blocky; thin-bedded, very fine grained

Shale, dark-gray to black, carbonaceous, fissile to platy, locally sheared and slaty; locally silty, pyritic, with red-

dish-brown plant spores; commonly weathers to fragments with red-, yellow-, or green-hued surfaces.

Shale, grayish-black, in part carbonaceous; brittle, fissile. Contains small asphaltic lenses in extremely deformed outcrop southeast of mouth of Kettle Island Branch. Unit poorly exposed; forms gently sloping, colluvium-

covered slopes at base of Pine Mountain.

ules; middle part granular and oolitic, locally fossiliferous; sandy and argillaceous near top. Upper part,

seen only in fault slices, is medium- to dark-gray, lustrous, partly calcareous shale with thin greenish-gray

crops out. Limestone and shale sequence reported in drillers' logs.

shale or siltstone interbeds and lenses.

greenish-gray sandstone at top of unit in a few places.

moderately quartzose, locally pebbly; poorly exposed in fault slices. Shale, medium- to greenish-gray, rarely

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SYSTEM	SERIES			GROUP, FORMATION, MEMBER, AND BED	LITHOLOGY	THICKNESS OF COAL BED, IN FEET	THICK NESS IN FEI	S,	DESCRIPTION
UATER- NARY				Puckett Sand- stone Member Kendrick Shale			0-25 240+		Sand, silt, clay and gravel. Alluvium occurs chiefly in poorly stratified floodplain and terrace deposits along Cumberland River, Tom Fork, and Puckett and Brownies Creeks. Colluvium and landslide deposits, not map ped, consist mainly of large angular sandstone blocks and boulders in unsorted sand, silt and clay matrix common on most hillsides and abundant as veneer on southern foothills of Pine Mountain.
			go Formation	of Jillson (1919) Creech coal zone { Darby(?) coal bed	7.95	1-3 0-2	220-300	780+	Shale, siltstone, sandstone, and coal: Shale and siltstone, olive- to dark-gray; shale commonly silty. Kendrick Shale of Jillson (1919) and unnamed fossiliferous siltstone below Creech coal zone contain sparse marine fossils in roadcuts in mining area southeast of Cardinal. Sandstone, light-gray, generally silty, mostly very fine to fine-grained, commonly micaceous; usually discontinuous or interbedded with shale; poorly exposed except for thick, crossbedded Puckett Sandstone Member 120 feet above Creech coal zone near Cardinal
	nian		Mingo	Kellioka coal bed		0-2 0-2½ 0-1½ 2½-4½	220-260		Upper coal bed of Creech coal zone is probably the same as Amburgy(?) coal bed of Varilla quadrangl (Englund, Landis, and Smith, 1963). The name "Kellioka" has been applied to different coal beds in adjacen quadrangles; Kellioka coal bed of Varilla quadrangle is apparently continuous with the Darby(?) coal bed of this quadrangle. Kellioka coal bed of this quadrangle occurs from 40 to 80 feet below the Darby(?) coal bed. In some areas Darby(?) and Kellioka are each split into two coal beds which are separated by as mucl
	sylvai	dno					180-240		as 50 feet of shale and siltstone. Harlan coal bed persistent, occurs at base of formation.
	and Middle Pennsylvanian	Breathitt Gr	tion	Path Fork coal zone		1/2-2 0-2 0-11/2 0-3 11/2-31/2	330-420		Shale, siltstone, sandstone, and coal: Shale and siltstone, medium- to dark-gray, locally dark-gray to black with ironstone nodules common in lowest third of unit; generally interbedded with thin silty sandstone beds Sandstone, medium- to light-gray, very fine to fine-grained, silty, locally micaceous, crossbedded or ripple bedded. Sandstone ledges below Mason and above Path Fork coal beds are generally prominent and con tinuous across most of map area. Both the coal bed at base of Hance coal zone and the Naese coal bed contain nonbanded coal and canneloid shale in some areas. The Mason rider coal bed is discontinuous; the Split Seam and Clear Fork coal beds occur in the southwestern part of the quadrangle.
VANIAN	Lower a		Hance Formation	Mason rider coal bed Mason coal bed		0-2 1-3½ 0-2	200-280	1110-1	The Naese Sandstone Member is medium gray, fine grained, quartzose, crossbedded, with micaceous laminae contains black shale lenses as much as 10 feet thick; locally contains a breccia bed. Member thins markedly east of Yellow Cliff Branch and is mapped separately only where thicker than about 30 feet. It has beer considered the upper member of the Lee Formation in the Varilla quadrangle (Englund, Landis, and Smith 1963), and the probable lower sandstone member of the Hance Formation in the Ewing quadrangle (Englund Smith, Harris, and Stephens, 1963, p. 816). The stratigraphic problem at the upper boundary of the Lee For
NSYL				Split Seam coal bed		0-31/2	120-180		mation is discussed in greater detail by Englund (1964, p. B37-B38). As the Naese Sandstone Member of this quadrangle appears to intertongue with shale and siltstone of the lower Hance Formation, it is here considered a lenticular basal sandstone of the Hance Formation (see correlation diagram). Poor exposures in
PEN				Clear Fork coal bed * Naese coal bed		0-2 0-1	120-160		roadcuts and outcrops near Yellow Cliff Branch and Middle Fork of Watts Creek suggest that the Naese is thickest where it is locally unconformable on the Bee Rock Sandstone Member of the Lee Formation; the sandstone beds of the Naese are essentially indistinguishable from those of the underlying Lee Formation.
				†Naese Sand- stone Member	<u>\$</u>	0?-2	60-180		in this quadrangle.
Z H				Bee Rock Sandstone Member	0		160-325		Sandstone and shale: Sandstone, light- to medium-gray, very fine to coarse-grained, commonly quartzose, locally silty and micaceous, generally crossbedded; forms prominent cliffs along Pine Mountain. Quartz pebbles as much as 1 inch in mean diameter occur sporadically near top of unit over easternmost third of outcrop Shale is locally interbedded with the sandstone.
	Pennsylvanian	Formation		Tunnel coal bed Pebbly sand- stone beds		?	250-350	-1250	Sandstone, siltstone, shale and coal: Sandstone, light- to medium-gray, very fine to medium-grained, generall silty although moderately quartzose near base; in part crossbedded. A sequence of cliff-forming, pebbly quartzose, fine- to medium-grained sandstone beds as much as 80 feet thick occurs in upper part of unit mapped separately in eastern part of map area. Siltstone and shale near top of unit are medium to olive gray, form topographic swale; contain Tunnel coal bed which is inferred to be continuous along Pine Mountain, although it is exposed only locally.
	Lower Pen	9		Middlesboro(?) Member			400-575	950	Sandstone and shale: Sandstone in upper half of unit, white to medium-gray, fine- to medium-grained, mostly quartzose and pebbly, locally a conglomerate, massive, crossbedded; minor gray silty shale interbeds. Sand stone in lower half of unit, light- to olive-gray, silty, very fine to medium-grained, ripplebedded, generally thin-bedded; contains medium- to greenish-gray shale and silty shale interbeds. Basal sandstone, medium-gray, fine-grained, thick-bedded, crossbedded; moderately quartzose, contains scattered pebbles and loca conglomeratic zones; cliff forming. Lower half of unit grades westward into very fine to fine-grained moderately quartzose to silty sandstone. Sandstone beds in unit form three or four hogbacks on Pine Mountain.
NIAN	?								Sandstone and shale: Sandstone, light- to light-olive-gray, fine- to medium-grained, silty, in part moderately
AND AND PENNSYLVANIAN				Pennington Formation			700-110	00	quartzose; thin to locally thick bedded, in part ripplebedded or wavy bedded. Thick, moderately quartzose sandstone beds occur near top and base of unit. Shale interbeds, medium- to greenish-gray, silty, poorly exposed. Driller's log of the No. 2 Asher hole on Tom Fork shows 80 feet of fossiliferous shale and lime stone lying between sandstone beds near middle of unit; this sequence not seen in outcrop.
		_	Φ.	Upper member	3 3		80-140		Shale and limestone: Shale, dark-gray, with thin argillaceous dark-gray limestone interbeds near top of unit; underlies topographic bench along north slope of Pine Mountain and is almost completely covered by colluvium.
MISSISSIPPIAN		Newman	Limeston	Lower member			270-450	350-550	Limestone, light-greenish-gray to dark-bluish-gray, fine- to coarse-grained, in part with sparry calcite cement, partly oolitic, locally sandy or argillaceous; finely crystalline; chert nodules in basal part, chert bands and nodules as much as 100 feet above base of unit. Marine fossils common in middle and upper parts.
PPIAN MI	-7			Grainger Formation	7		275-36	0	Shale, siltstone, and sandstone: Shale, dusky-red to grayish-olive-green; thin interbeds of similarly colored silt- stone and of very fine grained sandstone in upper part.
- 0				-				1	

32'30" 72 Base from U.S. Geological Survey, 1954. Revised 1973 SCALE 1:24000 Geology mapped in 1967-71 The Carter Coordinate System letters and numbers used to designate five-minute divisions of latitude and longitude are shown along the margins; tick marks indicate one-minute divisions 10,000-foot grid based on Kentucky coordinate system QUADRANGLE LOCATION CONTOUR INTERVAL 40 FEET DATUM IS MEAN SEA LEVEL

NO VERTICAL EXAGGERATION

GEOLOGIC MAP OF THE BALKAN QUADRANGLE, BELL AND HARLAN COUNTIES, KENTUCKY

Albert J. Froelich and James F. Tazelaar

EXPLANATION AREA NORTH OF PINE MOUNTAIN Contact, approximately located Dashed where inferred or indefinite; dotted where concealed ______ Coal bed or coal zone Dashed where approximately located; short dashed where inferred; dotted where concealed Thrust fault, approximately located Dotted where concealed. Sawteeth on upper plate _____ Fault, approximately located Short dashed where inferred; dotted where concealed. Bar and ball on downthrown side ____ Tear fault, approximately located Dotted where concealed. Arrows indicate relative displacement Breathitt Formation Breathitt Formation, Overturned anticline intensely deformed, *c, unnamed coal bed Showing direction of dip of limbs hi, Hindman coal bed h, Hazard No. 8 coal bed *c, unnamed coal bed *h -. Hazard No. 7(?) coal bed hz, Hazard coal zone Strike and dip of beds m, base of Magoffin Beds of Morse (1931) *fcr, Fire Clay rider coal bed fc, Fire Clay coal bed ri, coal bed in Rim coal zone Approximate strike and dip of beds sc, Straight Creek coal bed Strike and dip of overturned beds Lee Formation *c , unnamed coal bed Strike of vertical beds Structure contours Pennington Formation Drawn on base of Fire Clay coal bed north of Pine Mountain; on base of Hance coal zone south of Pine Mountain. Projected where contoured horizon is missing. Contour interval 40 feet Newman Limestone DRILL HOLES FROM WHICH STRUCTURAL DATA WERE OBTAINED Grainger Formation Diamond-drill hole Gas well Show of gas AREA ALONG AND SOUTH OF PINE MOUNTAIN Caved adit Alluvium Letter symbol indicates coal bed Coal prospect or outcrop Letter symbol indicates coal bed Abandoned quarry (limestone) Mingo Formation cr, coal bed in Creech coal zone *c, unnamed coal bed Contour strip or auger mine d, Darby (?) coal bed kl, Kellioka coal bed hl, Harlan coal bed Strip mine Area completely stripped _ ^ ^ ^ ^ ^ ^ ^ ^ ^ Probable landslide scar Sawteeth on mobile side Hance Formation *pf, coal bed in Path Fork coal zone Outcrop of fossil-bearing strata *hn, coal bed in Hance coal zone *mr, Mason rider coal bed m, Magoffin Beds of Morse (1931) ma, Mason coal bed k, Kendrick Shale of Jillson (1919) *sp , Split Seam coal bed f, unnamed fossil bed *cf, Clear Fork coal bed *n, Naese coal bed Phan, Naese Sandstone Member ECONOMIC GEOLOGY Coal, gas, oil, and limestone are the principal mineral resources known in the quadrangle. Gas and oil accumulations are present mostly in pre-Pennsylvanian strata north of Pine Mountain. Thick Mississippian limestone beds on the northern slope of Pine Mountain Lee Formation are a potential source of large amounts of crushed Plbr, Bee Rock Sandstone Member Plh. Hensley Member Coal beds north of Pine Mountain: A general study *tv. Tunnel coal bed of coal resources in the region was made by Lyons Plhs, pebbly sandstone beds (1963). All production from this area has been com-Plm, Middlesboro (?) Member mon banded high-volatile A or B rank bituminous coal from the Breathitt Formation. The Straight Creek coal bed has been mined extensively in the Kettle Island area; it may contain large subsurface coal reserves elsewhere in the quadrangle. Pennington Formation The coal bed averages 3 feet in thickness and locally has a very thin shale parting. At mines near Kettle Island the coal is reportedly scoured and overlain by channel-fill sandstone (E. Dean, oral communication, 1968). Lyons (1963, p. 140) has included Straight Creek coal reserves with those of the Jellico coal bed. Newman Limestone Little is known regarding the Rim (or Moss) coal zone and the unnamed coal beds between the Rim and Mnu, upper member Mnl, lower member Fire Clay coal beds in this quadrangle. The principal coal bed of the Rim coal zone is mined extensively to the west of the map area; mineable reserves may be present in the subsurface north of Kettle Island. A persistent coal bed, locally called the Vanderpool coal bed, occurs about 100 feet below the Fire Clay Grainger Formation coal bed; it has been extensively mined by local residents for house coal. The Fire Clay coal bed, known locally as the Hazard No. 4, Crockett, or Dean seam, has been mined extensively in the western part of the area where it averages 21/2 feet thick. It varies in thickness, is split by shale Chattanooga Shale partings, and has not been mined elsewhere in the quad-*Shown locally by adit or outcrop symbol only The Fire Clay rider coal bed, locally called the Mc-Guire seam, commonly is thicker than the Fire Clay Structure contours and contacts do not precisely coal bed in the eastern part of the area and is the match Varilla quadrangle because of additional principal mined coal bed in the northwestern part of the quadrangle.

The principal coal bed above the Magoffin Beds of Morse (1931) is locally called the Hazard No. 7, although the latter coal occurs about 80 feet above the Hazard coal zone. Both of these coal beds are thickest east of Stoney Fork and in the stripped area north of Kettle The Hazard No. 8 coal bed is thickest and has been extensively stripped and augered east of Stoney Fork. The coal is split into a zone in this area, and the main coal bed averages 25 inches thick in a 6-foot zone of carbonaceous shale and thin coal beds. An unmapped coal bed about 50 feet below the Hazard No. 8 is locally as much as 4 feet thick in the northeastern part of the quadrangle. The Hindman coal bed, known locally as the Hazard No. 9, has been extensively augered in the northeastern part of the map area. Locally an overlying calcareous siltstone is in contact with this coal; operators report that where limy rocks directly overlie this coal bed its quality is low. Coal beds along and south of Pine Mountain: Several collapsed openings in the Tunnel coal bed of the Lee Formation were found north and west of Callaway. The extent and thickness of this bed in the Balkan quadrangle are not known. The coal was 31/2 to 5 feet thick where mined a few miles to the east in the Wallins Creek quadrangle (Froelich, 1972). A general description of the coal resources of the Breathitt Group in this region is given by Smith (1963). All commercial production from this area has been common banded bituminous coal of A or B rank from the Breathitt Group. Several coals beds were stripped, augered, and mined underground south and southwest of Cardinal in the late 1960's. However, the only active operation at the time of mapping was a small truck mine in the Mason coal bed on Tom Fork. The Mason thickens from an average of 2 feet just south of Pine Mountain to about 3 feet near the southern boundary of the quadrangle. The Split Seam, Clear Fork, Naese, and possibly coal beds in the Path Fork coal zone are locally thicker than 2 feet; however, they commonly are irregular in thickness, or are impure, or occur in steeply dipping Two coal beds more than 30 inches thick in the Hance coal zone probably contain the largest reserves in the area. The Hance has been mined underground only locally; because of unreliable roof conditions, it is more safely and readily recovered by stripping or The Harlan coal bed has been intensively mined and augered in the southeastern part of the quadrangle, and reserves are essentially depleted. The Kellioka and Darby(?) coal beds rarely exceed 2 feet in thickness; only the Kellioka has been locally mined and augered. Coal beds of the Creech coal zone are irregular in thickness and quality, and commonly are less than 2 feet thick. Of the 21 test holes drilled for oil and gas north of Pine Mountain, about half produce gas. The main producing formations are the Newman Limestone ("Big Lime"), Chattanooga Shale, and Hancock Dolomite ("Lockport" or "Corniferous") of Silurian age, with minor production from sandstone ("Maxton") of the Pennington Formation and sandstone ("Salt") of the Lee Formation. The only exploratory hole drilled south of Pine Mountain was abandoned, but it had gas shows in the lower member of the Newman Limestone and in the Chattanooga Shale. An abandoned quarry is in the Newman Limestone north of Straight Creek; the limestone is in a fault slice of the Kettle Island fault zone. This limestone deposit is accessible but limited in extent and quality limestone reserves are present in the lower member of the Newman Limestone on the north slope of Pine Mountain; however, access is steep and difficult as the bed lies 400 to 800 feet above the railroad spur line along Straight Creek. One of three reported cave openings in the lower part of the Newman Limestone is on the north side of Pine Mountain east of Laurel Ford. This cave and the nearby park-like Salting Ground are potential recreational sites; however, access in 1970 was difficult. Availability of ground water in the quadrangle and in surrounding areas is discussed by Price and others (1962) and by Kilburn and others (1962). They indicate that most of the drilled wells in Lee and Breathitt strata yield water at rates adequate for modern domestic supplies. The water comes mainly from joints and bedding plane openings in sandstone, shale, and coal and is soft to moderately hard, with noticeable amounts of iron. The lower member of the Newman Limestone at places produces good flows from Pine Mountain, and some springs yield prolifically from solution cavities and joints. The most favorable sites for construction are on the flood plain and terraces along Straight Creek, which are the only well-drained level surfaces north of Pine Mountain; similar alluviated areas south of Pine Mountain are present along Cumberland River, Tom Fork, and Puckett and Brownies Creeks; all are prone to periodic flooding. Rock falls, creep, and landslides have caused engineering design and maintenance problems in new highway and railroad cuts north and south of Pine Mountain. Failure has occurred in unconsolidated colluvial deposits and in dipping bedrock; landslide scars are locally prominent on the south slope of Pine Mountain east of Green Howard Branch. Bedding-plane landslides have repeatedly occurred in jointed rocks of the south-dipping Hance Formation north of Cumberland River (Froelich, 1970).

REFERENCES CITED Englund, K. J., 1964, Stratigraphy of the Lee Formation in the Cumberland Mountains of southeastern Kentucky: U.S. Geol. Survey Prof. Paper 501-B, p. Englund, K. J., Landis, E. R., and Smith, H. L., 1963, Geology of the Varilla quadrangle, Kentucky-Virginia: U.S. Geol. Survey Geol. Quad. Map GQ-190. Englund, K. J., Smith, H. L., Harris, L. D., and Stephens, J. G., 1963, Geology of the Ewing quadrangle, Kentucky and Virginia: U.S. Geol. Survey Froelich, A. J., 1970, Geologic setting of landslides along south slope of Pine Mountain, Kentucky, in Highway Research Record, No. 323, p. 1-5. _1972, Geology of the Wallins Creek quadrangle, Harlan and Bell Counties, Kentucky: U.S. Geol. vey Geol. Quad. Map GQ-1016. Jillson, W. R., 1919, The Kendrick Shale-a new calcareous fossil horizon in the coal measures of eastern Kentucky: Dept. of Geology and Forestry, Mineral and Forest Resources of Kentucky, ser. 5, v. 1, no. 2, Kilburn, Chabot, Price, W. E., Jr., and Mull, D. S., 1962, Availability of ground water in Bell, Clay, Jackson, Knox, Laurel, Leslie, McCreary, Owsley, Rockcastle, and Whitley Counties, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA-38. Lyons, E. J., 1963, Coal beds of the southwestern r serve district, in Huddle, J. W., Lyons, E. J., Smith, H. L., and Ferm, J. C., 1963, Coal reserves of eastern Kentucky: U.S. Geol. Survey Bull. 1120, p. 124-147. Morse, W. C., 1931, The Pennsylvanian invertebrate fauna of Kentucky, in Paleontology of Kentucky: Kentucky Geol. Survey, ser. 6, v. 36, p. 293-348. Price, W. E., Jr., Kilburn, Chabot, and Mull, D. S., 1962, Availability of ground water in Breathitt, Floyd, Harlan, Knott, Letcher, Martin, Magoffin, Perry, and Pike Counties, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA-36. Smith, H. L., 1963, Coal beds of the upper Cumberland River reserve district, in Huddle, J. W., Lyons, E. J., Smith, H. L., and Ferm, J. C., 1963, Coal reserves of

eastern Kentucky: U.S. Geol. Survey Bull. 1120, p.

VARILLA QUADRANGLE BALKAN QUADRANGLE (Englund, Landis, and Smith, 1963) Clear Fork /coal bed ______coal bed Yellow Creek Sandstone Member Naese coal bed Sandstone Member Bee Rock Sandstone Sandstone Member Tunnel coal bed Tunnel coal bed Pebbly sand-Sandstone stone beds and shale Hensley Member member D Correlation diagram showing relations between Lee Formation and Breathitt Group in Varilla and Balkan quadrangles

Bartholomew, M. J., 1977, Geology of the Greenfield and Sherando quadrangles,

Virginia: Virginia Division of Mineral Resources, Publication 4, 43 p.

Bartholomew, M. J., and Lowry, W. D., 1979, Geology of the Blacksburg

quadrangle, Virginia: Virginia Division of Mineral Resources, Publication 1

3rown, W. R., 1969, Geology of the Dillwyn quadrangle, Virginia: Virginia Division

Butts, C., and Edmundson, R. S., 1966, Geology and mineral resources of

onley, J. F., and Henika, W. S., 1973, Geology of the Snow Creek, Martinsville

Conley, J. F., and Toewe, E. C., 1968, Geology of the Martinsville West quadrangle

Edmundson, R. S., and Nunan, W. E., 1973, Geology of the Berryville, Stephenson,

Frederick County: Virginia Division of Mineral Resources, Bulletin 80, 142 p

East, Price, and Spray quadrangles, Virginia: Virginia Division of Mineral

Virginia: Virginia Division of Mineral Resources, Reports of Investigations 16

and Boyce quadrangles, Virginia: Virginia Division of Mineral Resources,

rn, E. H., 1968, Geology of the Buckingham quadrangle, Virginia: Virginia

map of the east half of the Winston-Salem quadrangle, North Carolina-

Virginia: U.S. Geological Survey Miscellaneous Investigations Series Map I-709-B, scale 1:250,000.

Waynesboro East and Waynesboro West quadrangles, Virginia: Virginia

__1978a, Geology of the Grottos quadrangle, Virginia: Virginia Division o

_1978b, Geology of the Mount Sidney quadrangle, Virginia: Virginia

_1978c, Geology of the Fort Defiance quadrangle, Virginia: Virginia

_1978d, Geology of the Crimora quadrangle, Virginia: Virginia Division

Sathright, T. M., II, Henika, W. S., and Sullivan, J. L., III 1977, Geology of the

Division of Mineral Resources, Reports of Investigations 15, 45 p. Espenshade, G. H., Rankin, D. W., Shaw, K. W., and Neuman, R. B., 1975, Geologic

of Mineral Resources, Reports of Investigations 10, 77 p

Resources, Reports of Investigations 33, 71 p.

Division of Mineral Resources, Publication 3, 53 p.

Mineral Resources, Publication 10, scale 1:24,000.

of Mineral Resources, Publication 13, scale 1:24,000.

of Investigations 21, 23 p.

nvestigations 24, 39 p.

I-709-A, scale 1:250,000

Division of Mineral Resources, Publication 11, scale 1:24,000.

Division of Mineral Resources, Publication 12, scale 1:24,000

Gathright, T. M., II, and Nystrom, P. G., Jr., 1974, Geology of the Ashby Gap

quadrangle, Virginia: Virginia Division of Mineral Resources, Reports

Hack, J. T., 1965, Geomorphology of the Shenandoah Valley, Virginia and Wes

Henika, W. S., and Thayer, P. A., 1977, Geology of the Blairs, Mount Hermon

Resources, Publication 2, 45 p. Kozak, S. J., 1970, Geology of the Elliott Knob, Deerfield, Craigsville, and Augusta

LeGrand, H. E., 1960, Geology and ground-water resources of Pyttsylvania an

Lukert, M. T., III, and Nuckols, E. B., II, 1976, Geology of the Linden and Flint Hil

McGuire, O. S., 1970, Geology of the Eagle Rock, Strom, Oriskany, and Salisbury

Milici, R. C., Spiker, C. T., and Wilson, J. M., 1963, Geologic map of Virginia

Rader, E. K., 1967, Geology of the Staunton, Churchville, Greenville, and Stuarts

Draft quadrangles, Virginia: Virginia Division of Mineral Resources, Reports of

rginia Division of Mineral Resources, Reports of Investigations 19, 30 p

Virginia: Virginia Division of Mineral Resources, Reports of Investigations 40

1976, Geology of the Strasburg and Toms Brook quadrangles, Virgi

Virginia Division of Mineral Resources, Reports of Investigations 45, 104

Warren County, Virginia: Virginia Division of Mineral Resources, Publication

Rader, E. K., and Webb, H. W., 1979, Geologic factors affecting land modification

Rankin, D. W., Espenshade, G. H., and Neuman, R. B., 1972, Geologic map of the

Spencer, E. W., 1968, Geology of the Natural Bridge, Sugarloaf Mountain

S. Soil Conservation Service, 1979, General soil map of Virginia: Lanham

5. Soil Conservation Service, published soil surveys of individual counties

oung, R. S., and Rader, E. K., 1974, Geology of the Woodstock, Wolf Gap,

WEST VIRGINIA

Campbell, M. R., 1900, Description of the Huntington quadrangle, West Virginia

Geological Survey Geologic Atlas of the United States, Folio 72, 9 p.

Cardwell, D. H., Erwin, R. B., and Woodward, H. P., 1968, Geologic map of We

Dennison, J. M., 1963, Geology of the Keyser 7.5' quadrangle [West Virginia]: West

Felton, L. C., 1978, Mass movement in the Smoke Hole region, Valley and Ridge

Gillespie, W. H., and Clendening, J. A., 1968, A flora from proglacial Lake

Grimsley, G. P., 1907, County reports and maps—Ohio, Brooke, and Hancock

Counties [West Virginia]: West Virginia Geological and Economic Survey, 35

Counties [West Virginia]: West Virginia Geological and Economic Survey, 644 p. laught, O. L., 1968, Geology of the Charleston area: West Virginia Geological and

Hennen, R. V., 1909, County reports and maps-Marshall, Wetzel, and Tyler

West Virginia]: West Virginia Geological and Economic Survey, 574 p.

[West Virginia]: West Virginia Geological and Economic Survey, 712 p.

[West Virginia]: West Virginia Geological and Economic Survey, 783 p.

Hennen, R. V., and Reger, D. B., 1914, County reports and maps—Preston County

Krebs, C. E., 1911, County reports and maps—Jackson, Mason, and Putnam

Counties, [West Virginia]: West Virginia Geological and Economic Survey,

1913, County reports and maps—Cabell, Wayne, and Lincoln Countie

_1914, County reports and maps—Kanawha County, [West Virginia]

_1915, County reports and maps—Boone County, [West Virginia]: We

[West Virginia]: West Virginia Geological and Economic Survey, 566 p.

[West Virginia]: West Virginia Geological and Economic Survey, 483 p.

Krebs, C. E., and Teets, D. D., Jr., 1916, County reports and maps-Raleigh

County, [West Virginia]: West Virginia Geological and Economic Survey, 77

essing, P., Kulander, B. R., Wilson, B. D., Dean, S. L., and Woodring, S. M., 197

Page, R. C., Burford, A. E., and Donaldson, A. C., 1964, Geology of the Martinsburg

Price, P. H., 1929, County reports and maps—Pocahontas County, [West Virginia]

[West Virginia]: West Virginia Geological and Economic Survey, 846 p.

eger, D. B., 1916, County reports and maps—Lewis and Gilmer Counties, [Wes

1918, County reports and maps-Barbour, Upshur, and western

1920, County reports and maps—Webster County, [West Virginia]: West

921, County reports and maps—Nicholas County, [West Virginia]

1923, County reports and maps—Tucker County, [West Virginia]: Wes

925, County reports and maps-Mercer, Monroe, and Summers

1931, County reports and maps—Randolph County, [West Virginia]

Counties, [West Virginia]: West Virginia Geological and Economic Survey,

Grant Counties, [West Virginia]: West Virginia Geological and Economic

Reger, D. B., and Tucker, R. C., 1924, County reports and maps-Mineral and

Rhodehamel, E. C., and Carlston, C. W., 1963, Geologic history of the Teays Vall

Tewalt, S. J., 1977, Fluvial terraces of a part of the South Branch of the

in West Virginia: Geological Society of America Bulletin, v. 74, p. 251-273

Potomac River: Morgantown, West Virginia University, M.S. thesis, 87 p.

maps-Pendleton County, [West Virginia]: West Virginia Geological and

maps—Hampshire and Hardy Counties, [West Virginia]: West Virginia

Filton, J. L., Prouty, W. F., Price, P. H., and Tucker, R. C., 1927, County reports an

Tilton, J. L., Prouty, W. F., Tucker, R. C., and Price, P. H., 1927, County reports and

Davies, W. E., U.S. Geological Survey, unpublished maps of landslides and strip mines, Canton $1^{\circ} \times 2^{\circ}$ quadrangle, scale 1:250,000.

Randolph Counties, [West Virginia]: West Virginia Geological and Economic

rice, P. H., and Heck, E. T., 1939, County reports and maps—Greenbrier Court

Virginia]: West Virginia Geological and Economic Survey, 660 p.

County. Summers County west of New River and the coal area of Merce

West Virginia landslides and slide-prone areas: West Virginia Geological and

.5' quadrangle [West Virginia]: West Virginia Geological and Economic

Virginia]: West Virginia Geological and Economic Survey, 775 p

Virginia]: West Virginia Geological and Economic Survey, 883 p.

Virginia Geological and Economic Survey, 1002 p.

West Virginia Geological and Economic Survey, 679 p.

Virginia Geological and Economic Survey, 648 p.

Economic Survey Environmental Bulletin, 60 p.

Virginia Geological and Economic Survey, 682 p.

Virginia Geological and Economic Survey, 542 p.

West Virginia Geological and Economic Survey, 847 p.

West Virginia Geological and Economic Survey, 989 p.

West Virginia Geological and Economic Survey, 531 p.

counties, [West Virginia]: West Virginia Geological and Economic Survey,

Counties, [West Virginia]: West Virginia Geological and Economic Survey,

_1915a, County reports and maps—Logan and Mingo Counties, [West

915b, County reports and maps-Wyoming and McDowell Counties

_1919, County reports and maps—Fayette County, [West Virginia]: West

7, County reports and maps—Braxton and Clay Counties, [West

_1911, County reports and maps—Wirt, Roane, and Calhoun Counties,

2. County reports and maps—Doddridge and Harrison Countie

Counties [West Virginia]: West Virginia Geological and Economic Survey, 3

and Ohio: U.S. Geological Survey Geologic Atlas of the United States, Folio

Virginia: West Virginia Geological and Economic Survey, scale 1:250,000.

irginia Geological and Economic Survey, Quadrangle Series Map X10, scale

physiographic province, West Virginia: Morgantown, West Virginia University,

1910, County reports and maps—Pleasants, Wood, and Ritch

1916, County reports and maps-Jefferson, Berkeley, and Morgan

1901. Description of the Charlestown quadrangle, West Virginia: U.S.

Mineral Resources, Reports of Investigations 13, 55 p.

Resources, Reports of Investigations 35, 69 p.

Monongahela: Castanea, v. 33, p. 267–300.

Economic Survey Bulletin 34, 38 p.

Maryland, U.S. Soil Conservation Service, scale 1:750,000.

west half of the Winston-Salem quadrangle, North Carolina, Virginia, and

ennessee: U.S. Geological Survey Miscellaneous Investigations Series Map

Buchanan, and Arnold Valley quadrangles, Virginia: Virginia Division of

ler, E. K., and Biggs, T. H., 1975, Geology of the Front Royal quadrangl

_1969, Geology of the Stokesville and Parnassus quadrangles, Virgini

Mineral Resources, Reports of Investigations 42, 43 p.

Virginia Division of Mineral Resources, scale 1:500,000.

Virginia, and origin of the residual ore deposits: U.S. Geological Survey

Danville, and Ringgold quadrangles, Virginia: Virginia Division of Mineral

Springs quadrangles, Virginia: Virginia Division of Mineral Resources, Reports

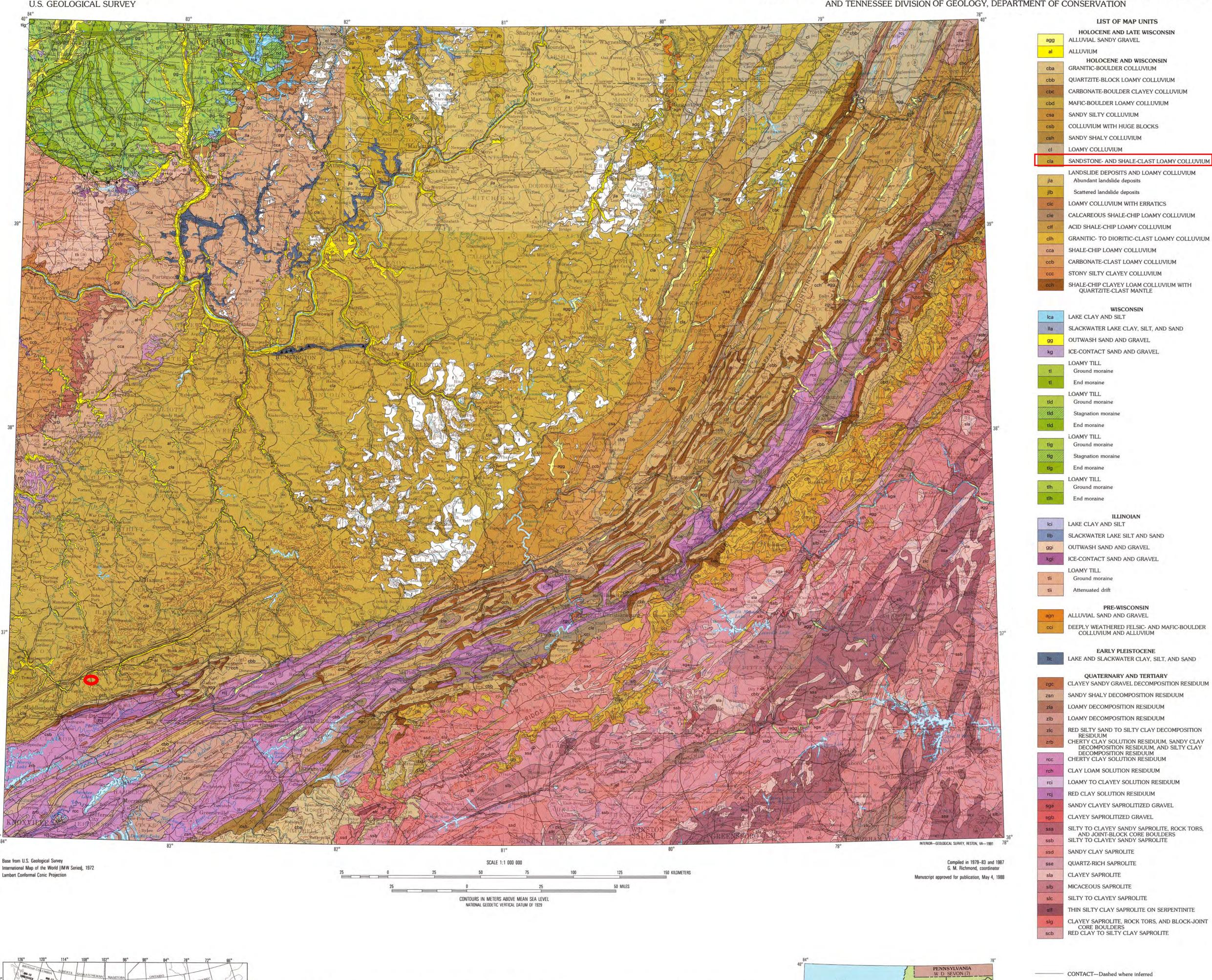
Halifax Counties: Virginia Division of Mineral Resources, Bulletin 75, 87 p.

quadrangles, Virginia: Virginia Division of Mineral Resources, Reports of

quadrangles, Virginia: Virginia Division of Mineral Resources, Reports of

__1976, Geology of the Daleville quadrangle, Virginia: Virginia Division of

Reports of Investigations 34, 112 p.



NORTH DAKOTA MINNESOTA INDEX TO INTERNATIONAL MAP OF THE WORLD

DEPARTMENT OF THE INTERIOR

1:1,000,000 TOPOGRAPHIC SERIES Showing location of the Quaternary Geologic Map of the Blue Ridge 4°× 6° Quadrangle in red [U.S. Geological Survey, Miscellaneous Investigations Series, Map I-1420 (NJ-17)] and other published maps in the Quaternary Geologic Atlas of the United States in yellow.

NOTE: This map is a product of collaboration of State geological surveys, universities, and the U.S. Geological Survey, and is designed for both scientific and practical purposes. It was prepared in two stages. First, separate maps and map explanations of the parts of States included in the quadrangle were prepared by the State compilers. Second, these maps were integrated and locally supplemented by the editors; map unit symbols were revised to a uniform system of classification; and map unit descriptions were prepared from information received from the State compilers and from additional sources. The diagrams accompanying the map were prepared by the editors. The footnote on saprolite was prepared in part by E. T. Cleaves, Maryland Geological Survey, and in part by R. B. Daniels, North Carolina State Differences in mapping or interpretation in different areas were resolved by correspondence to the extent possible. Most simply reflect differences in available information or in

philosophies of mapping, and should encourage further

conterminous United States have been mapped and described.

Less than forty percent of the surficial deposits of the

Traditionally, mapping of surficial deposits has focused on

glacial, alluvial, eolian, lacustrine, marine, and landslide deposits. Slope and upland deposits have been mapped in detail only in restricted areas. However, an enormous amount of engineering construction and many important problems of land use and land management are associated with regions that have extensive slope and upland deposits (colluvium, residuum, and saprolite, for example). These materials have many different physical characteristics. Therefore, an effort has been made to classify, map, and describe these deposits, based in large part on unpublished interpretations, published and unpublished subsoil data, and the distribution of bedrock parent materials. The classification is crude, but represents a irst step toward a more refined and useful product. For scientific purposes, the map differentiates Quatersuch as lithology, texture, genesis, stratigraphic relationships, and age, as shown on the correlation diagram and indicated in the map unit descriptions. Some geomorphic features, such as end moraines, are distinguished as map units. Erosional ndforms, such as stream terraces, are not distinguished, and differentiation of sequences of alluvial deposits of different

ages in most regions is not possible at a scale of 1:1,000,000.

Most landslide deposits are too small to be shown at this scale,

map units. Areas of abundant and of scattered landslide deposits are distinguished in parts of Ohio and Kentucky (W. E. Davies, unpub. mapping, 1984), where they are identified as units jla and jlb. However, landslide deposits are known to be present throughout the area of unit cla. Similarly, open-pit coal mines and spoil piles, shown by symbol "f" where mapped, also are present throughout the coal mining area of unit cla, but have not been mapped on a regional For practical purposes, the map is a surficial materials map. Materials are distinguished on the basis of texture, composition, and local specific characteristics such as swelling clay. It is not a map of soils as soils are recognized and map of soils as recognized in engineering geology, or o subsoils or parent materials from which pedologic and agronomic soils are formed. As a materials map it serves as a base from which a wide variety of derivative maps for use in planning engineering, land use, or land management projects

but areas in which landslides are present are distinguished as

can be compiled.

WEST VIRGINIA R E BEHLING (2) M RICHMOND (5) TENNESSEE R A MILLER (8) NORTH CAROLINA RESPONSIBILITY FOR STATE COMPILATIONS 1) DEPARTMENT OF ENVIRONMENTAL SCIENCE, UNIVERSITY OF VIRGINIA DEPARTMENT OF GEOLOGY AND GEOGRAPHY, UNIVERSITY OF WEST VIRGINIA 3) DEPARTMENT OF GEOLOGY, UNIVERSITY OF NORTH CAROLINA 4) SOIL SCIENCE DEPARTMENT, NORTH CAROLINA STATE UNIVERSITY 5) U.S. GEOLOGICAL SURVE

DEPARTMENT OF GEOLOGY AND MINERALOGY, OHIO STATE UNIVERSITY) PENNSYLVANIA BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY, DEPARTMENT OF ENVIRONMENTAL RESOURCES (8) TENNESSEE DIVISION OF GEOLOGY, DEPARTMENT OF CONSERVATION

== MELTWATER CHANNEL E BEHLING (2) DIRECTION OF ICE MOVEMENT INDICATED BY STRIA-OUTER LIMIT OF GLACIAL ADVANCE—Dashed where inferred. Ticks on side of advance BURIED MORAINE BENEATH LOAMY TILL (tld) PLEISTOCENE OR PLIOCENE) f AREAS OF OPEN-PIT COAL MINES AND SPOIL PILES

than 10 m at base of colluvial fans and aprons ea characterized by abundant landslide deposits (10-50 percent of mapped area)—Mapped only in north-central part of quad-Area characterized by scattered landslide deposits (2-10 percent of mapped area)-Mapped only in north-central part of OAMY COLLUVIUM¹ WITH ERRATICS—Similar to the loamy colluvium (cl), but contains scattered erratics. Mapped areas ▲ SAND AND GRAVEL OF TEAYS FORMATION (EARLY nclude small deposits of older intensely weathered loamy till o inoian age. Till is orange red to yellowish brown, brown, or brownish gray, and leached throughout. Joint surfaces are intensely stained with manganese and iron oxide, and charstony. Clasts in the till are mostly locally derived shale and Clear Creek section, Ohio-Stratigraphic sequence, from sandstone, but erratic lag boulders and cobbles of limestone, oldest to youngest: silt and sand; gravel and pre-Illinoia granite, granitic gneiss, and quartzite are common on its surface. ll: "Yarmouth(?)" paleosol: pre-Illinoian or pre-Illinoian luvium and Illinoian till are mantled with loess 1-2 m thick pre-Rainsboro" till: gravel: Illinoian Rainsboro Till; sand Thickness of till mostly less than 2 m; thickness of colluvium 1-4 m and gravel; Rainsboro Till (Rosengreen, 1974) Fall Creek section, Ohio—Stratigraphic sequence, from oldest to youngest: Illinoian Rainsboro Till; silt; "Sangamon" CALCAREOUS SHALE-CHIP LOAMY COLLUVIUM1—Yellowishbrown silt clay loam characterized by abundant chips of paleosol; late Wisconsin Boston Till (wood in till, 20,910 calcareous shale and thin-bedded shaly limestone. Matrix 40 BP, ISGS-44); rubble and gravel with weathered moderately plastic. Underlies gently rolling terrain. The northward extension of unit cle in the Chesapeake Bay quadrangle, profile; late Wisconsin Caesar Till (Rosengreen, 197 Blinco Branch section, Ohio-Type section for Boston Til adjacent to the east, was inadvertently designated acid shalechip loamy colluvium (clf), but properly is calcareous shale-chip tratigraphic sequence, from oldest to youngest: Illino oamy colluvium (cle). It is derived from the calcareous sboro Till (wood in till, greater than 37,770 BF SGS-59); gravel and sand; "Sangamon" paleosol; late Martinsburg Shale. Thickness 0.3-1 m Visconsin Boston Till; loess (Rosengreen, 1974) ACID SHALE-CHIP LOAMY COLLUVIUM1—Dark-gray to grayish-Rainsboro section, Ohio-Stratigraphic sequence, from brown, yellowish-brown or reddish-yellow, sandy to silty clay oldest to youngest: pre-Illinoian till or Illinoian Rainsboro loam; contains slabs and chips of noncalcareous shale and thin-Fill; silt; gravel; Rainsboro Till; gravel; Rainsboro Till; bedded sandstone. Commonly grades into underlying bedrock sand; Illinoian Rainsboro(?) Till; gravel and sand; loess through a creep zone in which shale and sandstone beds are

> mantled with material derived from adjacent rock uplands. GRANITIC- TO DIORITIC-CLAST LOAMY COLLUVIUM1-Brown to dark-brown, bouldery, sandy clay loam. Clasts angular to subangular, chiefly granite, granodiorite, and quartz-diorite igneous and metamorphic rocks. Mapped areas include thin siduum on gently sloping uplands and many rock outcrops. Thickness 0.5–2 m; thicker at base of slopes SHALE-CHIP LOAMY COLLUVIUM1—Greenish-gray to paleyellowish-gray, silty clay loam; locally blocks and chips of shale and siltstone in a matrix of disintegrated shale. Formed on teeply dissected terrain; slumped masses and creep structures common. Thickness generally 3-6 m; locally as much as 12 m CARBONATE-CLAST LOAMY COLLUVIUM¹—Yellowish-brown to orange silty clay, containing scattered to numerous cobble- to boulder-size, subangular to subround limestone slabs and, locally, shale chips. Local karst features where overlies limestone. Mapped areas include local alluvium and bedrock exposures along streams. Thickness 1–2.5 m STONY SILTY CLAYEY COLLUVIUM¹—Yellowish-, orange-, or reddish-brown, calcareous, silty clay loam. Contains abundant angular to subangular pebble- to boulder-size fragments of

limestone and angular chips to slabs of shale: also contains scattered subangular to well-rounded erratics of limestone, dolomite, chert, quartz, and Precambrian igneous and metamorphic rocks, a colluvial lag from a former mantle of Illinoian till now extensively eroded and preserved only locally in undissected areas. Upper part includes admixed loess; loess generally less than 1 m thick locally mantles the collusium on uplands and undissected gentle to moderate slopes. Mapped areas include numerous bedrock outcrops, especially on steep 3-6 m. locally more than 30 m slopes. A few isolated sinkholes where limestone is at the surface. Thickness as much as 2 m or brown to brownish-gray calcareous sand and gravel. Textures

CONTACT ALLUVIAL LAKE DEPOSITS DEPOSITS

GLACIAL DEPOSITS

DESCRIPTION OF MAP UNITS

HOLOCENE AND LATE WISCONSIN

ALLUVIAL SANDY GRAVEL-White, light-gray to dark-brown,

poorly sorted, sandy pebble-to-boulder sized gravel; grades

upward into sandy to silty clay; locally contains lenses of angular,

predominantly of quartz and quartzite but, in places, includes

some granitic crystalline rock or limestone. Underlies flood

ains, alluvial fans, and low terraces. Thickness 3-10 m

sand, and gravel. Calcareous to noncalcareous; stratified;

silt, fine sand, and minor lenses of clay and organic matter; lower

part mostly sand and rounded gravel; locally cobble or boulder

gravel. Clasts chiefly sandstone and shale; some platy limestone

locally. North of Ohio River, includes clasts of crystalline rocks,

and massive limestone and dolomite derived from glacial

deposits. Underlies flood plains, low stream terraces, and

alluvial fans. In places overlain by unmapped peat or swamp

deposits. Mapped areas locally include small deposits of till,

outwash, or ice-contact sand and gravel (gg, kg), and glacio

lacustrine clay and silt (Ica) as well as some old upland gravel

Along Ohio River includes late Wisconsin outwash sand and

gravel (gg) that underlies a sequence of discontinuous low.

middle, and high terrace remnants which are too narrow to show

at map scale. Thickness commonly 1-4 m; rarely more than 10 m

GRANITIC-BOULDER COLLUVIUM1-Pale- to dark-brown, yel-

lowish-red, or grayish-yellow, poorly sorted, silty, sandy loam to

sandy clay. Angular clasts and round to subround cobble- to

boulder-size joint-block core stones of partly weathered feld

spathic crystalline rocks comprise 15-60 percent of deposit.

Mantles steep slopes; includes creep, mudflow, landslide, and

outcrops, small areas of saprolite, and bouldery alluvial-far

QUARTZITE-BLOCK LOAMY COLLUVIUM1-Gray to yellowish-

eposits. Overlies saprolite locally, especially at the base of

slopes. Thickness ranges from about 2 m on upper slopes to as

brown or pale-reddish-brown, unsorted sand, silt, and clay.

Contains angular to subround blocks and cobble-size detritus o

crests of quartzitic sandstone ridges. On steep slopes, commonly

forms talus and debris cones that overlie weathered shale-chip

loamy colluvium (cca) developed in shale bedrock. On gently

sloping uplands, overlies thin decomposition residuum on

quartzitic sandstone. Above 600 m elevation, commonly forms

block fields and block streams. Mapped areas contain numerous

ARBONATE-BOULDER CLAYEY COLLUVIUM1-Yellowish-

silty clay. Contains abundant angular to subangular or rounded

cobble- to boulder-size clasts of limestone or dolomite. Mantles

brown, unsorted silt loam; contains angular clasts and round to

subround joint-block core boulders of mafic volcanic rock.

commonly partly weathered. Locally overlies saprolite. Mantles

slopes of knobs and ridges underlain by mafic rock, which locally

projects as tors and pinnacles on summit and crest areas.

SANDY SILTY COLLUVIUM¹—Yellowish-brown to brownish-gray

napped separately (f). Thickness generally 1-2 m

sandy silt and silty sand, mixed with loess; contains angular to

subround clasts of sandstone, siltstone, and shale. Mantled by

about 1 m of younger loess. Mapped areas include bedrock

DLLUVIUM1 WITH HUGE BLOCKS-Light-gray to pale-yel-

outcrops and numerous areas of strip-coal-mine waste, some

owish-brown, poorly sorted, sandy, silty clay loam; contains

chips of siltstone and shale, and angular to slabby blocks of

sandstone, some as much as 10-15 m in diameter. Occurs on

steep slopes at west margins of the broad flat to gently sloping

uplands west of the Appalachian Mountains in Tennessee

Cumberland Plateau). Mapped areas include some cherty

clayey residuum (rcc). Thickness commonly 3-15 m, but may be

gray, unsorted sandy loam, locally clayey or silty; contains

abundant chips of shale, particles of clay, and small fragments of

sandstone. No boulders. Sand mostly quartz. Present only

gray or black sandy silt or clay loam mixture; noncalcareous to

weakly calcareous; locally very calcareous where derived from

limestone. Clasts chiefly sandstone, quartzitic sandstone, silt-

stone, and shale; limestone or conglomerate clasts common

locally. On gently sloping upland surfaces, commonly includes

solifluction deposits and locally includes some clayey solution

residuum developed on limestone. Thickness 1-2 m on gentle

slopes; 2-4 m at foot of slopes, and locally more than 10 m at

Light-gray, brownish-gray, or yellowish-gray, sandy loam to clay

loam; poorly sorted; unstratified. Contains angular to subround

or slabby, pebble- to boulder-size fragments of sandstone.

conglomeratic sandstone, and chips of shale. On steep slopes

clayey material tends to be unstable, and commonly is

associated with soil creep and landslides. Landslide deposits are

abundant to scattered, but have not been mapped in detail; they

underlie 21-50 percent of the land surface. Mapped areas of

colluvium include rock exposures on steep slopes and minor

LANDSLIDE DEPOSITS AND LOAMY COLLUVIUM1—Landslide

25 m at foot of some steep slopes

alluvium along streams. Thickness generally 2-7 m; as much as

deposits are developed in areas of colluvium (cla), chiefly as the

product of earth flows and slumps. Both the colluvium and the

underlying bedrock sandstone or shale commonly displaced.

arthflow deposits are pale-yellow, yellowish-brown, brown, to

gray or black heterogeneous mixtures of sand, silt, and clay in

small to large clasts of sandstone, siltstone, shale, and, locally,

platy limestone or coal. Slump deposits are masses of colluvium

a unit; original textures and bedding of both colluvium and

bedrock commonly retained. Mapped areas may include some

landslide deposits of pre-Wisconsin age. Thickness of earthflow

deposit generally less than 5 m; thickness of slump deposit

generally 2-30 m; thickness of colluvium (cla) between landslide

deposits 1-2 m on gentle slopes, 2-4 m on foot slopes, and more

pent downslope and disintegrated. Upper part may be locally

toes of colluvial fans and aprons
SANDSTONE- AND SHALE-CLAST LOAMY COLLUVIUM¹—

generally less than 15 m

LOAMY COLLUVIUM¹—Pale-yellow, yellowish-brown, or brown to

locally on northwest slopes of foothills in Tennessee. Thickness

SANDY SHALY COLLUVIUM1 - Gray, bluish-gray, or greenish-

slopes of knobs and ridges underlain by carbonate rock.

brown to reddish-brown, locally brick red, unsorted, sandy to

hard sandstone as large as 1 m in diameter. Mantles slopes and

HOLOCENE AND WISCONSIN

much as 10 m at the base of slopes

rock outcrops. Thickness 1–10 m

cbd MAFIC-BOULDER LOAMY COLLUVIUM¹—Yellowish- to dark-

moderately to well sorted; texture variable. Upper part mostly

ALLUVIUM-Yellowish-brown, brown, reddish-brown, or gray silt,

noderately to well-sorted micaceous sand. Gravel consists

SHALE-CHIP CLAYEY LOAM COLLUVIUM1 WITH QUARTZITE-CLAST MANTLE—Yellowish-brown to red clay loam, containing weathered chips of shale and rotted clasts of limeston Uppermost part includes abundant angular to rounded fragment of sandstone and quartzite that form a resistant mantle on the shale-chip colluvium. The underlying shale or carbonate roc commonly are weathered to depths of 30 m or more; sinks are ocally developed in the carbonate rocks. Thickness of colluvium

LAKE CLAY AND SILT-Yellowish-brown, reddish-brown, brown to gray or bluish-gray, calcareous clay and silt. Well bedded to massive, commonly laminated, in places varved; locally inter bedded with sand and fine gravel. Ice-rafted pebbles, cobble and boulders common in lower part. Commonly cut by gullie where adjacent to major streams. Chiefly on extensive flat, low lying areas formerly occupied by glacial lakes, but also in sma separate lake basins. Mapped areas include some slackwate lake clay, silt, and sand (Ila), outwash and ice-contact sand an gravel (gg, kg), and alluvium (al). Commonly overlain by unmapped alluvium, peat, or swamp deposits. Thickness generally 1-3 m; locally more than 10 m SLACKWATER LAKE CLAY, SILT, AND SAND-Pale-vellow, yellowish-brown, and brown to bluish-gray or gray, calcareous to noncalcareous clay, silt, and fine sand. In some valleys, chief silt with local interbeds of plastic clay or fine sand; in other valleys, chiefly fine sand with interbeds of silt; locally include aminated beds of clay and silt, and in places contains mollus shells. Mapped areas include alluvium in upper parts of valley and on valley walls, and narrow ribbons of alluvium inset into terraced slackwater lake deposits in lower parts of valleys Commonly grades into or interfingers with alluvium (al) in upper parts of valleys and with outwash sand and gravel (gg) in lower generally less than 10 m parts. Materials were deposited in slackwater lakes in valleys

COLLUVIAL DEPOSITS

locally more than 6 m OUTWASH SAND AND GRAVEL-Gray, pale-yellowish-brown brown, or dark-reddish-brown sand and gravel. Commonly calcareous medium sand, gravel, cobbles, and boulders i glaciated areas; weakly calcareous to noncalcareous sand, fin gravel, and scattered cobbles in unglaciated terrain. Loc terbedded lenses of silt and clay. Well-stratified horizonta structures and poorly sorted, irregular beds of cobble or boulde gravel. Alternating gravel and silt beds continuous for great distances in some valley train deposits. Gravel deposits locall cemented by calcium carbonate. Clasts generally rounde chiefly sandstone, dolomite, limestone, siltstone, sandy shale ogether with erratic igneous and metamorphic rocks in placiated Ohio; chiefly sandstone, cherty sandstone, siltstone and sandy shale in unglaciated terrain. Underlies terrac remnants, valley trains, outwash plains, delta topset beds outwash fans and aprons, and fills of abandoned meltwate channels. Surfaces of deposit generally smooth, but locall pitted by ice-block depressions. Mapped areas include local ice ontact sand and gravel (kg), lake clay and silt (lca), and alluviun (al). Locally overlain by eolian sand and silt, alluvium, peat, o swamp deposits. Thickness 1-15 m; locally more than 30 m alluvium 1-10 m; thickest on lower slopes

ICE-CONTACT SAND AND GRAVEL-Yellowish-brown to gra generally calcareous, sand and gravel. Texture changes abrup laterally and vertically, from fine sand and silt to cobble and boulder gravel. In places, contains lenses or masses of clay, silt, flow till, or till. Sorting variable; irregularly to well bedded; fault folds, and slump or collapse structures common; local cemented with calcium carbonate. Clasts rounded to subangula clasts mostly similar to those of outwash sand and gravel (gg) same area. Larger clasts chiefly dolomite, limestone, and errati igneous and metamorphic rocks. Forms kames, kame terraces same deltas, interlobate moraines, and ice-fracture fillings. Ic block depressions common. Mapped areas include sma deposits of outwash sand and gravel (gg), lake clay and silt (Ica) alluvium (al), and till. Locally overlain by thin loess, alluvium peat, or swamp deposits. Thickness generally 2-30 m; locally more than 60 m LOAMY TILL (part of Darby Till in Ohio) — Yellowish-brown to oliv gray, bluish-gray, gray, or dark-gray, calcareous loam and silt

ributary to major outwash valley fills. Thickness generally 1-4 m;

1-2 m: locally thicker

oam; compact. Nonsorted to poorly sorted. Typically his horizontal platy structure, breaking into irregular pieces 1.5-4 c thick. Generally moderately pebbly to pebbly; locally cobbly c bouldery, Gravel lenses or interbeds common, Pebbles, cobble and small boulders chiefly dolomite and limestone; larg boulders chiefly erratic crystalline igneous and metamorph rocks and quartzite. The till locally is overlain by unmappe alluvium, peat, and swamp deposits. Mapped areas local include bedrock outcrops and small deposits of outwash and ic contact sand and gravel (gg, kg), lake clay and silt (lca), and Ground moraine-Thickness generally 1-3 m; rarely 6 m

End moraine-Forms broad, low ridges or complex areas of narrow, concentric or anastomosing ridges having knob-andkettle topography and shallow undrained depressions. Thickness OAMY TILL (Boston and Caesar Tills in Ohio)—Yellowish-brown, brown, dark-brown, or grayish-brown to gray, generally noncalcareous silt loam and sandy loam; nonsorted; compact ontains sparse pebbles, and a few cobbles; boulders uncommo Vell-defined "boulder belts" on surface locally. Clasts chiefl dolomite and limestone; some sandstone, shale, and errati gneous and metamorphic rocks. Mapped areas include sma posits of outwash and ice-contact sand and gravel (gg, kg), lake clay and silt (Ica), alluvium (al), and bedrock outcrops. ocally, till is overlain by alluvium, peat, or swamp deposits Ground moraine-Thickness generally less than 1.5 m on uplands, 3-6 m in valleys Stagnation moraine—Broad, irregular areas of hummocky collapsed

topography, typically with ice-disintegration features and iceblock depressions. Thickness generally 3-10 m nd moraine—Low ridges, generally with subdued constructions topography. Thickness generally 5-10 m; locally more than 15 m LOAMY TILL—Pale-yellow, yellowish-brown, brown, or dark-brown to light-gray or bluish-gray, calcareous loam, silt loam, clay loar and silty clay loam; nonsorted to poorly sorted. Typically ha rregular horizontal platy structure and is well jointed. Calcium carbonate joint fillings. Till is sparingly pebbly to pebbly; cobble and boulders locally common, particularly in end moraine Pebbles, cobbles, and small boulders chiefly dolomite, limestone. sandstone, and siltstone: large boulders chiefly erratic crystalling gneous and metamorphic rocks and quartzite. Mapped area ocally include small deposits of outwash and ice-contact sand and gravel (gg, kg), lake clay and silt (lca), alluvium (al), and edrock outcrops. Till locally overlain by loess 15-23 cm thick or by alluvium, peat, or swamp deposits Ground moraine—Thickness generally 1-3 m. rarely 6 m

Stagnation moraine—Broad, irregular areas of hummocky collapsed topography, locally having ice-disintegration features and iceblock depressions. Thickness generally 3-10 m and moraine-Broad, low ridges or complex areas of narrow, concentric or anastomozing ridges characterized by irregular ummocks and shallow undrained depressions. Thickness MY TILL—Yellowish-brown, reddish-brown, gravish-brown, or bluish-gray, locally mottled, calcareous loam, silt loam, and clay sorted; loose to compact, friable. Blocky structure. Calcius carbonate joint fillings. Moderately pebbly; cobbles and boulde ocally abundant. Clasts chiefly limestone and dolomite: som shale, sandstone, chert, and erratics of granite, gneiss, and quartzite. Limestone clasts less abundant, chert clasts mor abundant, and matrix more sandy and less clayey than in unit the Mapped areas include bedrock outcrops and small deposits of outwash and alluvium. Commonly overlain by loess 0.2-0.4 n thick, rarely 0.9 m

Ground moraine—Thickness commonly 2-3 m, rarely 6 m End moraine—Broad low ridges, narrow sharply defined ridges, or complex of concentric or anastomosing ridges characterized by irregular hummocks and shallow undrained depressions. Thick-Ici LAKE CLAY AND SILT—Yellow, yellowish-brown, grayish-brown or mottled yellow and grayish-brown to gray or bluish-gray silt

and clay, locally with minor fine sand. Well bedded to massive

commonly laminated or varved. Locally underlain by gravel and

sand. Commonly dissected by deep gullies. Underlies terrace

remnants in valleys formerly blocked by Illinoian glacier.

sand and gravel (ggi, kgi) and alluvium (al). Locally overlain by 25-1.5 m of loess or colluvium. Thickness generally 2-10 m, SLACKWATER LAKE SILT AND SAND—Pale-yellow, yellowish brown, or dark-brown to gray, weakly calcareous or noncalcareous silt and fine sand, locally with interbeds of plastic clay. Intensely weathered and dissected. Underlies terrace remnants in valleys ributary to major outwash valley fills. May include some deposit of early Wisconsin age. Mapped areas include small inset eposits of alluvium (al). Thickness generally 1-4 m, locally more OUTWASH SAND AND GRAVEL—Pale-yellow to yellowish-brown

red to reddish-brown, or brown to dark-grayish-brown, coarse sand and gravel. Calcareous or weakly calcareous in glaciated areas; weakly calcareous to noncalcareous in unglaciated errain. Horizontally bedded; intensely weathered; gravel locally cemented by secondary calcium carbonate. Clasts rounded average maximum size decreases downstream; in unglaciate errain, most are less than 2 cm, rarely more than 8 cm, in lon dimension. Clasts chiefly dolomite, limestone, sandstone, and gneous and metamorphic rocks. Underlies outwash plains or plands and terrace remnants along valley walls. Mapped areas nclude peat or swamp deposits in depressions, and small deposits of late Wisconsin outwash sand and gravel (gg) and alluvium (al). Commonly overlain by loess or sand 0.5-3 m thick vithin which is a buried Sangamon paleosol. Thickness general E-CONTACT SAND AND GRAVEI — Yellow red reddish-brown

vary abruptly, laterally and vertically; range from fine sand and rare pebbles to cobble gravel with lenses of flow till. Generally well stratified: moderately to poorly sorted. Locally characterized by faults, folds, and slump or collapse structures. Sand commonly crossbedded. Gravel commonly cemented by secondary calcium carbonate. Clasts rounded to subangular, chiefly dolomite limestone, sandstone, and shale. Constructional surface market by subdued hummocks; ice-block depressions generally filled with alluvium, peat, or swamp deposits. Underlies kames and dissected kame terrace remnants. Mapped areas include small deposits of outwash sand and gravel (ggi), till (tli), and alluvium (al). Locally overlain by as much as 3 m of loess, alluvium, peat, o swamp deposits. Thickness generally 2-20 m, locally more than

jlb clc cle clf clh cca ccb c

CORRELATION OF MAP UNITS

DECOMPOSITION DECOMPOSITION

AND SOLUTION

CLAYEY SAPROLITIZED GRAVEL4—Dark-red to reddish-brown

sandy or loamy clay. Contains scattered stained pebbles of

quartz and ghost pebbles and cobbles of other rock types partly

altered to clay. Underlies dissected sloping ridgetops whose

distribution suggests that deposits may be remnants of Tertiary

alluvial fans. Locally, saprolite extends through the gravel into

underlying bedrock where it changes in character depending on

rock type and is of variable thickness. The saprolitized gravel

SILTY TO CLAYEY SANDY SAPROLITE⁴, ROCK TORS, AND

JOINT-BLOCK CORE BOULDERS—Dark-red, reddish-brown,

reddish-yellow, or white, slightly micaceous, sandy clay to silty or

clayey medium sand. Developed in massive granite, granite

gneiss, or similar massive felsic igneous or metamorphic rocks.

exceed kaolinite in lower part. Feldspar is the predominar

weatherable mineral in lower part; muscovite or its pseudomorphs

predominate in upper part. Saprolite is permeable and strongly

acidic; it grades into bedrock through a zone of partly decomposed

joint-block core boulders. Abundant joint-block core boulders

are associated with bedrock knobs and tors in mountain and hill

areas. Pavement outcrops, as much as 10 hectares, are present in

some upland areas. Saprolite is present locally with both.

Fragments of vein quartz are locally abundant in the colluvium

weatherable mineral in lower part; muscovite or its pseudomorp

partly weathered slabby fragments in matrix of micaceous silt to

as micaceous rock ribs, and slabby to bouldery colluvium,

imerous vein-quartz fragments. Thickness commonly less than

especially at base of steep slopes. Colluvium commonly contain

slopes to about 3 m on gentle slopes

CLAYEY SAPROLITE⁴—Greenish-gray, pale-yellowish-orange

moderate-yellow, or dark-red, slightly micaceous to micaceous,

metamorphic, mafic metavolcanic, and ultramafic rocks. Where

rocks are massive to weakly gneissic, the saprolite commonly

pebble, and is characterized by a pinnacled bedrock base. Clay

component is mixed smectite and kaolinite having low to high

shrink and swell potential. Sand is chiefly calcic feldspar, biotite,

vermiculite, hornblende, and minor quartz. Mapped areas

containing bedrock fragments, and widely scattered bedrock

include small deposits of locally derived colluvium commonly

yellowish-red, or gray, micaceous, clayey to slightly clayey sand

to clayey sandy silt. Developed in felsic, micaceous schist. Clay is

kaolinite, with lesser amounts of gibbsite. Mica mostly weathered

to vermiculite and (or) kaolinite near ground surface. Shrink and

swell potential generally low. Mapped areas include bedrock

exposures and small deposits of locally derived colluvium

brown, or red fine sandy silt to slightly clayey silt. Developed in

phyllite, argillite, slate, and felsic metavolcanic rocks. Clasts of

quartz and slabs and splinters of parent rock common in lowe

part. Clay is predominantly kaolinite but gibbsite present in

places. Mapped areas include bedrock exposures on slopes and

hill crests and locally derived colluvium, especially at base of

slopes. Thickness ranges from less than 0.5 m on steep slopes to

greenish-gray to pale-vellowish-brown silty clay. Contains small

fragments and slabs of serpentinite. Extensive smooth pavement

outcrops of serpentinite are common. Thickness of saprolite less

BOULDERS-Pale-yellowish-orange, orange-brown, or dark-

commonly diabase. Clay is mixed kaolinite and smectite;

range of shrink and swell potential. Sand chiefly partly altered

calcic feldspar. Angular pea-size grus present in places. Bedrock

knobs or tors common and generally surrounded by saprolite

Mapped areas include small deposits of locally derived boulder

clay; developed in metavolcanic greenstone. Clay chiefly

colluvium, especially at base of steep slopes. Thickness of

RED CLAY TO SILTY CLAY SAPROLITE⁴—Dark-red clay to silty

kaolinitic. Mapped only in Virginia. Thickness 10-30 m

LUVIUM is a general term applied for purposes of this map to material transported and

DMPOSITION RESIDUUM, for purposes of this map, is defined as material derived

TION RESIDUUM, for purposes of this map, is defined as material derived by in-place

saprolite depends on the abundance of dark minerals in the parent rock and on the

wever, in places, structureless saprolite may occur between structured material be colluvium or modern soil above. Replication of bedrock features in saprolite res

minerals in the parent rock and the drainage regimen. For example, the clay minerals

saprolite developed on mafic rocks, in which hornblende and plagiciase are the prima minerals, are chiefly smectite and kaolinite in poorly drained areas, kaolinite in we

ersistent minor component only where internal drainage is excelle

isovolumetric chemical alteration of weatherable minerals. In weathering,

porosity increases greatly. Saprolite texture ranges from sandy to clayey depending on the abundance of minerals that are resistant to weathering, such as quartz, in the

aprolite thickness is directly related to slope angle and to the lithology an

ess of saprolite developed on felsic gneiss or schist on gently sloping upla

st, saprolite developed in quartzite and serpentinite is commonly less than 2 m th

mmonly exceeds 6 m (and locally may exceed 30 m); on slopes of 6° – 12° the thick mmonly ranges from 2–6 m; on slopes exceeding 12° it is generally less than 2 r

Saprolite has been mapped in terms of variety only in very limited areas. For purpose of this map, it is mapped in accordance with the distribution of different kinds of bedroof from which differing varieties of saprolites are derived. Differences due to slope angloculd not be effectively shown at the scale of this map. Information on rock permeability

SOURCES OF INFORMATION

Englund, K. J., and Windolph, J. F., Jr., 1975, Geologic map of the Olive Hill

McDowell, R. C., 1976, Geologic map of the Colfax quadrangle, Kentucky: U.S.

Geological Survey Geologic Quadrangle Map GQ-1332, scale 1:24,000

McDowell, R. C., Grabowski, G. J., Jr., and Moore, S. L., 1981, Geologic map of

Mytton, J. M., and McDowell, R. C., 1970, Geologic map of the Hillsboro

Outerbridge, W. F., 1970, Geologic map of the Sherburne quadrangle, northeastern

Wigley, P. B., 1978, Geologic map of the Moorefield quadrangle, Kentucky: U.S.

MARYLAND

Geological Survey Geologic Quadrangle Map GQ-1517, scale 1:24,000.

Maryland Geological Survey, 1968, Geologic map of Maryland: Maryland

NORTH CAROLINA

quadrangle, northeastern Kentucky: U.S. Geological Survey Geologic Quad-

quadrangle, Kentucky: U.S. Geological Survey Geologic Quadrangle Map

Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-854, scale

suitable for mapping varieties of saprolite is not regionally available.

ngle Map GQ-1270, scale 1:24,000.

GO-876, scale 1:24,000.

Geological Survey, scale 1:250,000.

Kentucky: U.S. Geological Survey, scale 1:250,000.

f carbonate rock or carbonate-cemented rock with no appreciable subsequent

ish blues are produced below. Saprolites grade down through partly weathered resh parent rock

he structure and texture of the bedrock are characteristically preserved in saprolite.

red, sandy to silty clay. Developed on massive mafic roc

smectite particularly common in areas of poor drainage. Broa

as much as 5 m on gentle lowland slopes
THIN SILTY CLAY SAPROLITE⁴ ON SERPENTINITE—Pale-

CLAYEY SAPROLITE⁴, ROCK TORS, AND JOINT-BLOCK CORE

than 1 m, commonly less than 0.5 m

saprolite less than 2 m to more than 5 m

SILTY TO CLAYEY SAPROLITE4—Gray, greenish-gray, yellowish

exposures. Thickness less than 1 m to as much as 15 m

MICACEOUS SAPROLITE4-Red, reddish-brown, dark-brown,

includes joint-block core stones ranging in size from boulder to

clayey sand, sandy clay, or clayey silt. Developed in mafi

Mapped areas of saprolite commonly include locally derived

uvium containing boulders, especially at base of steep slopes

Clay is mostly kaolinite in upper part, but gibbsite may equal or

ranges in thickness from 2 m to 6 m

LOAMY TILL (Rainsboro Till in Ohio)-Yellowish-brown to dark gray, calcareous loam, silt loam, and minor sandy loam; pebbly to cobbly, locally stony. Large boulders uncommon. Nonsorted to very poorly sorted. Tough and compact; locally cemented by secondary calcium carbonate. Oxidized till typically has horizontal platy structure. Intensely weathered; generally leached through ut where less than 3 m thick. Thick clay skins and intense iron oxide and manganese oxide stains on joint surfaces. Clast chiefly dolomite and limestone with minor sandstone, shale, an erratic igneous and metamorphic rocks. Ghost outlines o completely decomposed dolomite and limestone clasts and rotted granite pebbles common in leached till. Till is mostly thin and discontinuous; thick till chiefly on lower slopes beneath younger colluvium and solifluction deposits. Subdued rolling constructional surface is locally extensively dissected. Mapped areas include small solifluction and colluvial deposits, bedrock outcrops, outwash and ice-contact deposits, lake clay and sil slackwater lake clay, silt, and sand (Ila, Ilb), and alluvium (al). The commonly overlain by 0.5-3 m of loess of Illinoian and Wisconsin age that locally includes a humic gley paleosol. Till thickness

Attenuated drift—Discontinuous deposits of loamy till separated by areas of colluvium containing scattered erratics. Some areas of till are hummocky; others are merely thin veneers. Texture are more sandy than in ground moraine. Thickness generally less

PRE-WISCONSIN ALLUVIAL SAND AND GRAVEL-Yellowish- to reddish-brown or gray sand, gravel, cobbles, and boulders with lenses of silt and clay. Clasts mostly sandstone and quartzite. Underlies hig terraces along Potomac River in Pennsylvania. Considered to be of possible Illinoian age. Thickness variable but commonly DEEPLY WEATHERED FELSIC- AND MAFIC-BOULDER COL LUVIUM1 AND ALLUVIUM-Yellowish-red to dark-reddishbrown, silty clay loam; kaolinitic. Contains scattered angular to rounded pebbles, cobbles, and boulders of felsic and mafic rocks stone lines and layers of saprolitized gravel common. Forms deeply dissected colluvial aprons or alluvial fans of possible llinoian age. Overlie saprolite, which is exposed at surface between tongues or lobes of the colluvium or alluvium and

EARLY PLEISTOCENE LAKE AND SLACKWATER CLAY, SILT, AND SAND (Minford Silt in Ohio and West Virginia)—Yellowish-brown, pinkish-brown reddish-brown, dark-reddish-brown, light-greenish-gray, grayish brown, or brownish-gray to blue, bluish-gray, or light-gray, generally noncalcareous clay and silt with some sand. Prednantly well laminated, moderately plastic, fine silt and clay overlying horizontally bedded alluvial fine sand and silt. Som small chert and quartz pebbles, secondary gypsum crystals, and ferruginous concretions in lower part. Slackwater deposits occur in valleys tributary to the ancestral Teays Valley; consist of fine sand, locally interbedded with clay and silt. Lake sediments have reversed magnetic polarity indicating an age older than the Brunhes Normal Polarity Chron. Occur as terrace remnants scattered upland deposits, and extensive fills in abandoned ancestral valley of Teays River and other ancestral valleys tributary to the Ohio River. Generally dissected by deep gullies. hown only locally in West Virginia; commonly overlain by of outwash (gg, ggi), lake clay and silt (lca), and alluvium (al) Commonly overlain by 1-3 m of loess or colluvium. Overlies and and gravel of the Teays Formation (early Pleistocene liocene); shown by symbol on map. M. R. Campbell (1900 and Ohio Railroad in the ancestral Teays Valley, in West Virginia but the formation name was misspelled Teay in publication. (See

QUATERNARY AND TERTIARY LAYEY SANDY GRAVEL DECOMPOSITION RESIDUUM2-Yellowish-brown to dark-red pebbles, gravel, and cobbles in a sandy to silty clay loam matrix. Underlies a sequence of hig terraces and alluvial fans that are increasingly dissected with increasing height above stream. Clasts mostly quartzite and sandstone, deeply stained. Highest terrace surfaces characterize by lag boulder accumulations. Lower terrace deposits are increasingly fine grained upward. Sinkholes common in eposits overlying limestone. Thickness 3-10 m; locally as much SANDY SHALY DECOMPOSITION RESIDUUM2-Grayish-, vellowish-, or reddish-brown sandy loam to clay loam. Lower part contains shale chips or sandstone fragments. Mapped are include some thin stony loam colluvium, especially on steep slopes, and bedrock outcrops, especially along ridge cres hickness commonly less than 3 m, but locally as much as 6 r LOAMY DECOMPOSITION RESIDUUM²—Pale-vellow, vellowish

also discussion by Rhodehamel and Carlston, 1963.) Thickness

brown, brown, or dark-brown, noncalcareous to weakly calcareou sandy loam, loam, and silt loam on ridge crests. Derived from sandstone and, to a lesser extent, from shale bedrock. Mapped areas include small deposits of nonsorted, quartzite-block loam colluvium (cbb) as thick as 3-5 m, and extensive bedrock outcrops. Rubble formed by frost shattering of sandstone and quartzitic sandstone: bouldery where derived from quartziti sandstone; channery where derived from sandstone. Thickness of residuum 1-2 m LOAMY DECOMPOSITION RESIDUUM2-Yellowish-brown, reddish-brown or purple, noncalcareous loam, silt loam, and clay or gentle slopes. Mapped areas include some quartzite-block loamy colluvium (cbb) and scattered bedrock outcrops on steeper slopes. Thickness less than 1 m RED SILTY SAND TO SILTY CLAY DECOMPOSITION RESID-

UUM2—Red, reddish-gray, reddish-brown, or purplish-red silty sandy loam to silty clay loam. Locally includes rounded pebble and cobbles, chiefly quartz. Lower part contains chips and larger fragments of red shale or red sandstone and grades down into red sandstone or shale bedrock. Deposit contains crumbly clasts of diorite along lineaments aligned over underlying diorite dike Mapped areas locally include thin overlying colluvium or alluvium derived from adjacent uplands. Thickness 0.5-3 n TY CLAY SOLUTION RESIDUUM3, SANDY CLAY DECOMPOSITION RESIDUUM², AND SILTY CLAY DECOM-POSITION RESIDUUM²—Unit comprises three residua that cannot be shown separately at scale of map. Cherty clay solution ubangular slabs of limestone in lower part and is developed o limestone characterized by sink holes and other karst features Sandy clay decomposition residuum is yellowish-brown, porous and ferruginous or calcareous; it includes slabby sandston fragments and is developed on sandstone. Silty clay decomposition residuum is pale-yellowish-brown to grayish-brown clay or silt clay that contains shale chips; it is characterized by creen

structures on slopes and is developed on shale. Mapped areas

include bedrock outcrops and some locally derived colluvium, as thick as 8 m, on steep slopes. Thickness generally less than 5 m, but locally as much as 10 m CHERTY CLAY SOLUTION RESIDUUM3-Reddish-yellow to yellowish-brown, or pale-brown to light-reddish-brown, commonly mottled sandy or silty clay: plastic locally cherty Chert grav, vellowish brown, or vellowish orange, locally light green of black, and is present in highly variable abundance as angular t subround chunks or boulders. Lower part of deposit contains solution-surfaced slabs of limestone; clay extends along fracture into underlying limestone bedrock. Contact with underlying bedrock is abrupt and pinnacled. Underlies valleys between mountain ridges; sinks and karst features common. Mappe areas include colluvium, derived from adjacent sandstone ridges, and small bedrock outcrops. Thickness highly variable; less than 2 m to as much as 25 m LAY LOAM SOLUTION RESIDUUM3—Reddish-brown clay to

clay loam; contains subangular slabs of solution-surfaced limestone in places. Contact with bedrock irregular, locally pinnacled. Sinks and other karst features scattered to abundan Mapped areas include sparse bedrock outcrops. Thickness 1-7 r LOAMY TO CLAYEY SOLUTION RESIDUUM3-Pale-yellow yellowish-brown, yellowish-red, and reddish-brown, noncalcareous to weakly calcareous tough to plastic silt loam, silty clay loam, clay loam, silty clay, and clay. On siliceous carbonate bedrock, contains chert fragments; on interbedded carbonate and clastic rock, contains fragments of chert, shale, and sandstone. Bedrock outcrops and sinkholes are common. ickness commonly less than 1 m RED CLAY SOLUTION RESIDUUM³—Dark-red to reddish-brown clay, clay loam, or silty clay loam; includes some zones of sandy lay. Lower part commonly contains smooth limestone slabs or boulders and is in abrupt solution contact with underlyin limestone bedrock, into which it extends along fractures Relatively few sinkholes. Mapped areas include local bedroc

exposures and large amounts of colluvium reworked from the

residuum. Thickness as much as 25 m; highly variable

SANDY CLAYEY SAPROLITIZED GRAVEL⁴—Dark-red to reddish-

brown sandy or loamy clay. Contains scattered stained pebbles

of quartz and ghost pebbles and cobbles of other rock types

altered to clay. Underlies dissected flat ridgetops whos

distribution suggests that deposits may be remnants of a former

too small to map, particularly along meander loops of rivers.

Tertiary alluvial terrace system. Exposed at numerous localities

Thickness 1–10 m

Burke, R.T.A., and Lambert, H. D., 1917, Soil survey of Allegheny County, North Carolina: U.S. Department of Agriculture, Department of Soils, 26 p. Hardison, R. B., and Perkins, S. O., 1914, Soil survey of Ashe County, North Carolina: U.S. Department of Agriculture, Department of Soils, 32 p. Jurney, R. C., and Perkins, S. O., 1921, Soil survey of Wilkes County, North Carolina: U.S. Department of Agriculture, Bureau of Soils, p. 305-32 Lapham, J. E., and Meeker, F. M., 1903, Soil survey of the Asheville area, North Carolina: U.S. Department of Agriculture, Bureau of Soils, p. 279-297. Leighty, W. J., Perkins, S. O., Croom, C. W., and Davis, W. A., 1958, Soil survey of Watauga County, North Carolina: U.S. Soil Conservation Service, 75 p. n Carolina Department of Conservation and Development, Division of Mineral Resources, 1958, Geologic map of North Carolina: Department of Natural Resources and Community Development, Division of Land Resources, scale Stephens, R. B., 1977, Soil survey of Guilford County, North Carolina: U.S. Soil Conservation Service, 77 p.

Brown, D. M., 1948, The Pleistocene geology of Clark County, Ohio: Columbus, Ohio State University, M.S. thesis, 73 p. Conley, J. F., 1956, The glacial geology of Fairfield County: Columbus, Ohio State University, M.S. thesis, 130 p. Pove, G. D., 1960, Water resources of Licking County, Ohio: Ohio Division of Water Bulletin 36, 96 p. Fisher, S. P., Fanaff, A. S., and Picking, L. W., 1968, Landslides of southeastern Ohio: Ohio Journal of Science, v. 68, p. 65-80 Forsyth, J. L., 1962, Glacial geology, Chapter 7 in Wolfe, E. W., Forsyth, J. L., and Dove, G. D., Geology of Fairfield County, Ohio: Ohio Geological Survey Bulletin 30, p. 116–147.

SAPROLITE

_1965, Contribution of soils to the mapping and interpretation Wisconsin tills in western Ohio: Ohio Journal of Science, v. 65, p. 220-227 _1966, Glacial map of Licking County, Ohio: Ohio Geological Survey Report of Investigations 59, scale 1:62,500. oster, J. W., 1950, Glaciations and ice lake of Paint Creek Valley, Ohio: Columbu Ohio State University, M.S. thesis, 57 p. Goldthwait, R. P., 1950, Wisconsin glacial deposits, in Norris, S. E., The water resources of Greene County, Ohio: Ohio Division of Water Bulletin 19, p. 13-19. 952, Glacial deposits, in Norris, S. E., Cross, W. P., Goldthwait, R. P. and Sanderson, E. E., 1952, The water resources of Clark County, Ohio: Ohio Water Research Board Bulletin 22, p. 44-46. 958, Geology and water-bearing properties of the unconsolidated deposits, in Schmidt, J. J., The ground-water resources of Franklin County, Ohio: Ohio Division of Water Bulletin 30, p. 17-21.

Goldthwait, R. P., Stewart, D. P., Franzi, D. A., and Quinn, M. J., 1981, Quaternary

Hocking and Scioto River Valleys, Ohio: Ohio Journal of Science, v. 59,

Leverett, Frank, 1902, Glacial formations and drainage features of the Erie and

Thickness of saprolite commonly less than 2 m SILTY TO CLAYEY SANDY SAPROLITE⁴—Dark-red, reddishdeposits of southwestern Ohio, in Roberts, T. G., editor, Geomorphological hydrology, geoarcheology, engineering geology: Geological Society of America, Field Trip Guidebook, v. 3, 94th Annual Meeting, Cincinnati, 1987 brown, reddish-yellow, or white silty sand to slightly clavey sand. Developed in gneissic granite, felsic schist interlayered with gneiss, foliated granitic rocks, and felsic metavolcanic rocks. In Goldthwait, R. P., White, G. W., and Forsyth, J. L., 1961 [revised 1967], Glacial map upper part, clay predominantly kaolinite, but in lower part, of Ohio: U.S. Geological Survey Miscellaneous Geologic Investigations Map gibbsite may equal or exceed kaolinite. Illite and vermiculite are L-316, scale 1:500,000 minor components. Partly weathered feldspar is predominant Hoyer, M. C., 1976, Quaternary valley fill of the abandoned Teays drainage system ones, R. L., 1959, Outwash terraces along Licking River, Ohio: Columbus, Ohio Grades into underlying bedrock through an irregular zone of State University, M.S. thesis, 94 p Kempton, J. P., and Goldthwait, R. P., 1959, Glacial outwash terraces of the clayey sand. Mapped areas include bedrock exposures, commonly

Ohio Basins: U.S. Geological Survey Monograph 41, 802 p. 2 m, but may exceed 6 m on well-drained uplands SANDY CLAY SAPROLITE⁴—Red, yellowish-red, dark-brown, Lockwood, W. N., 1954, Progress report of subsurface study of the Teays River valley sediments in Pike, Jackson, and Scioto Counties [Ohio]: Ohio Division of yellow, light-gray, or greenish-gray slightly clayey sand to sandy Water Open-File Report, 32 p. clay. Developed in metamorphic or igneous rocks of intermediat Merrill, W. M., 1953, Pleistocene history of a part of the Hocking River Valley, Ohio: composition. Clays are mixed smectite and kaolinite where Ohio Journal of Science, v. 53, p. 143-158. saprolite developed on more mafic rocks; they have moderate Moos, M. H., 1970, The age and significance of a paleosol in Fayette County, Ohio: shrink and swell potential. On more felsic source rocks, clay is Columbus, Ohio State University, M.S. thesis, 88 p. predominantly kaolinite. Sand fraction is principally feldspar and Norris, S. E., 1959, The water resources of Madison County, Ohio: Ohio Division of quartz, and includes biotite, hornblende, and vermiculite in mor Water Bulletin 33, 63 p. mafic varieties. Soft rock fragments or ghosts of fragments may Quinn, M. J., 1974, Glacial geology of Ross County, Ohio: Columbus, Ohio State be abundant. Mapped areas include locally derived colluvium University, Ph.D. dissertation, 162 and bedrock exposures. Thickness commonly less than 5 m. Quinn, M. J., and Goldthwait, R. P., 1985, The glacial geology of Ross County, QUARTZ-RICH SAPROLITE⁴—Gray, pale-yellow, pale-brown, or Ohio: Ohio Geological Survey Report of Investigations 127, 42 p. pale-yellowish-red, locally micaceous, slightly clayey to silty, very osengreen, T. E., 1970, The glacial geology of Highland County, Ohio: Columbus, sandy saprolite. Clay is predominantly kaolinite. Angular or Ohio State University, Ph.D. dissertation, 163 p. irregularly shaped, partly disintegrated chunks or slabs of rock _1974, Glacial geology of Highland County, Ohio: Ohio Geological common in lower part. Saprolite is developed in quartzite, Survey Report of Investigations 92, 36 p. quartz-rich metasedimentary rocks, or quartz-mica schist. Schmidt, J. J., 1954, The water resources of Ross County, Ohio: Ohio Division of Manned areas include rock outcrops on steep slopes or ridge Water Information Circular 4, 26 p. crests, and locally derived sandy, stony colluvium, especially at Schuster, R. L., 1952, The glacial geology of Pickaway County, Ohio: Columbus, base of slopes. Thickness ranges from less than 0.5 m on steep Ohio State University, M.S. thesis, 74 p

> R. C., and Schmidt, J. J., 1953, The water resources of Pike County, Ohio: Ohio Division of Water Information Circular 1, 23 p. Stauffer, C. R., Hubbard, G. D., and Bownocker, J. A., 1911, Geology of the Columbus quadrangle: Ohio Geological Survey Bulletin 14, p. 191-319. Steiger, J. R. and Holowaychuk, Nicholas, 1971, Particle-size and carbonate inalysis of glacial till and lacustrine deposits in western Ohio, in Goldthwaii symposium: Columbus, Ohio State University Press, p. 275-289. Stout, Wilber, 1918, Geology of Muskingum County [Ohio]: Ohio Geological Survey Bulletin 21, 351 Stout, Wilber, and Schaaf, Downs, 1931, Minford silts of southern Ohio: Geological Society of America Bulletin, v. 42, p. 663-672. Stout, Wilber, Ver Skeeg, Karl, and Lamb, G. F., 1943, Geology of water in Ohio:

Sharpe, C. F. S., and Dosch, E. F., 1942, Relation of soil-creep to earthflow in the

Ohio Geological Survey Bulletin 44, 694 p. Sturgeon, M. T., and associates, 1958, The geology and mineral resources of Athens County, Ohio: Ohio Geological Survey Bulletin 57, 600 p. Teller, J. T., 1964, The glacial geology of Clinton County, Ohio: Columbus, Ohio State University, M.S. thesis, 107 p. _1967, Glacial geology of Clinton County, Ohio: Ohio Geological Surve Report of Investigations 67, scale 1:62.500. Thompson, M. L., Smeck, N. E., and Bigham, J. M., 1981, Parent materials and paleosols in the Teays River valley, Ohio: Soil Science Society of America Journal, v. 45, p. 918-925. J.S. Soil Conservation Service, published and unpublished soil survey maps of Walker, A. C., 1953, The water resources of Jackson County, Ohio: Ohio Division

of Water Information Circular 3, 20 Walker, A. C., and Schmidt, J. J., 1953, The water resources of Scioto County, Dhio: Ohio Division of Water Information Circular 2, 23 p. Wolfe, E. W., Forsyth, J. L., and Dove, G. D., 1962, Geology of Fairfield County: Ohio Geological Survey Bulletin 60, 230 p. blished map information: Pavies, W. E., U.S. Geological Survey, unpublished maps of landslides and strip mines, Clarksburg 1° × 2° quadrangle, scale 1:250,000. additional map information contributed by R. E. Choate, J. L. Forsyth, R. P. Goldthwait, Nicholas Holowaychuk, and R. J. Larson.

PENNSYLVANIA Briggs, R. P., Pomeroy, J. S., and Davies, W. E., 1975, Landsliding in Allegheny County, Pennsylvania: U.S. Geological Survey Circular 728, 18 p Ciolkosz, E. J., Latshaw, G. J., Cunningham, R. L., and Sevon, W. D., 1971, Pare material, topography, and time as soil forming factors in east-central Pennsylvania: Soil Science Society of America, Soils-Geomorphology Fi Conference Guidebook, 1971, University Park, Pennsylvania State University Agronomy Department, Agronomy Series 21, 53 p. Ciolkosz, E. J., Peterson, G. W., Cunningham, R. L., and Matelski, R.P., 1979, Soil developed from colluvium in the Ridge and Valley area of Pennsylvania: Soil Science, v. 128, p. 153-162. Crowl, G. H., and Sevon, W. D., 1980, Glacial border deposits of late Wisconsin age northeastern Pennsylvania: Pennsylvania Geological Survey, Fourth Series, General Geology Report 71, 68 p. inningham, R. L., Ciolkosz, E. J., Matelski, R. P., Petersen, G. W., and Pennock, R.

Jr., 1974, Characteristics, interpretations, and uses of Pennsylvania soils developed from colluvium: Pennsylvania State University Agricultural Experiment Station Progress Report 344, 50 p. , C. S., 1951, Pleistocene frost action near the border of the Wisconsin drift in Pennsylvania: Ohio Journal of Science, v. 51, p. 116-125. .956, Surficial geology and geomorphology of Potter County, Penn-Goodman, K. V., 1953, Brown forest, polygenetic, and congeliturbate profiles o Potter County, Pennsylvania: Soil Science Society of America Proceedings, Gray, Carlyle, Shepps, V. C., and others, compilers, 1960, Geologic map of Pennsylvania: Pennsylvania Topographic and Geologic Survey, Fourth Series, scale 1:250.000. Gross, D. L. and Moran, S. R., 1971, Grain-size and mineralogical gradations within tills of the Allegheny Plateau, in Goldthwait, R. P., Forsyth, J. L., Gross, D. I and Pessl, Fred, Jr., editors, Till-A symposium: Columbus, Ohio State University Press, p. 251–274.

Geological Survey, Fourth Series, Bulletin W3, 215 p.

everett, Frank, 1902, Glacial formations and drainage features of the Erie and Ohio Basins: U.S. Geological Survey Monograph 41, 802 p. 1934, Glacial deposits outside the Wisconsin terminal moraine Pennsylvania: Pennsylvania Geological Survey, Fourth Series, Bulletin G7 Lewis, H. C., 1882, Report on the terminal moraine in Pennsylvania and western New York: Pennsylvania Geological Survey, Second Report, Progress Report luller, E. H., 1977, Quaternary geology of New York, Niagara Sheet: New York State Museum and Science Service, Map and Chart Series 28, scale 1:250,000. Pomeroy, J. S., and Davies, W. E., 1975, Map of susceptibility to landsliding, County, Pennsylvania: U.S. Geological Survey Miscellaneous Field Studies Map MF-685-B, scale 1:50,000 Preston, R. W., 1950, Glacial foreland of northwestern Pennsylvania: Pennsylvania Geologists, 16th Annual Meeting, Pittsburgh, Guidebook, 47 p. Sharpe, C.F.S., and Dosch, E. F., 1942, Relation of soil-creep to earthflow in the Applachian Plateaus: Journal of Geomorphology, v. 5, p. 312-324. Shepps, V. C., 1955, Glacial geology of a part of northwestern Pennsylvania: Shepps, V. C., White, G. W., Droste, J. B., and Sitler, R. F., 1959, Glacial geology of northwestern Pennsylvania: Pennsylvania Geological Survey, Fourth Series,

Shepps, V. C., and others, 1960, Geologic map of Pennsylvania: Pennsylvania

Leggette, R. M., 1936, Ground-water in northwestern Pennsylvania: Pennsylvania

Geological Survey, Fourth Series, Map 1, scale 1:250,000. Sitler, R. F., 1957, Glacial geology of a part of western Pennsylvania: Urbana, Tharin, J. C., 1958, Textural studies of the Wisconsin tills of northwestern Pennyslvania: Urbana, University of Illinois, M.S. thesis. J.S. Soil Conservation Service, published soil survey maps of individual Wagner, W. R., and others, 1970, Geology of the Pittsburgh area: Pennsylvania Geological Survey, Fourth Series, General Geology Report G59, 145 p White, G. W., 1971, Thickness of Wisconsinan tills in Grand River and Killbuck lobes, northeastern Ohio and northwestern Pennsulvania, in Goldthwait, R. F. Forsyth, J. L., Gross, D. L., and Pessl, Fred, Jr., editors, Till-A symposium: Columbus, Ohio State University Press, p. 149–163.

White, G. W., Totten, S. M., and Gross, D. L., 1969, Pleistocene stratigraphy northwestern Pennsylvania: Pennsylvania Geological Survey Bulletin G55, 88 p. npublished map information: Davies, W. E., U.S. Geological Survey, unpublished map of landslides and strip mines, Clarksburg 1° × 2° quadrangle, Pennsylvania, scale 1:250,000.

Hardeman, W. D., Miller, R. A., and Swingle, G. D., 1966, Geologic map of Tennessee: Tennessee Department of Conservation, Division of Geology,

Division of Mineral Resources, Bulletin 81, 78 p.

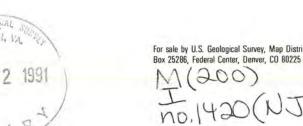
Mineral Resources, Reports of Investigations 37, 40 p.

3 1818 00124267 4

Allen, R. M., 1967, Geology and mineral resources of Page County: Virginia Amato, R. V., 1974, Geology of the Salem quadrangle, Virginia: Virginia Division of

Economic Survey, 384 p.

Geological and Economic Survey, 624 p.



QUATERNARY GEOLOGIC MAP OF THE BLUE RIDGE 4° × 6° QUADRANGLE, UNITED STATES

State compilations by Alan D. Howard, Robert E. Behling, Walter H. Wheeler, Raymond B. Daniels, W C Swadley, Gerald M. Richmond, Richard P. Goldthwait, David S. Fullerton William D. Sevon, and Robert A. Miller

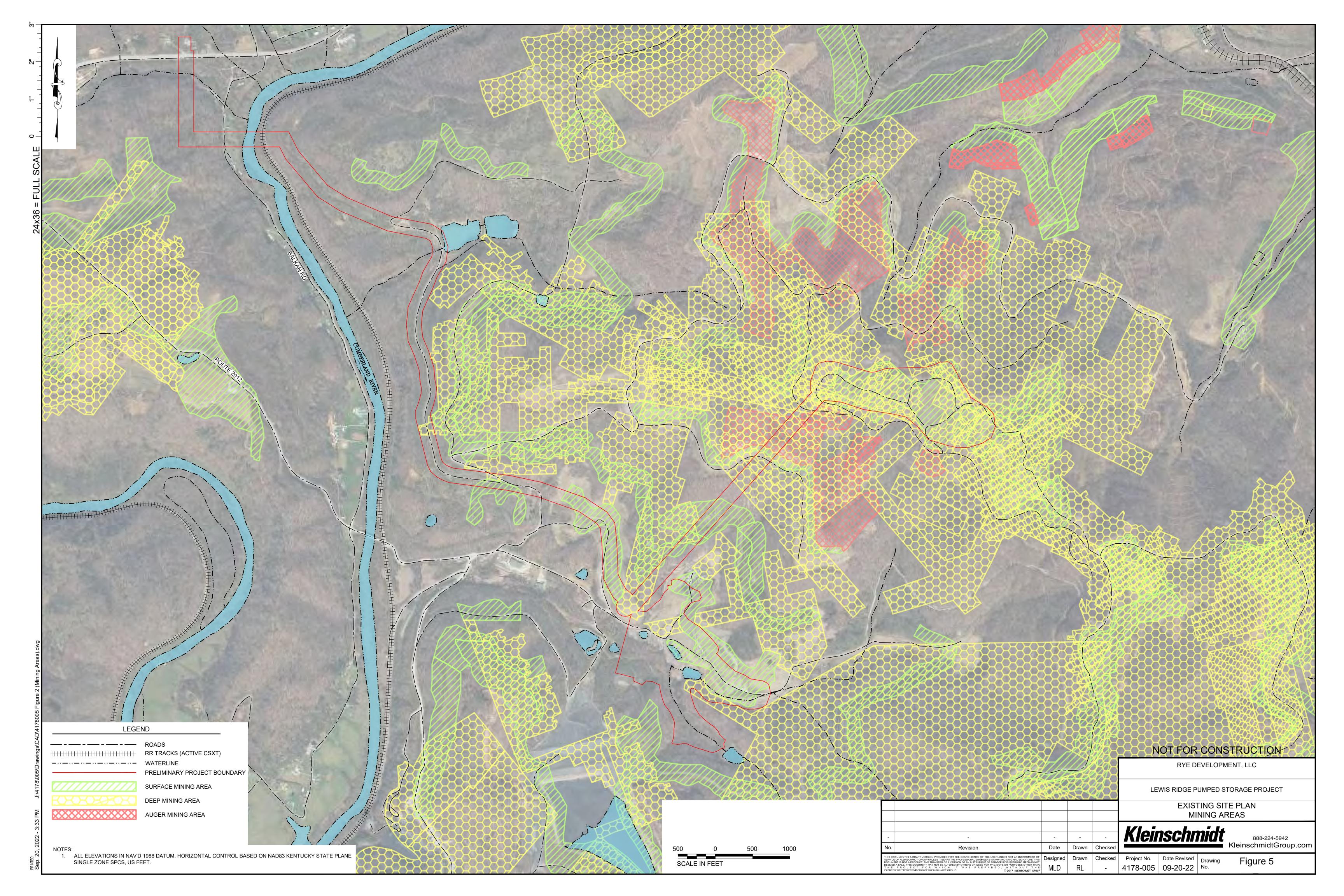
Edited and integrated by Gerald M. Richmond, David S. Fullerton, and Ann Coe Christiansen

1991

OUATERNARY GEOLOGIC ATLAS OF THE UNITED STATES

APPENDIX C

MINING MAP



APPENDIX D

USDA NRCS PHYSICAL SOIL PROPERTIES OF BELL AND HARLAN COUNTIES,
KENTUCKY

Bell and Harlan Counties, Kentucky

[Entries under "Erosion Factors--T" apply to the entire profile. Entries under "Wind Erodibility Group" and "Wind Erodibility Index" apply only to the surface layer. Absence of an entry indicates that data were not estimated. This report shows only the major soils in each map unit]

Man ayundad					Moist	Saturated	Available	Linear	Organic	Ero	sion fac	tors	Wind	Win
Map symbol and soil name	Depth	Sand	Silt	Clay	bulk density	hydraulic conductivity	water capacity	extensi- bility	matter	Kw	Kf	Т	erodi- bility group	erod bility inde
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct				•	
AgB:														
Allegheny	0-8	20-52	28-65	10-27	1.43-1.48	4.00-14.00	0.17-0.21	0.4-1.4	1.0-4.0	.32	.32	5	5	56
• ,	8-33	20-60	20-65	12-35	1.44-1.63	4.00-14.00	0.15-0.19	0.5-2.5	0.0-0.5	.37	.37			
	33-42	30-70	15-60	5-35	1.61-1.65	4.00-14.00	0.11-0.15	0.2-2.5	0.0-0.5	.32	.32			
	42-72	30-70	15-50	5-35	1.44-1.62	4.00-14.00	0.11-0.15	0.1-2.5	0.0-0.5	.37	.37			
	72-82	35-75	10-50	5-35	1.49-1.68	4.00-14.00	0.10-0.15	0.1-2.5	0.0-0.5	.32	.32			
AtF:														
Alticrest	0-2			8-18	1.40-1.55	14.00-42.00	0.12-0.18	0.0-2.9	1.0-3.0	.17	.17	2	3	86
	2-33			8-18	1.40-1.55	14.00-42.00	0.10-0.16	0.0-2.9	0.0-0.5	.24	.37			
	33-43													
Helechawa	0-5			4-15	1.10-1.40	14.00-42.00	0.10-0.18	0.0-2.9	2.0-10	.15	.15	5	3	86
	5-49			7-18	1.35-1.70	14.00-42.00	0.08-0.14	0.0-2.9	0.8-1.5	.24	.24			
	49-63			5-15	1.50-1.70	14.00-42.00	0.08-0.13	0.0-2.9	0.3-0.8	.28	.28			
	63-73													
Totz	0-7			3-12	1.15-1.35	42.00-141.00	0.07-0.12	0.0-2.9	1.0-5.0	.32	.32	1	3	86
	7-18			3-12	1.50-1.70	42.00-141.00	0.05-0.11	0.0-2.9	0.0-0.8	.37	.37			
	18-28													
CgF:														
Cloverlick	0-2				0.05-0.10	42.00-141.00	0.15-0.45		61-78			5	7	38
	2-8	23-52	28-50	7-27	1.05-1.52	14.11-42.34	0.11-0.15	0.2-1.7	0.5-3.0	.10	.20			
	8-24	18-45	28-65	7-27	1.25-1.52	4.23-42.34	0.12-0.16	0.1-1.7	0.3-0.7	.24	.37			
	24-43	20-52	28-65	7-27	1.25-1.52	14.11-42.34	0.07-0.11	0.1-2.1	0.0-1.0	.15	43			
	43-80	28-60	28-60	5-35	1.00-1.50	4.23-42.34	0.05-0.09	0.0-2.1	0.3-0.7	.10	.37			



Map symbol					Moist	Saturated	Available	Linear	Organic	Eros	sion fac	tors	Wind	Win erod
and soil name	Depth	Sand	Silt	Clay	bulk density	hydraulic conductivity	water capacity	extensi- bility	matter	Kw	Kf	Т	erodi- bility group	bilit inde
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct				•	
CgF:														
Guyandotte	0-2				0.20-0.35	42.00-141.00	0.15-0.39		30-90			5	6	48
	2-5				0.26-0.35	42.00-141.00	0.15-0.38		30-90					
	5-15	52-75	8-35	5-20	1.08-1.53	4.00-42.00	0.07-0.11	0.1-0.7	2.0-10	.02	.05			
	15-67	30-70	15-55	3-20	1.35-1.60	4.00-42.00	0.03-0.07	0.0-1.0	0.2-1.5	.05	.24			
Highsplint	0-1				0.05-0.10	42.00-141.00	0.15-0.43		61-78			5	8	0
	1-4	15-35	50-65	10-27	1.22-1.46	4.23-42.34	0.08-0.12	0.2-1.3	0.5-5.0	.10	.32			
	4-11	15-35	40-65	18-34	1.39-1.48	4.23-42.34	0.07-0.11	0.4-2.0	0.3-0.7	.10	.37			
	11-28	15-35	40-65	18-34	1.39-1.53	4.23-42.34	0.07-0.11	0.4-2.0	0.3-0.7	.10	.37			
	28-48	15-40	35-60	18-34	1.39-1.44	4.23-42.34	0.07-0.11	0.4-2.0	0.3-0.7	.10	.37			
	48-85	15-50	28-50	7-40	1.40-1.58	1.41-14.11	0.07-0.11	0.1-2.7	0.2-0.7	.10	.43			
Cr:														
Craigsville, occasionally	0-9			5-15	1.20-1.40	14.11-141.14	0.07-0.15	0.0-2.9	1.0-5.0	.10	.17	3	5	56
flooded	9-20			5-15	1.30-1.60	14.11-141.14	0.06-0.15	0.0-2.9	0.5-1.0	.15	.28			
	20-60			5-10	1.35-1.55	42.34-141.14	0.04-0.09	0.0-2.9	0.5-1.0	.05	.24			
Philo, occasionally flooded	0-9			10-18	1.20-1.40	14.11-42.34	0.10-0.14	0.0-2.9	2.0-4.0	.17	.17	5	3	86
	9-60			5-18	1.20-1.40	4.23-14.11	0.10-0.20	0.0-2.9	0.0-0.5	.55	.55			
Du:														
Dumps, mine (tailings & tipples)														
FbC:														
Fairpoint, unstable fill	0-3			18-27	1.40-1.55	4.23-14.11	0.09-0.18	0.0-2.9	0.0-0.5	.20	.43	5	7	38
	3-60			18-35	1.60-1.80	1.41-4.23	0.03-0.10	3.0-5.9	0.0-0.5	.05	.49			
Bethesda, unstable fill	0-7			18-27	1.40-1.55	4.23-14.11	0.10-0.16	0.0-2.9	0.0-0.5	.15	.37	5	8	0
	7-60			18-35	1.60-1.90	1.41-4.23	0.04-0.13	0.0-2.9	0.0-0.5	.10	.37			



Map symbol					Moist	Saturated	Available	Linear	Organic	Ero	sion fac	tors	Wind	Win
and soil name	Depth	Sand	Silt	Clay	bulk density	hydraulic conductivity	water capacity	extensi- bility	matter	Kw	Kf	Т	erodi- bility group	eroc bilit inde
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
FbF:														
Fairpoint, unstable fill	0-11	24-52	28-50	7-27	1.35-1.50	4.23-14.11	0.14-0.20	0.3-2.3	0.5-2.0	.20	.37	3	7	38
	11-32	10-52	28-60	7-40	1.60-1.80	1.40-4.00	0.03-0.10	0.2-2.9	0.0-0.3	.10	.43			
	32-41	20-52	28-60	7-27	1.60-1.80	1.40-4.00	0.00-0.10	0.0-1.7	0.0-0.3	.10	.43			
	41-51	20-52	28-60	7-27	1.60-1.80	1.40-4.00	0.01-0.10	0.0-1.0	0.0-0.3	.05	.43			
	51-58	20-52	28-60	7-27	1.60-1.80	1.40-4.00	0.01-0.10	0.0-1.0	0.0-0.3	.10	.49			
	58-72	20-52	28-60	7-27	1.60-1.80	1.40-4.00	0.01-0.10	0.0-1.0	0.0-0.3	.05	.43			
Bethesda, unstable fill	0-12	18-52	28-60	7-40	1.35-1.50	4.23-14.11	0.14-0.20	0.3-4.0	0.5-5.0	.20	.37	5	7	38
	12-36	10-52	28-60	7-40	1.60-1.80	1.40-4.00	0.03-0.10	0.1-3.2	0.0-5.0	.15	.37			
	36-58	10-52	28-60	7-35	1.60-1.80	1.40-4.00	0.03-0.10	0.1-2.5	0.0-5.0	.15	.37			
	58-72	20-52	28-60	7-35	1.60-1.80	1.40-4.00	0.01-0.10	0.0-2.5	0.0-5.0	.10	.28			
GsD:														
Gilpin	0-6			15-27	1.20-1.40	4.23-14.11	0.18-0.22	0.0-2.9	1.0-3.0	.32	.32	3	6	48
	6-28			20-35	1.20-1.45	4.23-14.11	0.08-0.16	0.0-2.9	0.0-0.5	.24	.43			
	28-38													
Shelocta	0-12			10-27	1.15-1.30	4.00-14.00	0.16-0.22	0.0-2.9	0.5-5.0	.32	.32	3	5	56
	12-48			18-45	1.30-1.55	4.00-14.00	0.10-0.20	0.0-2.9	0.0-0.5	.43	.43			
	48-58													
GtF:														
Gilpin, very stony	0-1				0.05-0.10	42.00-141.00	0.00-0.30		52-86			2	5	56
	1-5	10-43	30-70	7-27	1.01-1.45	4.00-14.00	0.12-0.18	0.2-1.7	2.0-4.0	.24	.37			
	5-11	10-52	28-70	18-27	1.20-1.61	4.00-14.00	0.08-0.12	0.7-1.8	1.0-2.0	.28	.49			
	11-20	10-45	28-65	18-35	1.20-1.80	4.00-14.00	0.08-0.12	0.7-3.1	0.3-1.0	.32	.55			
	20-28	10-45	28-65	15-35	1.20-1.80	4.00-14.00	0.08-0.12	0.6-3.8	0.0-0.5	.24	.49			
	28-38					0.01-0.10								



Map symbol					Moist	Saturated	Available	Linear	Organic	Ero	sion fac	tors	Wind erodi-	Wind erodi
and soil name	Depth	Sand	Silt	Clay	bulk density	hydraulic conductivity	water capacity	extensi- bility	matter	Kw	Kf	Т	bility group	bility index
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct				L	<u> </u>
GtF:														
Rayne, very stony	0-1				0.05-0.10	42.00-141.00	0.00-0.30		52-86			4	5	56
	1-2	10-45	45-70	10-27	0.50-1.00	4.00-14.00	0.16-0.22	0.4-1.7	1.0-4.0	.37	.37			
	2-7	10-45	28-65	10-27	1.30-1.60	4.00-14.00	0.10-0.20	0.4-1.9	0.5-3.0	.43	.43			
	7-17	10-45	28-62	15-35	1.30-1.50	4.00-14.00	0.08-0.16	0.5-2.0	0.3-0.8	.49	.49			
	17-24	10-45	28-65	18-35	1.40-1.80	4.00-14.00	0.08-0.16	0.3-1.9	0.3-0.8	.49	.49			
	24-31	10-45	28-65	18-35	1.40-1.80	4.00-14.00	0.08-0.16	0.3-2.1	0.0-0.8	.24	.43			
	31-44	10-32	41-70	18-27	1.35-1.46	4.00-14.00	0.08-0.16	0.4-1.0	0.0-0.3	.17	.49			
	44-54					0.00-0.01								
Sequoia, very stony	0-1				0.05-0.10	42.00-141.00	0.00-0.30		52-86			3	5	56
	1-5	6-39	34-72	15-27	1.00-1.42	4.23-14.11	0.17-0.20	0.0-2.9	0.5-2.0	.49	.49			
	5-12	6-39	16-55	27-45	1.31-1.50	1.41-4.23	0.08-0.16	0.0-5.9	0.0-0.5	.43	.43			
	12-20	6-39	6-45	35-55	1.31-1.45	1.41-4.23	0.08-0.16	0.0-5.9	0.0-0.5	.28	.28			
	20-34	6-39	6-45	35-55	1.31-1.45	1.41-4.23	0.08-0.16	0.0-5.9	0.0-0.5	.28	.28			
	34-44					0.00-1.41								
HeF:														
Helechawa	0-1				0.22-0.27	42.00-141.00	0.15-0.45		61-78			5	2	134
	1-3	40-90	2-50	4-15	0.70-1.43	14.00-42.00	0.10-0.14	0.1-0.9	4.0-20	.05	.05			
	3-12	40-90	2-50	4-15	1.40-1.53	14.00-42.00	0.13-0.17	0.1-0.7	1.3-4.0	.15	.15			
	12-45	40-85	2-50	4-17	1.43-1.67	14.00-42.00	0.11-0.15	0.1-0.9	0.1-1.3	.28	.28			
	45-80	40-90	2-50	4-27	1.45-1.64	14.00-42.00	0.10-0.14	0.1-1.4	0.1-1.0	.17	.17			
Varilla	0-2				0.22-0.27	42.00-141.00	0.15-0.45		61-78			3	5	56
	2-5	30-70	20-67	2-27	1.29-1.48	14.00-42.00	0.10-0.14	0.0-1.2	0.7-6.0	.10	.20			
	5-12	30-70	28-67	2-27	1.48-1.60	14.00-42.00	0.09-0.13	0.0-1.1	0.5-2.0	.17	.32			
	12-22	30-70	28-64	2-27	1.48-1.63	14.00-42.00	0.06-0.10	0.0-0.9	0.1-1.0	.15	.37			
	22-36	30-70	21-64	2-27	1.43-1.60	14.00-42.00	0.05-0.09	0.0-0.9	0.1-1.0	.10	.37			
	36-47	40-76	21-50	3-18	1.43-1.60	14.00-42.00	0.03-0.07	0.0-0.6	0.1-0.5	.05	.28			
	47-66	43-90	5-50	2-18	1.43-1.60	14.00-141.00	0.01-0.03	0.0-0.6	0.1-0.5	.02	.17			



Map symbol					Moist	Saturated	Available	Linear	Organic	Ero	sion fac	tors	Wind erodi-	Win erod
and soil name	Depth	Sand	Silt	Clay	bulk density	hydraulic conductivity	water capacity	extensi- bility	matter	Kw	Kf	Т	bility group	bility inde
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct				•	
HeF:														
Jefferson	0-1				0.22-0.27	42.00-141.00	0.15-0.45		61-78			5	6	48
	1-10	24-70	10-65	10-20	1.34-1.47	14.11-42.34	0.14-0.18	0.3-0.9	0.8-5.0	.20	.32			
	10-24	21-70	10-53	10-27	1.48-1.55	14.11-42.34	0.13-0.17	0.3-1.3	0.4-0.8	.43	.43			
	24-41	21-70	10-53	10-27	1.54-1.64	14.11-42.34	0.13-0.17	0.3-1.3	0.2-0.4	.43	.43			
	41-81	28-75	20-50	5-30	1.50-1.58	14.11-42.34	0.08-0.12	0.1-1.2	0.1-0.2	.15	.37			
HsF:														
Highsplint	0-4			15-27	1.10-1.30	4.23-42.34	0.07-0.15	0.0-2.9	0.5-5.0	.10	.32	5	8	0
- '	4-48			18-34	1.30-1.55	4.23-42.34	0.07-0.13	0.0-2.9	0.3-0.7	.10	.43			
	48-60			18-34	1.55-1.70	1.41-14.11	0.05-0.11	0.0-2.9	0.2-0.7	.15	.43			
Cloverlick	0-11			18-27	1.00-1.20	4.00-14.00	0.20-0.24	0.0-2.9	5.0-15	.10	.20	5	8	0
	11-45			15-30	1.30-1.50	4.00-14.00	0.12-0.20	0.0-2.9	0.3-0.8	.10	.37			
	45-60			15-30	1.30-1.60	4.00-14.00	0.05-0.12	0.0-2.9	0.0-0.5	.10	.37			
Guyandotte	0-13			5-27	1.00-1.30	4.00-14.00	0.10-0.16	0.0-2.9	2.0-10	.10	.37	5	8	0
•	13-60			5-27	1.30-1.60	4.00-14.00	0.05-0.15	0.0-2.9	0.3-0.8	.10	.43			
Ph:														
Philo, occasionally flooded	0-9			10-18	1.20-1.40	14.11-42.34	0.10-0.14	0.0-2.9	2.0-4.0	.17	.17	3	3	86
·	9-37			10-18	1.20-1.40	4.23-14.11	0.10-0.20	0.0-2.9	0.0-0.5	.28	.28			
	37-60			5-18	1.20-1.40	14.00-42.00	0.06-0.10	0.0-2.9	0.0-0.5	.05	.32			
Po:														
Pope, occasionally flooded	0-4			5-15	1.20-1.40	14.00-42.00	0.10-0.16	0.0-2.9	1.0-4.0	.20	.20	4	3	86
•	4-23			5-18	1.30-1.60	4.00-42.00	0.10-0.18	0.0-2.9	0.3-0.8	.32	.32			
	23-59			5-20	1.30-1.60	4.00-42.00	0.10-0.18	0.0-2.9	0.0-0.5	.20	.20			
	59-62			5-20	1.30-1.60	4.00-42.00	0.10-0.18	0.0-2.9	0.0-0.5	.02	.10			



Map symbol					Moist	Saturated	Available	Linear	Organic	Ero	sion fac	ctors	Wind erodi-	Win erod
and soil name	Depth	Sand	Silt	Clay	bulk density	hydraulic conductivity	water capacity	extensi- bility	matter	Kw	Kf	Т	bility group	bilit inde
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
Sb:														
Shelbiana, occasionally	0-15			10-27	1.20-1.40	4.23-14.11	0.12-0.22	0.0-2.9	2.0-6.0	.32	.32	5	5	56
flooded	15-70			18-34	1.20-1.50	4.23-14.11	0.12-0.22	0.0-2.9	0.3-0.8	.43	.43			
SgE:														
Shelocta	0-6			10-27	1.15-1.30	4.23-14.11	0.16-0.22	0.0-2.9	0.5-5.0	.32	.32	3	5	56
	6-33			20-34	1.30-1.55	4.23-14.11	0.10-0.20	0.0-2.9	0.5-2.0	.43	.43			
	33-58			15-45	1.30-1.55	4.23-42.34	0.08-0.16	0.0-2.9	0.0-0.5	.24	.43			
	58-68													
Gilpin	0-6			15-27	1.20-1.40	4.23-14.11	0.18-0.22	0.0-2.9	1.0-3.0	.32	.32	3	6	48
	6-26			18-35	1.20-1.45	4.23-14.11	0.08-0.16	0.0-2.9	0.0-0.5	.43	.43			
	26-36													
ShF:														
Shelocta, very stony	0-1				0.15-0.30	42.00-141.00	0.27-0.38		52-86			4	5	56
	1-3	10-35	50-70	10-27	1.26-1.39	4.00-14.00	0.12-0.22	0.6-2.9	1.0-10	.32	.32			
	3-7	10-45	28-65	10-27	1.31-1.42	4.00-14.00	0.11-0.17	0.5-2.8	0.5-3.0	.37	.37			
	7-23	20-45	28-62	18-35	1.34-1.50	4.00-14.00	0.11-0.19	0.7-2.6	0.3-1.0	.32	.43			
	23-34	10-45	28-65	18-35	1.42-1.53	4.00-14.00	0.07-0.19	0.4-2.7	0.3-0.8	.28	.49			
	34-45	10-45	28-65	18-35	1.42-1.53	4.00-14.00	0.08-0.20	0.4-2.9	0.1-0.5	.17	.43			
	45-59	10-32	50-70	18-27	1.35-1.46	4.00-14.00	0.00-0.18	0.5-1.7	0.0-0.3	.64	.64			
	59-69					0.00-0.01								
Highsplint, very stony	0-1				0.05-0.10	42.00-141.00	0.14-0.26		61-78			5	8	0
	1-4	13-32	50-64	7-27	1.22-1.46	4.23-42.34	0.07-0.14	0.2-1.3	0.5-5.0	.10	.32			
	4-11	13-40	35-64	18-34	1.39-1.48	4.23-42.34	0.07-0.14	0.4-2.0	0.3-0.7	.10	.37			
	11-28	13-35	42-62	18-34	1.39-1.53	4.23-42.34	0.07-0.13	0.4-2.0	0.3-0.7	.10	.37			
	28-48	18-40	40-62	18-34	1.39-1.44	4.23-42.34	0.07-0.15	0.4-2.0	0.3-0.7	.10	.37			
	48-85	18-40	40-62	18-34	1.40-1.58	1.41-14.11	0.07-0.15	0.4-2.0	0.2-0.7	.10	.43			



Map symbol					Moist	Saturated	Available	Linear	Organia	Ero	sion fac	tors	Wind erodi-	Wind erodi
and soil name	Depth	Sand	Silt	Clay	bulk density	hydraulic conductivity	water capacity	extensi- bility	Organic matter	Kw	Kf	Т	bility group	bility inde
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
ShF:														
Gilpin, very stony	0-1				0.05-0.10	42.00-141.00	0.25-0.34		52-86			2	6	48
	1-5	10-40	50-70	7-27	1.01-1.45	4.00-14.00	0.11-0.17	0.1-1.5	2.0-4.0	.24	.37			
	5-11	10-50	30-70	18-27	1.20-1.61	4.00-14.00	0.10-0.20	0.7-1.8	1.0-2.0	.28	.49			
	11-20	10-45	24-70	18-35	1.20-1.80	4.00-14.00	0.10-0.23	0.7-3.1	0.3-1.0	.32	.55			
	20-28	10-45	28-70	15-40	1.20-1.80	4.00-14.00	0.00-0.23	0.6-4.8	0.0-0.5	.24	.49			
	28-38					0.01-0.10								
SkF:														
Shelocta, very stony	0-1				0.05-0.10	42.00-141.00	0.00-0.30		52-86			4	5	56
	1-3	10-45	45-70	10-27	0.50-1.00	4.00-14.00	0.16-0.22	0.3-2.6	2.0-12	.32	.32			
	3-7	10-45	28-65	10-27	1.30-1.60	4.00-14.00	0.10-0.20	0.4-1.9	1.5-5.0	.32	.32			
	7-23	20-45	28-62	18-35	1.30-1.50	4.00-14.00	0.08-0.16	0.5-2.0	1.0-2.0	.28	.43			
	23-34	10-45	28-65	18-35	1.40-1.80	4.00-14.00	0.08-0.16	0.3-1.9	0.3-0.8	.28	.49			
	34-45	10-45	28-65	18-35	1.40-1.80	4.00-14.00	0.08-0.16	0.3-2.1	0.0-0.8	.17	.43			
	45-59	8-32	50-70	18-27	1.35-1.46	4.00-14.00	0.08-0.16	0.4-1.0	0.0-0.3	.64	.64			
	59-69					0.00-0.01								
Kimper, very stony	0-2				0.05-0.10	42.00-141.00	0.00-0.03		61-78			5	7	38
	2-8	23-52	28-50	8-27	1.00-1.50	14.11-42.34	0.09-0.15	0.2-1.9	0.5-3.0	.10	.24			
	8-13	20-65	20-70	8-27	1.00-1.50	14.11-42.34	0.09-0.15	0.2-1.3	0.5-1.8	.17	.37			
	13-27	20-65	20-65	8-27	1.25-1.60	14.11-42.34	0.07-0.15	0.2-1.5	0.0-1.0	.24	.43			
	27-41	20-65	20-65	8-27	1.25-1.50	14.11-42.34	0.07-0.15	0.3-1.9	0.0-1.0	.20	.37			
	41-52	20-65	20-65	8-35	1.25-1.50	14.11-42.34	0.07-0.15	0.2-2.7	0.0-1.0	.15	.37			
	52-64	20-65	20-70	8-35	1.25-1.60	14.11-42.34	0.07-0.15	0.2-2.7	0.0-1.0	.15	.37			
	64-75	20-65	20-70	8-35	1.25-1.50	14.11-42.34	0.07-0.15	0.2-2.7	0.0-1.0	.15	.49			
	75-85					0.42-1.40								



Map symbol					Moist	Saturated	Available	Linear	Organic	Ero	sion fac	tors	Wind erodi-	Wind erodi-
and soil name	Depth	Sand	Silt	Clay	bulk density	hydraulic conductivity	water capacity	extensi- bility	matter	Kw	Kf	Т	bility group	bility index
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct		<u> </u>			•
SkF:														
Cloverlick, very stony	0-2				0.05-0.10	42.00-141.00	0.00-0.03		61-78			5	7	38
	2-8	23-52	28-50	8-27	1.00-1.50	14.11-42.34	0.09-0.15	0.2-1.7	0.5-3.0	.10	.20			
	8-24	18-45	28-65	8-27	1.00-1.50	4.23-42.34	0.07-0.13	0.2-3.0	0.3-0.7	.24	.37			
	24-43	20-52	28-65	8-27	1.00-1.50	14.11-42.34	0.07-0.15	0.0-1.6	0.0-1.0	.15	.43			
	43-80	40-60	8-52	8-35	1.00-1.50	4.23-42.34	0.03-0.13	0.0-2.1	0.3-0.7	.10	.37			
SmF:														
Shelocta	0-8			10-25	1.15-1.30	4.00-14.00	0.16-0.22	0.0-2.9	0.5-5.0	.32	.32	3	5	56
	8-31			18-34	1.30-1.55	4.00-14.00	0.10-0.20	0.0-2.9	0.3-0.8	.28	.43			
	31-55			15-34	1.30-1.55	4.00-14.00	0.08-0.16	0.0-2.9	0.0-0.5	.24	.43			
	55-65													
Kimper	0-7			12-27	1.00-1.40	4.23-42.34	0.13-0.20	0.0-2.9	2.0-15	.15	.28	5	6	48
	7-48			18-30	1.20-1.70	4.23-14.11	0.13-0.20	0.0-2.9	0.5-2.0	.24	.43			
	48-62			12-20	1.20-1.70	4.23-42.34	0.10-0.16	0.0-2.9	0.0-0.5	.37	.64			
	62-72													
Cutshin	0-17			12-27	1.20-1.40	4.23-14.11	0.08-0.16	0.0-2.9	3.0-7.0	.28	.28	3	5	56
	17-60			12-27	1.20-1.40	4.23-14.11	0.08-0.16	0.0-2.9	0.5-2.0	.15	.37			
Ud:														
Udorthents, unstable fill														
Urban land														
UrE:														
Udorthents, unstable fill														
Urban land														



Map symbol					Moist	Saturated	Available	Linear	Organic	Ero	sion fac	tors	Wind erodi-	Wind erodi-
and soil name	Depth	Sand	Silt	Clay	bulk density	hydraulic conductivity	water capacity	extensi- bility	matter	Kw	Kf	Т	bility group	bility index
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct				•	•
VrD:														
Varilla	0-5			3-20	1.00-1.40	14.11-42.34	0.10-0.13	0.0-2.9	1.0-6.0	.05	.15	5	7	38
	5-31			3-20	1.45-1.65	14.11-42.34	0.05-0.10	0.0-2.9	0.5-1.5	.10	.32			
	31-60			3-20	1.45-1.65	14.11-141.14	0.01-0.05	0.0-2.9	0.0-0.5	.05	.24			
W:														
Water														



APPENDIX E RARE SPECIES INFORMATION



United States Department of the Interior



FISH AND WILDLIFE SERVICE

Kentucky Ecological Services Field Office J C Watts Federal Building, Room 265 330 West Broadway Frankfort, KY 40601-8670 Phone: (502) 695-0468 Fax: (502) 695-1024

In Reply Refer To:

August 23, 2022

Project Code: 2022-0077606

Project Name: Lewis Ridge Pumped Storage Project

Subject: List of threatened and endangered species that may occur in your proposed project

location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)

(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see https://www.fws.gov/birds/policies-and-regulations.php.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures see https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds.php.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/birds/policies-and-regulations/executive-orders/e0-13186.php.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

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Attachment	C	١.
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Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Kentucky Ecological Services Field Office J C Watts Federal Building, Room 265 330 West Broadway Frankfort, KY 40601-8670 (502) 695-0468

Project Summary

Project Code: 2022-0077606

Project Name: Lewis Ridge Pumped Storage Project

Project Type: Dam - New Construction

Project Description: The project is located within the communities of Blackmont, Tejay,

Balkan, and Callaway, Kentucky adjacent to the Cumberland River in Bell County, Kentucky. The project is a proposed pumped storage hydroelectric generating facility, which will involve the construction of new water storage, water conveyance, and generation facilities at off-

channel locations where no such facilities exist at this time.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@36.7659582,-83.54975996325211,14z



Counties: Bell County, Kentucky

Endangered Species Act Species

There is a total of 4 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 3 of these species should be considered only under certain conditions.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries¹, as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an
office of the National Oceanic and Atmospheric Administration within the Department of
Commerce.

Mammals

NAME STATUS

Gray Bat *Myotis grisescens*

Endangered

No critical habitat has been designated for this species.

This species only needs to be considered under the following conditions:

The project area includes potential gray bat habitat.

Species profile: https://ecos.fws.gov/ecp/species/6329

General project design guidelines:

 $\frac{https://ipac.ecosphere.fws.gov/project/KFABX7SDJVCNXEIUNJI4GRMDMI/documents/generated/6422.pdf}{}$

Indiana Bat Myotis sodalis

Endangered

There is **final** critical habitat for this species. The location of the critical habitat is not available. This species only needs to be considered under the following conditions:

- The project area includes 'potential' habitat. All activities in this location should consider possible effects to this species.
- The project area includes known 'swarming 1' habitat.

Species profile: https://ecos.fws.gov/ecp/species/5949

General project design guidelines:

 $\frac{https://ipac.ecosphere.fws.gov/project/KFABX7SDJVCNXEIUNJI4GRMDMI/documents/generated/6422.pdf$

Northern Long-eared Bat Myotis septentrionalis

Threatened

No critical habitat has been designated for this species.

This species only needs to be considered under the following conditions:

• The specified area includes areas in which incidental take would not be prohibited under the 4(d) rule. For reporting purposes, please use the "streamlined consultation form," linked to in the "general project design guidelines" for the species.

Species profile: https://ecos.fws.gov/ecp/species/9045

General project design guidelines:

https://ipac.ecosphere.fws.gov/project/KFABX7SDJVCNXEIUNJI4GRMDMI/documents/generated/6422.pdf

Insects

NAME STATUS

Monarch Butterfly *Danaus plexippus*

Candidate

No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

IPaC User Contact Information

Agency: RESPEC
Name: Michael Ricci
Address: 146 E 3rd St
City: Lexington

State: KY Zip: 40508

Email michael.ricci@respec.com

Phone: 8593614540

Lead Agency Contact Information

Lead Agency: Army Corps of Engineers



Species Information

State Threatened, Endangered, and Special Concern Species observations for selected counties

Linked life history provided courtesy of NatureServe Explorer.

Records may include both recent and historical observations.

US Status Definitions Kentucky Status Definitions

List State Threatened, Endangered, and Special Concern Species observations in 1 selected county. Selected county is: Bell.

Scientific Name and Life History	Common Name and Pictures	Class	County	US Status	KY Status	WAP	Reference
Accipiter striatus	Sharp-shinned Hawk	Aves	Bell	N	S	Yes	Reference
Anguispira rugoderma	Pine Mountain Disc	Gastropoda	Bell	N	Е		Reference
Anodontoides denigrata	Cumberland Papershell	Bivalvia	Bell	N	E	Yes	Reference
Callophrys irus	Frosted Elfin	Insecta	Bell	N	Е		Reference
Calopteryx dimidiata	Sparkling Jewelwing	Insecta	Bell	N	E		Reference
Cambarus buntingi	Longclaw Crayfish	Malacostraca	Bell	N	Т	Yes	Reference
Cambarus guenteri	Redbird Crayfish	Malacostraca	Bell	N	S		Reference
Cambarus parvoculus	Mountain Midget Crayfish	Malacostraca	Bell	N	S	Yes	Reference
Cardellina canadensis	Canada Warbler	Aves	Bell	N	S	Yes	Reference
Cemophora coccinea	Scarletsnake	Reptilia	Bell	N	S	Yes	Reference
Centronyx henslowii	Henslow's Sparrow	Aves	Bell	N	S	Yes	Reference
Certhia americana	Brown Creeper	Aves	Bell	N	Т		Reference
Cheumatopsyche helma	Helma's Net- spinning Caddisfly	Insecta	Bell	N	Н		Reference
Chrosomus cumberlandensis	Blackside Dace	Actinopterygii	Bell	Т	Т	Yes	Reference

Circus hudsonius	Northern Harrier	Aves	Bell	N	Т	Yes	Reference
Corvus corax	Common Raven	Aves	Bell	N	Т	Yes	Reference
Cryptobranchus alleganiensis alleganiensis	Eastern Hellbender	Amphibia	Bell	N	S	Yes	Reference
Empidonax minimus	Least Flycatcher	Aves	Bell	N	E	Yes	Reference
Etheostoma sagitta	Cumberland Arrow Darter	Actinopterygii	Bell	С	S	Yes	Reference
Falco peregrinus	Peregrine Falcon	Aves	Bell	N	E	Yes	Reference
Fumonelix wetherbyi	Clifty Covert	Gastropoda	Bell	N	S		Reference
Haliaeetus leucocephalus	Bald Eagle	Aves	Bell	N	S	Yes	Reference
Junco hyemalis	Dark-eyed Junco	Aves	Bell	N	S		Reference
Lampsilis ovata	Pocketbook	Bivalvia	Bell	N	E	Yes	Reference
Lophodytes cucullatus	Hooded Merganser	Aves	Bell	N	Т	Yes	Reference
Lytrosis permagnaria	A Geometrid Moth	Insecta	Bell	N	E		Reference
Manophylax butleri	A Limnephilid Caddisfly	Insecta	Bell	N	S		Reference
Myodes gapperi maurus	Kentucky Red- backed Vole	Mammalia	Bell	N	S	Yes	Reference
Myotis grisescens	Gray Myotis	Mammalia	Bell	E	Т	Yes	Reference
Myotis leibii	Eastern Small- footed Myotis	Mammalia	Bell	N	Т	Yes	Reference
Myotis lucifugus	Little Brown Bat	Mammalia	Bell	N	Т	Yes	Reference
Myotis septentrionalis	Northern Myotis	Mammalia	Bell	Т	E	Yes	Reference
Ophisaurus attenuatus Iongicaudus	Eastern Slender Glass Lizard	Reptilia	Bell	N	Т	Yes	Reference
Pandion haliaetus	Osprey	Aves	Bell	N	S	Yes	Reference
Passerculus sandwichensis	Savannah Sparrow	Aves	Bell	N	S	Yes	Reference
Patera panselenus	Virginia Bladetooth	Gastropoda	Bell	N	S		Reference
Perimyotis subflavus	Eastern Pipistrelle	Mammalia	Bell	N	Т	Yes	Reference

Peucaea aestivalis	Bachman's Sparrow	Aves	Bell	N	E	Yes	Reference
Phalacrocorax auritus	Double-crested Cormorant	Aves	Bell	N	S		Reference
Pheucticus Iudovicianus	Rose-breasted Grosbeak	Aves	Bell	N	S		Reference
Plestiodon anthracinus	Coal Skink	Reptilia	Bell	N	E	Yes	Reference
Plestiodon inexpectatus	Southeastern Five- lined Skink	Reptilia	Bell	N	S	Yes	Reference
Plethodon pauleyi	Yellow-spotted Woodland Salamander	Amphibia	Bell	N	E	Yes	Reference
Podilymbus podiceps	Pied-billed Grebe	Aves	Bell	N	E	Yes	Reference
Polygonia faunus	Green Comma	Insecta	Bell	N	Н		Reference
Pseudanophthalmus frigidus	Icebox Cave Beetle	Insecta	Bell	С	E		Reference
Setophaga fusca	Blackburnian Warbler	Aves	Bell	N	Т		Reference
Sitta canadensis	Red-breasted Nuthatch	Aves	Bell	N	Е		Reference
Sorex cinereus	Cinereus Shrew	Mammalia	Bell	N	S	Yes	Reference
Spatula discors	Blue-winged Teal	Aves	Bell	N	Т		Reference
Spilogale putorius	Eastern Spotted Skunk	Mammalia	Bell	N	S	Yes	Reference
Stylurus notatus	Elusive Clubtail	Insecta	Bell	N	E		Reference
Tyto alba	Barn Owl	Aves	Bell	N	S	Yes	Reference
Vermivora chrysoptera	Golden-winged Warbler	Aves	Bell	N	Е	Yes	Reference

54 species are listed



KY Office of Kentucky Nature Preserves

KY Rare Plant Database | Status/Rank Explanation | Glossary | Credits



Additional Resources:







Adlumia fungosa - Allegheny-vine

Search Results : Bell County

Amianthium muscitoxicum - Fly Poison

<u>Baptisia tinctoria</u> - Yellow Wild Indigo

Boykinia aconitifolia - Brook Saxifrage

<u>Calamagrostis porteri ssp. porteri</u> - Porter's Reedgrass

<u>Calopogon tuberosus</u> - Grass Pink

Carex austrocaroliniana - Tarheel Sedge

<u>Castanea pumila</u> - Allegheny Chinkapin

Chelone obliqua var. obliqua - Red Turtlehead

<u>Chrysosplenium americanum</u> - American Golden-saxifrage

<u>Convallaria montana</u> - American Lily-of-the-valley

<u>Corydalis sempervirens</u> - Rock Harlequin

<u>Deschampsia flexuosa</u> - Crinkled Hairgrass

Gentiana decora - Showy Gentian

Houstonia serpyllifolia - Michaux's Bluets

Lathyrus venosus - Smooth Veiny Peavine

<u>Liparis loeselii</u> - Loesel's Twayblade

Listera smallii - Kidney-leaf Twayblade

<u>Melampyrum lineare var. latifolium</u> - American Cowwheat

<u>Monotropsis odorata</u> - Sweet Pinesap

Polytrichum pallidisetum - A Hair Cap Moss

Prosartes maculata - Nodding Mandarin

<u>Salvia urticifolia</u> - Nettle-leaf Sage

Silene ovata - Ovate Catchfly

Solidago curtisii - Curtis' Goldenrod

Solidago puberula - Downy Goldenrod

Solidago roanensis - Roan Mountain Goldenrod

Trillium undulatum - Painted Trillium

<u>Veratrum parviflorum</u> - Appalachian Bunchflower

Note: To print pages from this site change Page Setup to Landscape

Data Last Updated: November 2018

Office of Kentucky Nature Preserves

300 Sower Blvd Frankfort,KY 40601 Phone: (502) 573-2886 Email: <u>naturepreserves@ky.gov</u>

Feedback: <u>Naturepreserves@ky.gov</u> | <u>About the Agency</u> | <u>About this Site</u> <u>Privacy</u> | <u>Disclaimer</u> | <u>Individuals with Disabilities</u> | <u>Resources</u>



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APPENDIX F

EJSCREEN REPORTS (VERSION 2.0) FOR CENSUS TRACT 9604,
BLOCK GROUPS 1 AND 2



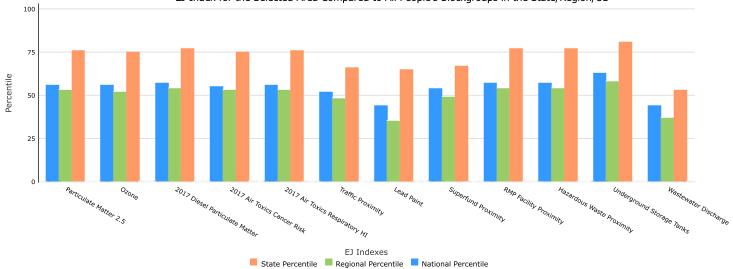


EJScreen Report (Version 2.0)

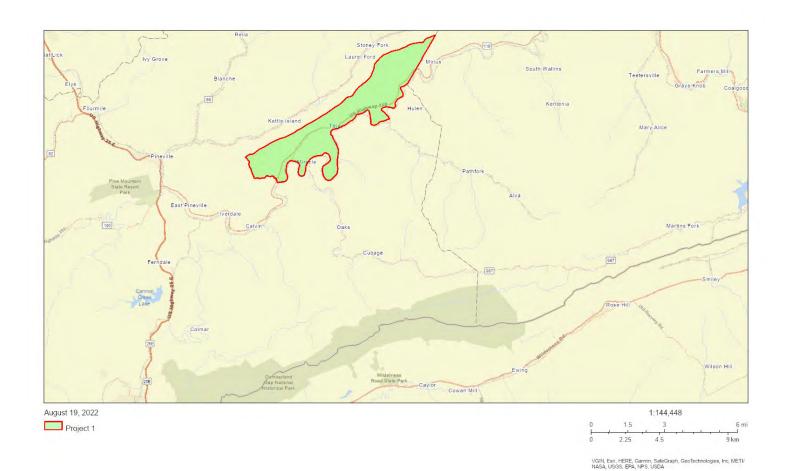
Blockgroup: 210139604001 KENTUCKY, EPA Region 4 Approximate Population: 856 Input Area (sq. miles): 11.31

input Area (54) inics/i 1151								
Selected Variables	Percentile in State	Percentile in EPA Region	Percentile in USA					
Environmental Justice Indexes	•	•	•					
EJ Index for Particulate Matter 2.5	76	53	56					
EJ Index for Ozone	75	52	56					
EJ Index for 2017 Diesel Particulate Matter*	77	54	57					
EJ Index for 2017 Air Toxics Cancer Risk*	75	53	55					
EJ Index for 2017 Air Toxics Respiratory HI*	76	53	56					
EJ Index for Traffic Proximity	66	48	52					
EJ Index for Lead Paint	65	35	44					
EJ Index for Superfund Proximity	67	49	54					
EJ Index for RMP Facility Proximity	77	54	57					
EJ Index for Hazardous Waste Proximity	77	54	57					
EJ Index for Underground Storage Tanks	81	58	63					
EJ Index for Wastewater Discharge	53	37	44					

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/Region/US



This report shows the values for environmental and demographic indicators and EJScreen indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state, EPA region, or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJScreen documentation for discussion of these issues before using reports.



Sites reporting to EPA	_
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

0-141 V1-1	Value	State		EPA Region		USA	
Selected Variables	Value		%tile	Avg.	%tile	Avg.	%tile
Pollution and Sources							
Particulate Matter 2.5 (µg/m³)	7.64	8.9	5	8.18	27	8.74	24
Ozone (ppb)	40.3	42.4	16	37.9	59	42.6	33
2017 Diesel Particulate Matter* (µg/m³)	0.0706	0.226	0	0.261	<50th	0.295	<50th
2017 Air Toxics Cancer Risk* (lifetime risk per million)	30	29	99	31	80-90th	29	80-90th
2017 Air Toxics Respiratory HI*	0.3	0.36	46	0.4	<50th	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	43	380	30	430	28	710	21
Lead Paint (% Pre-1960 Housing)	0.25	0.23	69	0.15	81	0.28	59
Superfund Proximity (site count/km distance)	0.052	0.039	80	0.083	60	0.13	43
RMP Facility Proximity (facility count/km distance)	0.043	0.67	6	0.6	3	0.75	3
Hazardous Waste Proximity (facility count/km distance)	0.03	0.77	11	0.62	3	2.2	3
Underground Storage Tanks (count/km²)	0	1.1	16	3.5	10	3.9	16
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.00025	1.3	45	0.45	50	12	38
Socioeconomic Indicators							
Demographic Index	33%	26%	73	37%	50	36%	54
People of Color	0%	15%	8	39%	1	40%	1
Low Income	65%	37%	90	35%	91	31%	92
Unemployment Rate	11%	6%	85	6%	86	5%	87
Linguistically Isolated	0%	1%	73	3%	51	5%	45
Less Than High School Education	32%	14%	94	13%	94	12%	92
Under Age 5	7%	6%	68	6%	71	6%	68
Over Age 64	14%	16%	43	17%	46	16%	50

"Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's 2017 Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

For additional information, see: www.epa.gov/environmentaljustice (https://www.epa.gov/environmentaljustice)

EJScreen is a screening tool for pre-decisional use only. It can help identify areas that may warrant additional consideration, analysis, or outreach. It does not provide a basis for decision-making, but it may help identify potential areas of EJ concern. Users should keep in mind that screening tools are subject to substantial uncertainty in their demographic and environmental data, particularly when looking at small geographic areas. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJScreen documentation for discussion of these issues before using reports. This screening tool does not provide data on every environmental impact and demographic factor that may be relevant to a particular location. EJScreen outputs should be supplemented with additional information and local knowledge before taking any action to address potential EJ concerns.



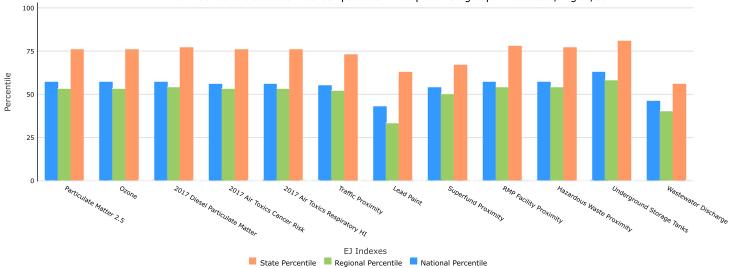


EJScreen Report (Version 2.0)

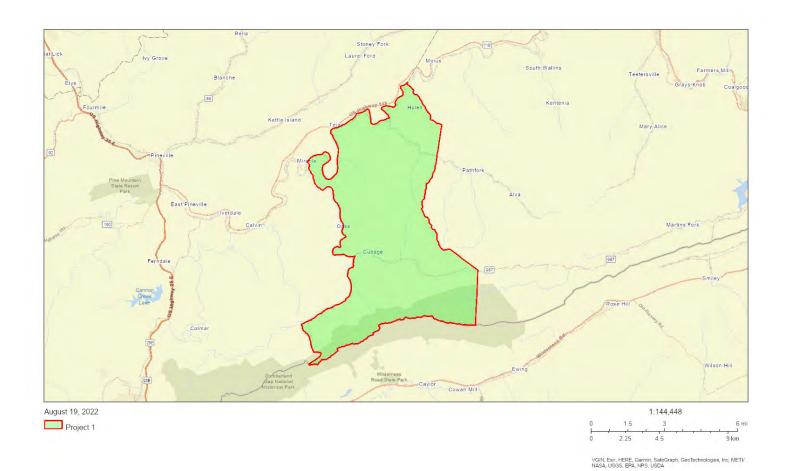
Blockgroup: 210139604002 KENTUCKY, EPA Region 4 Approximate Population: 1,060 Input Area (sg. miles): 42.03

input Area (sq. nines). 42.05								
Percentile in State	Percentile in EPA Region	Percentile in USA						
-	•							
76	53	57						
76	53	57						
77	54	57						
76	53	56						
76	53	56						
73	52	55						
63	33	43						
67	50	54						
78	54	57						
77	54	57						
81	58	63						
56	40	46						
	76 76 77 76 76 78 73 63 67 78 77	Percentile in State Percentile in EPA Region 76 53 76 53 77 54 76 53 76 53 73 52 63 33 67 50 78 54 77 54 81 58						

EJ Index for the Selected Area Compared to All People's Blockgroups in the State/Region/US



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Traffic Proximity (daily traffic count/distance to road)	6.2	380	11	430	8	710	5
Lead Paint (% Pre-1960 Housing)	0.35	0.23	80	0.15	87	0.28	67
Superfund Proximity (site count/km distance)	0.059	0.039	84	0.083	64	0.13	48
RMP Facility Proximity (facility count/km distance)	0.043	0.67	6	0.6	3	0.75	3
Hazardous Waste Proximity (facility count/km distance)	0.035	0.77	13	0.62	5	2.2	4
Underground Storage Tanks (count/km²)	0	1.1	16	3.5	10	3.9	16
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.00016	1.3	41	0.45	46	12	34
Socioeconomic Indicators							
Demographic Index	34%	26%	75	37%	52	36%	55
People of Color	1%	15%	14	39%	3	40%	3
Low Income	66%	37%	90	35%	92	31%	92
Unemployment Rate	2%	6%	31	6%	28	5%	30
Linguistically Isolated	2%	1%	80	3%	62	5%	55
Less Than High School Education	24%	14%	85	13%	86	12%	85
Under Age 5	2%	6%	11	6%	14	6%	13
Over Age 64	15%	16%	44	17%	48	16%	51

"Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's 2017 Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update. (https://www.epa.gov/haps/air-toxics-data-update)

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