EVOLVE-Central Appalachia (Evolve-CAPP) - Basinal Resource Assessment

Coal Preparation Society of America &
Society of Mining Engineers Central Appalachian Section
CoalProTec Conference & Exhibition
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Lexington, KY

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Outline

- Disclaimer
- Introduction
- Database Compilation
- Data Review
- Preliminary Resource Estimation
  - Basic Methodology
  - Resource Estimation Examples
- Summary

ACKNOWLEDGEMENT

"This material is based upon work supported by the Department of Energy under Award Number DE-FE0032055."

DISCLAIMER

Introduction

The Evolve-CAPP Project = developing and implementing strategies to enable the Central Appalachian Basin to realize its full economic potential for producing high-value, non-fuel, carbon-ore (CO) products, rare earth elements (REE), and critical minerals (CM).

- The Basinal Assessment of CORE-CM Resources is a state-of-the-art geological model and comprehensive database that will be used to identify, locate, and quantify in-situ resources in the basin.
- Restrictive aspects of resource recovery, such as ownership and legal restrictions, are being considered in estimating recoverable resources.
- A gap analysis of missing or unavailable data that could not be fully integrated in the initial assessment due to budget, access, or other constraints during the assessment effort is planned.
- A characterization and data acquisition plan to fully characterize the basin's CORE-CM potential will address gaps in data. The plan will be developed with input from project team members and relevant stakeholders, including land and mineral holding companies and coal operators, who maintain sampling programs as part of their normal operations.

Introduction

From Karmis, M. – October 27, 2021 Project Kickoff Meeting:

Subtask 2.1

Preliminary Basinal Resource Estimate

- Identify CORE-CM, and other important minerals, most likely available within the study area and develop a comprehensive database of existing data sources
- Preliminary quantification of CORE-CM resources using a geologic model based on individual volumetric representations of coal seam of interest that captures the spatial variability of properties such as stratigraphic thickness, mineral concentration and recovery factors
- Restrictive aspects of resource recovery, such as ownership and legal restrictions, will be considered in estimating potentially recoverable resources and will be included in the Initial Basinal Resource Assessment deliverable
- E-CAPP team has significant experience in developing resource assessment studies for the coal and gas sectors, based on accepted international standards and reporting to the SEC

Introduction

From Karmis, M. – October 27, 2021 Project Kickoff Meeting:

Subtask 2.2

Basinal Resource Gap Analysis

- Gap Analysis is conducted throughout data collection, classification and assessment tasks
  - Collect – Organize – Classify – Prioritize – Estimate – Analyze

Subtask 2.3

Characterization and Data Acquisition Plan

- *Class 1 Data* – Data sources and quality is deemed suitable for this phase of the project. It will be included in the "high level" resource assessment.
- *Class 2 Data* – Data source and quality could be useful in subsequent phases of the project -- possibly a target for gap analysis and augmentation by data acquisition efforts.
- *Class 3 Data* – Data source and quality confirmed to be unsuitable for this project, either due to lack of coverage and density, or poor concentrations to be of interest. No further evaluation necessary.
- *Class 4 Data* – No evaluation performed; data source and quality poor and unusable.
- All data sources will be summarized with a brief description of data, ownership, access, and will be uploaded to the NETL EDX platform.

Sampling Plan Development: NETL approval - Environmental Questionnaires will identify the sampling organization, county, sampling site, and methodology. **Samples may also be donated by industry.**

Establishing E-CAPP Sample Storage Lab in Abingdon, Virginia, as a joint VaDOE/VCCER-VT Facility

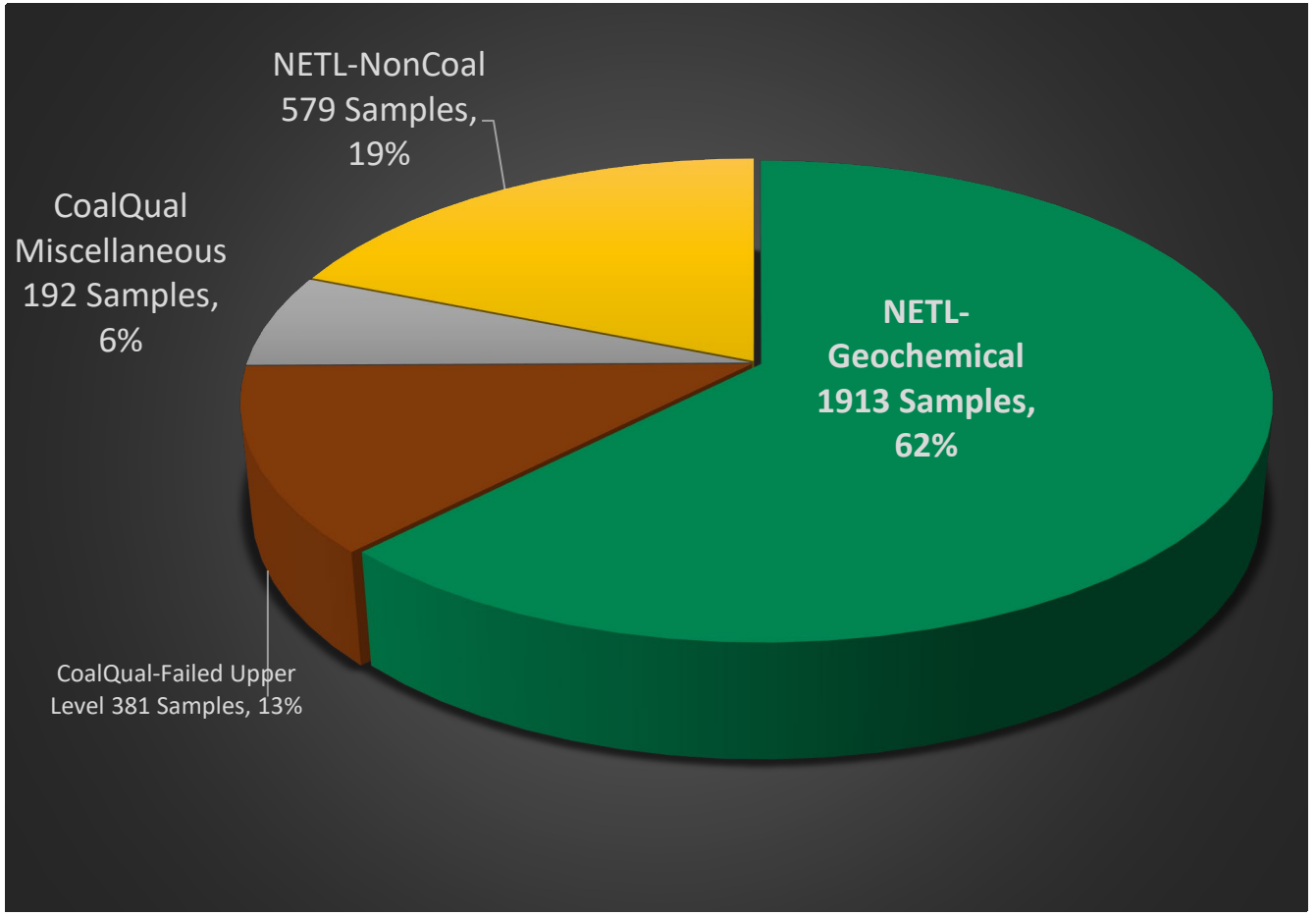
Database Compilation – Data Sources

Databases Incorporated to Date

- NETL-Geochemical (CoalQual)
- NETL-NonCoal
- CoalQual – Failed Upper Level
- CoalQual - Miscellaneous

NETL Sub-Databases Still to be Added into Comprehensive Database

- Non-Coal
- Major Chem
- Other Chem
- Unknown Chem



Data Review

Ranking	Kentucky	Samples	Ranking	Tennessee	Samples	Ranking	Virginia	Samples	Ranking	West virginia	Samples
	UNKNOWN	196		UNKNOWN	60		UNKNOWN	36		UNKNOWN	262
	NO DATA ENTERED	90	1	BIG MARY	7	1	DORCHESTER	71	1	EAGLE	66
1	FIRE CLAY	49	2	PEWEE	5	2	CLINTWOOD	67	2	SEWELL	65
2	PEACH ORCHARD	43	3	MASON	4	3	UPPER BANNER	38	3	POCAHONTAS NO 3	51
3	HAZARD	36	4	REX	4	4	LYONS	35	4	NO 5 BLOCK	49
4	RICHARDSON	35	5	WINDROCK	4	5	KENNEDY	31	5	BECKLEY	46
5	UNNAMED	35	6	BLUE GEM	3	6	JAWBONE	25	6	COALBURG	44
6	UPPER ELKHORN NO 3	29	6	COAL CREEK	3	7	LOWER BANNER	24	7	REDSTONE	42
7	JELLICO	27	6	GLEN MARY	3	8	SPLASHDAM	23	8	NO 2 GAS	39
8	BLUE GEM	24	6	JELLICO	3	9	BLAIR	18	9	CAMPBELL CREEK	34
9	FIRE CLAY RIDER	22	6	POPLAR LICK	3	9	NORTON	18	10	STOCKTON	33
9	HAZARD NO 7	22	7	NEMO	2	10	IMBODEN	16		WINIFREDE	28
10	UPPER PEACH ORCHARD	19	7	WALNUT MOUNTAIN	2		POCAHONTAS NO 3	15		POCAHONTAS NO 6	26
	UPPER ELKHORN NO 2	18	8	JORDAN	1		JEWELL	11		FIRE CREEK	24
	BROAS	17	8	JOYNER	1		TILLER	11		ALMA	23
	HINDMAN	16	8	LANTANA	1		HAGY	10		CEDAR GROVE	21
	WHITESBURG	16	8	LOW SPLINT	1		RAVEN	10		PITTSBURGH	21
	LOWER PEACH ORCHARD	15	8	PIONEER	1		TAGGART	10		POWELLTON	19
	MANCHESTER	15	8	POPLAR CREEK	1		COVE CREEK	7		PEERLESS	17
	WILLIAMSON	13	8	STRAY	1		PARDEE	7		HERNSHAW	16
	FRANCIS	11					JAWBONE-TILLER	6		NO DATA ENTERED	14
	HADDIX	11					KELLY	6		LITTLE RALEIGH	12
	HAZARD NO 8	10					LOWER SEABOARD	6		POCAHONTAS NO 4	12
	POND CREEK	10					NO DATA ENTERED	6		UPPER CEDAR GROVE	12
	UPPER ELKHORN NO 1	10					UPPER HORSEPEN	6		LOWER CEDAR GROVE	11
	LILY	9					LEE	5		UPPER NO 5 BLOCK	11
	LOWER ELKHORN	9					MERRIMAC	5		LOWER KITTANNING	8
	STEARNS	9					MIDDLE HORSEPEN	5		LOWER NO 5 BLOCK	8
	AMBURGY	9					WILSON	5		SEWELL A	8

USGS COALQUAL Data Summary (Virginia)

517 Samples
69 Related Samples
586 Total Samples

569 Samples Within Evolve CAPP Project Area
17 Samples Outside Evolve CAPP Project Area

Samples collected between 1973 and 1989

Samples by County

County	No. of Samples
Wise	193
Buchanan	131
Dickenson	104
Russell	55
Tazewell	48
Lee	28
Scott	10
Grand Total	**569**

Sample Types

Sample Type	No. of Samples
Channel	283
Weathered Channel	208
Drill Core	76
Grab	1
Road Cut	1
Grand Total	**569**

Note: Drill Core samples from 28 individual locations, 68 channel locations have multiple coal bench samples. Samples from 315 unique locations

USGS COALQUAL Data Summary (West Virginia)

609 Samples
331 Related Samples
940 Total Samples

682 Samples Within Evolve CAPP Project Area
258 Samples Outside Evolve CAPP Project Area

Samples collected between 1973 and 1985

Samples by County

County	No. of Samples	County	No. of Samples
Kanawha	95	Mercer	24
Logan	89	Pocahontas	22
McDowell	83	Randolph	22
Raleigh	83	Greenbrier	18
Boone	75	Braxton	3
Nicholas	58	Clay	1
Fayette	55	Lincoln	1
Mingo	52	Summers	1
Grand Total	**682**		

Note: 4 Counties within project area have no Samples (Cabell, Calhoun, Putnam, Roane)

Sample Types

Sample Type	No. of Samples
Channel	630
Weathered Channel	16
Drill Core	15
Unknown	12
Road Cut	5
Grand Total	**666**

Note: Channel Samples/Road Cut from 388 unique locations (114 locations represent 377 samples), Drill Core Samples from 10 unique locations

USGS COALQUAL Data Summary (Kentucky)

1,006 Samples
78 Related Samples
1,084 Total Samples

857 Samples Within Evolve CAPP Project Area
227 Samples Outside Evolve CAPP Project Area

Samples collected between 1974 and 1986

Samples by County

County	No. of Samples	County	No. of Samples	County	No. of Samples	County	No. of Samples
Pike	91	Knott	37	Magoffin	21	Greenup	7
Lawrence	83	Breathitt	35	Whitley	18	Lee	7
Bell	67	Harlan	31	Owsley	15	Carter	6
Clay	64	Johnson	24	Boyd	13	Wayne	5
Perry	63	Knox	22	McCreary	11	Rockcastle	4
Floyd	48	Morgan	22	Wolfe	11	Pulaski	2
Leslie	48	Laurel	21	Jackson	8		
Martin	45	Letcher	21	Elliott	7		
Grand Total	**857**						

Note: 7 Counties within project area have no samples

Sample Types

Sample Type	No. of Samples
Channel	565
Drill Core	117
Road Cut	109
Weathered Channel	66
Grand Total	**857**

Note: Drill Core samples from 64 individual locations, 85 channel and road cut, locations have multiple coal bench samples (226). Samples from 663 unique locations

USGS COALQUAL Data Summary (Tennessee)

62 Samples
0 Related Samples
62 Total Samples

49 Samples Within Evolve CAPP Project Area
13 Samples Outside Evolve CAPP Project Area

Samples collected between 1975 and 1981

Samples by County

County	No. of Samples
Anderson	13
Campbell	14
Claiborne	10
Fentress	2
Morgan	2
Scott	8
Grand Total	**49**

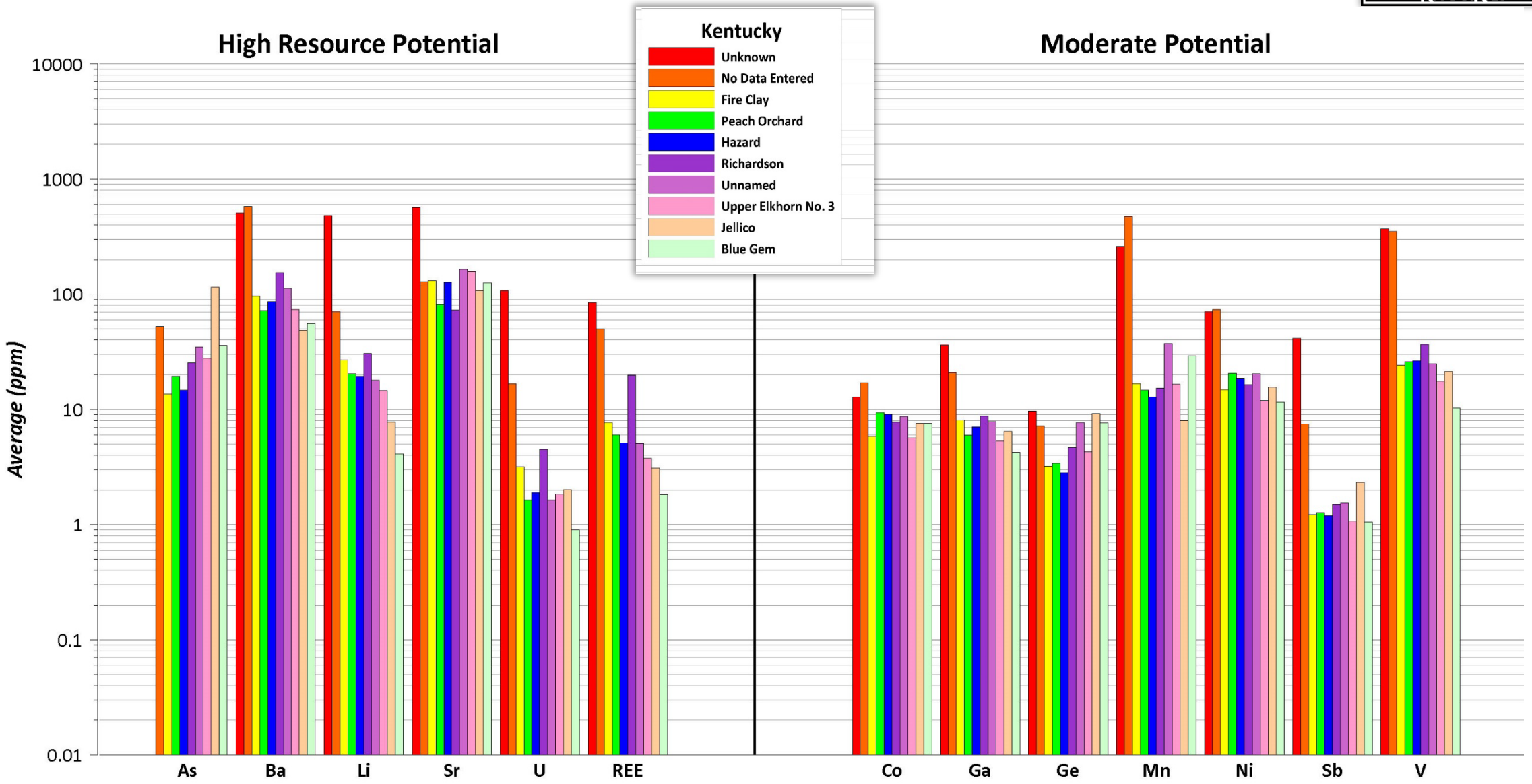
Note: 6 Counties within project area have no samples

Sample Types

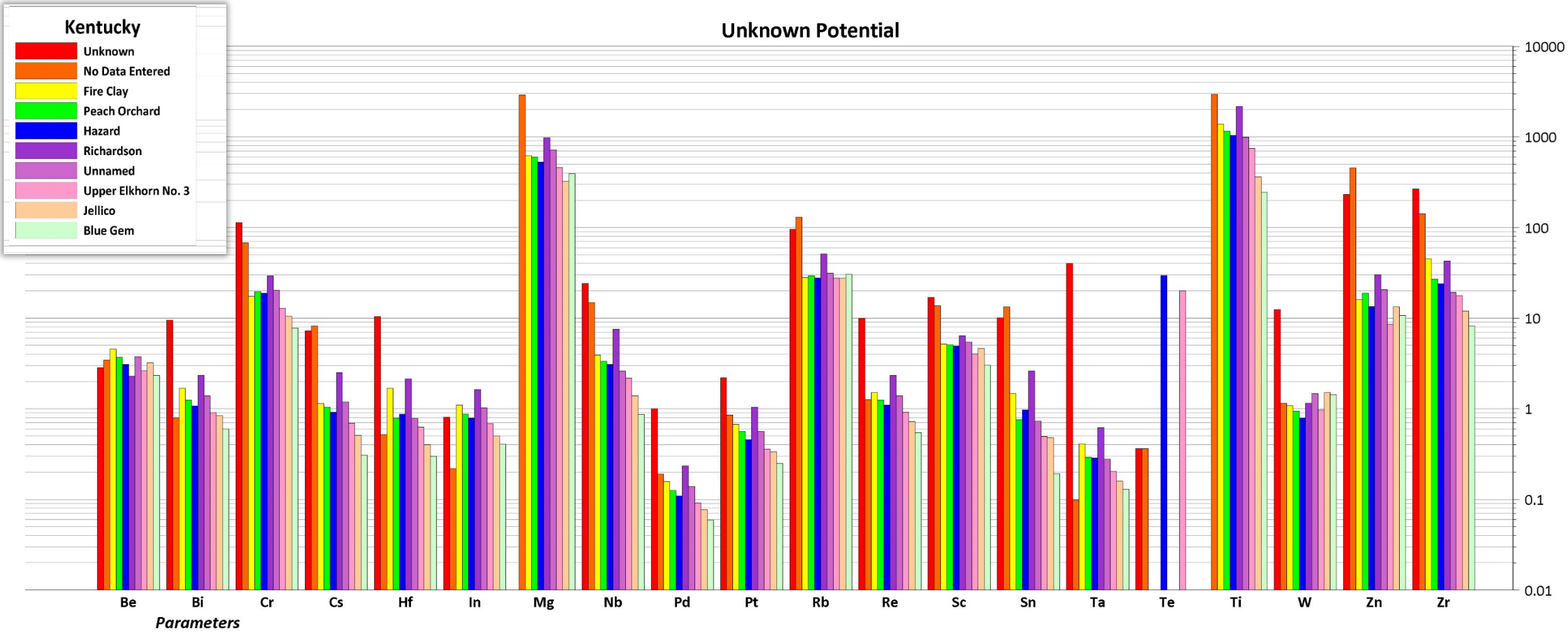
Sample Type	No. of Samples
Channel	49
Grand Total	**49**

Note: Channel Samples from 46 unique locations

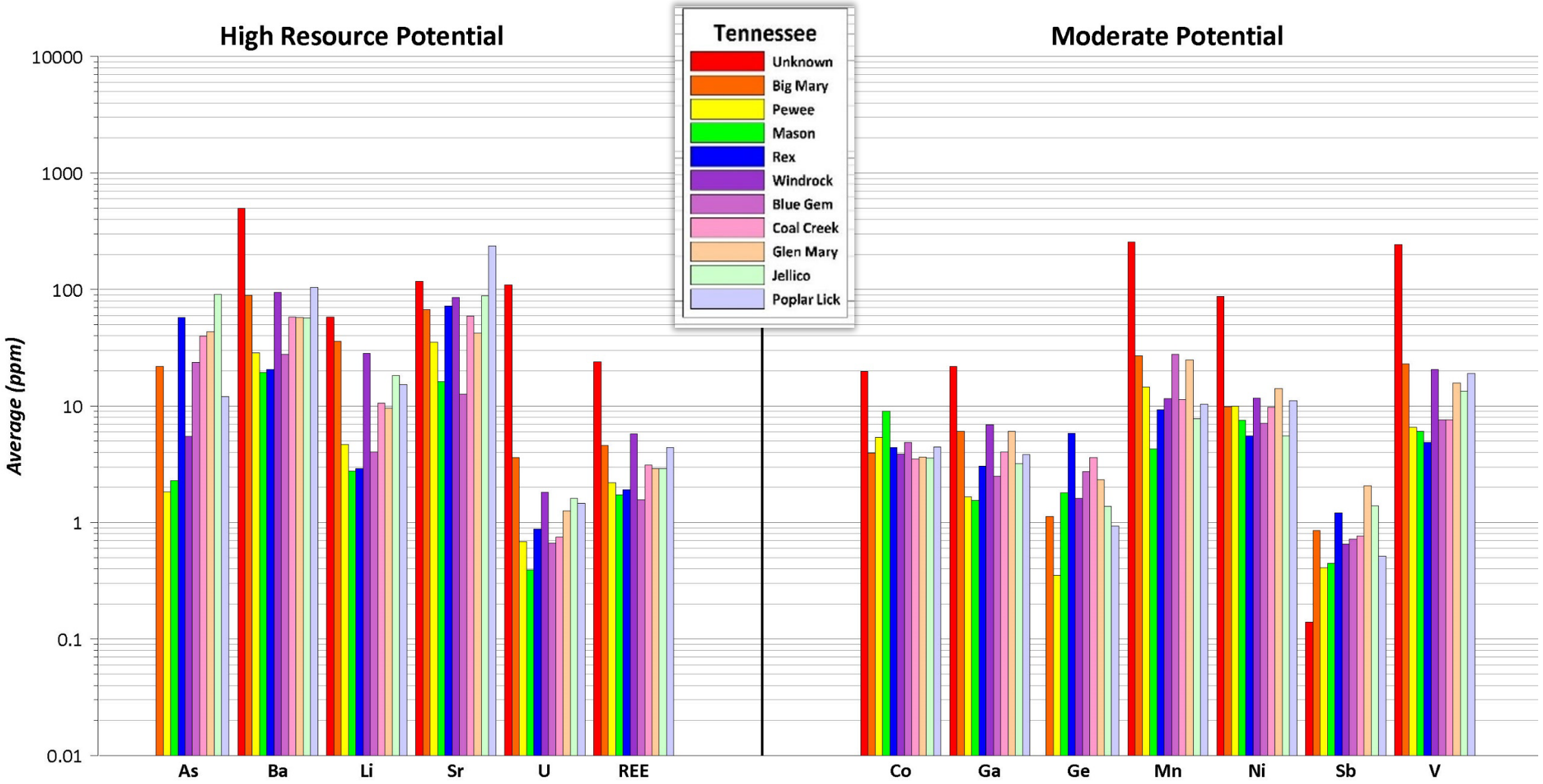
Data Review – Coal Seams - Kentucky



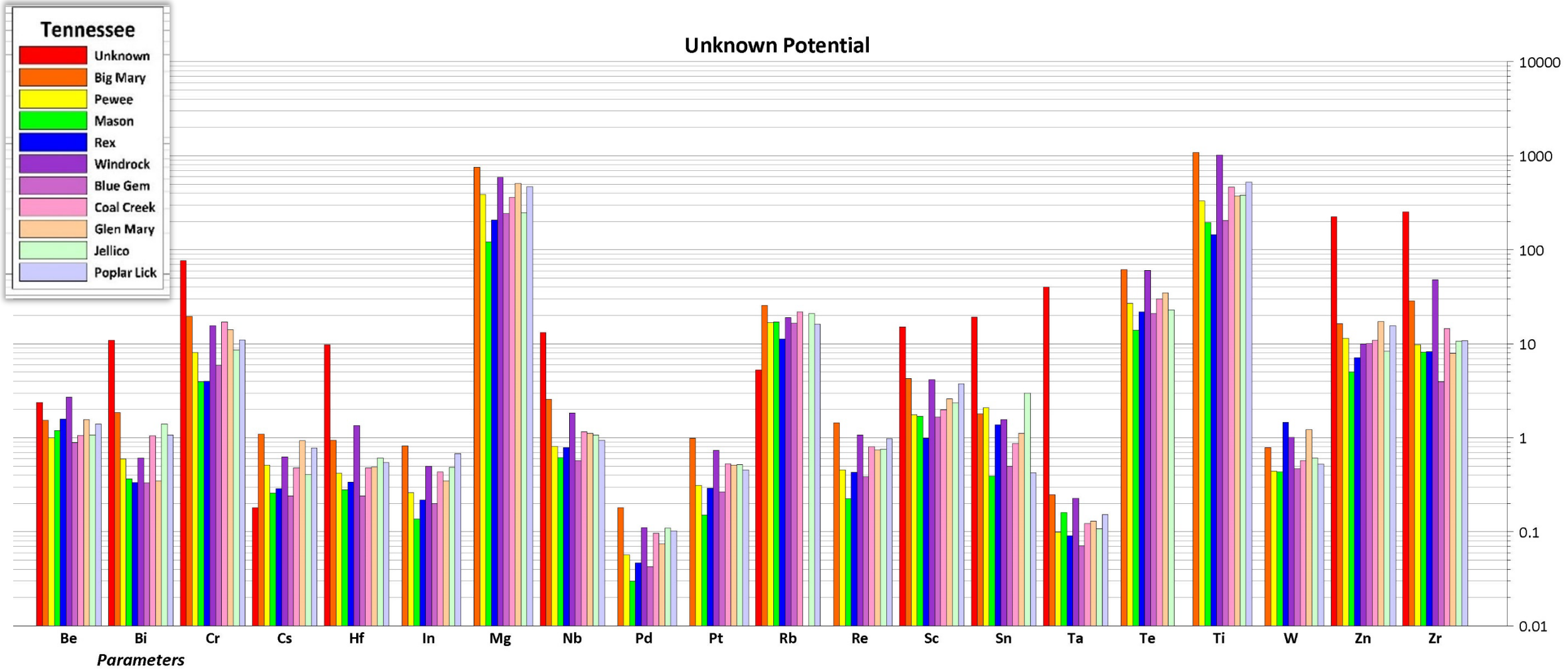
Data Review – Coal Seams - Kentucky



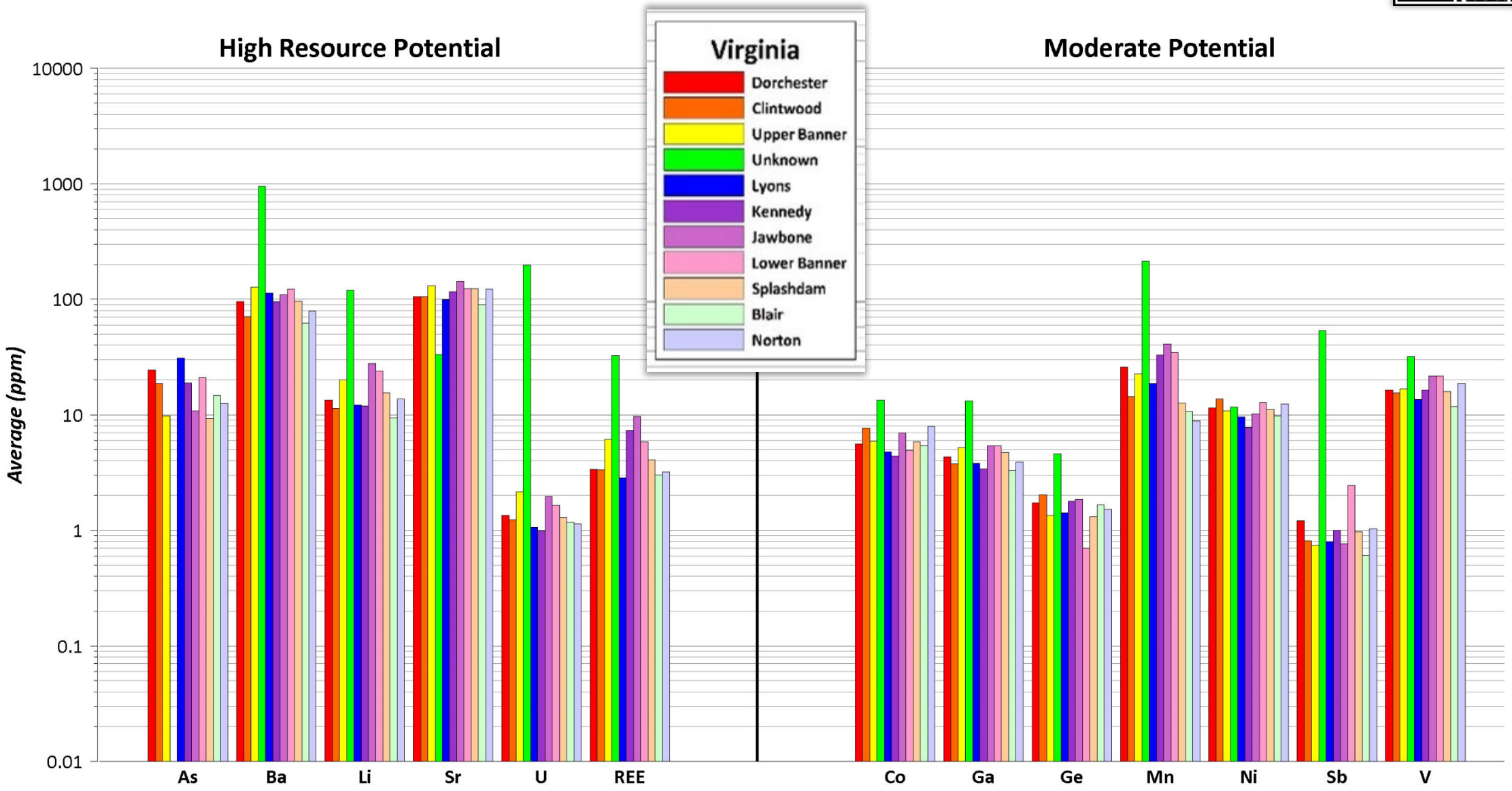
Data Review – Coal Seams - Tennessee



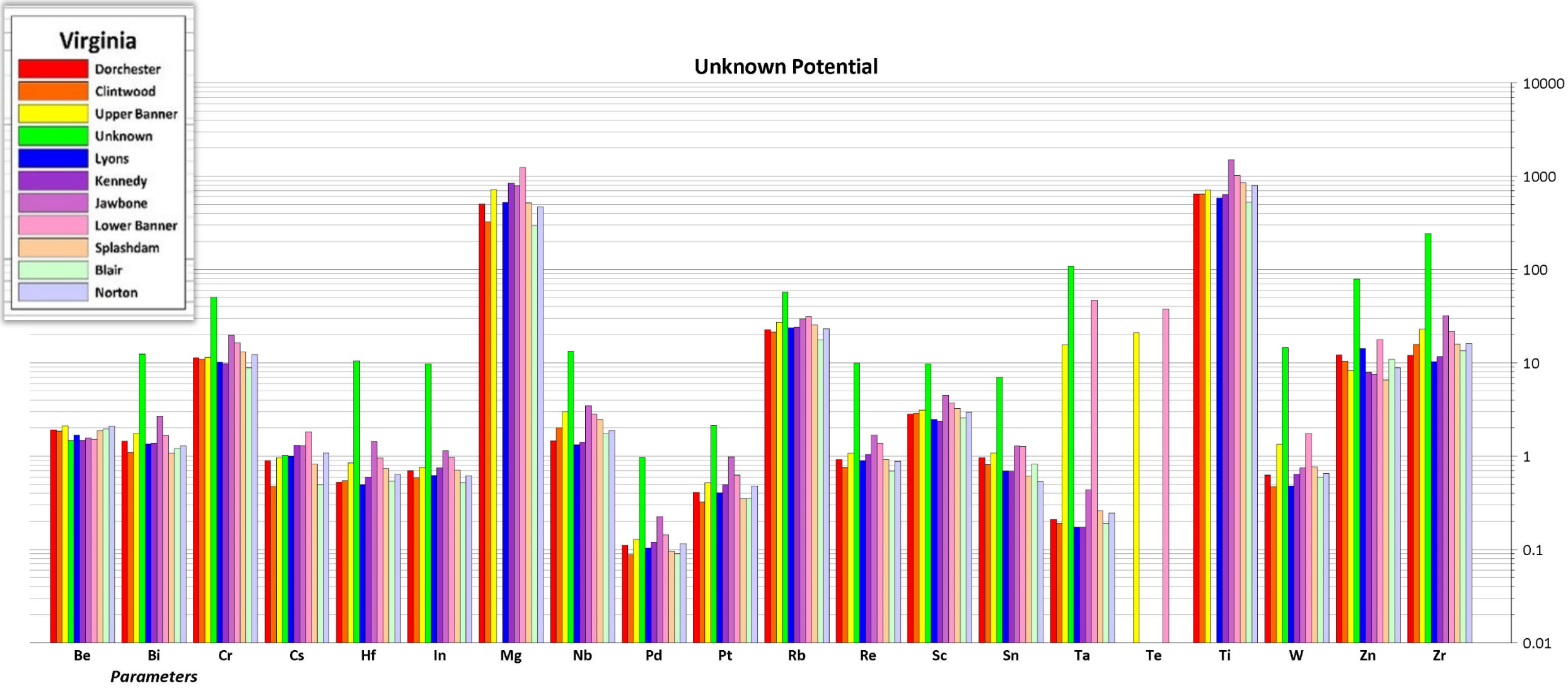
Data Review – Coal Seams - Tennessee



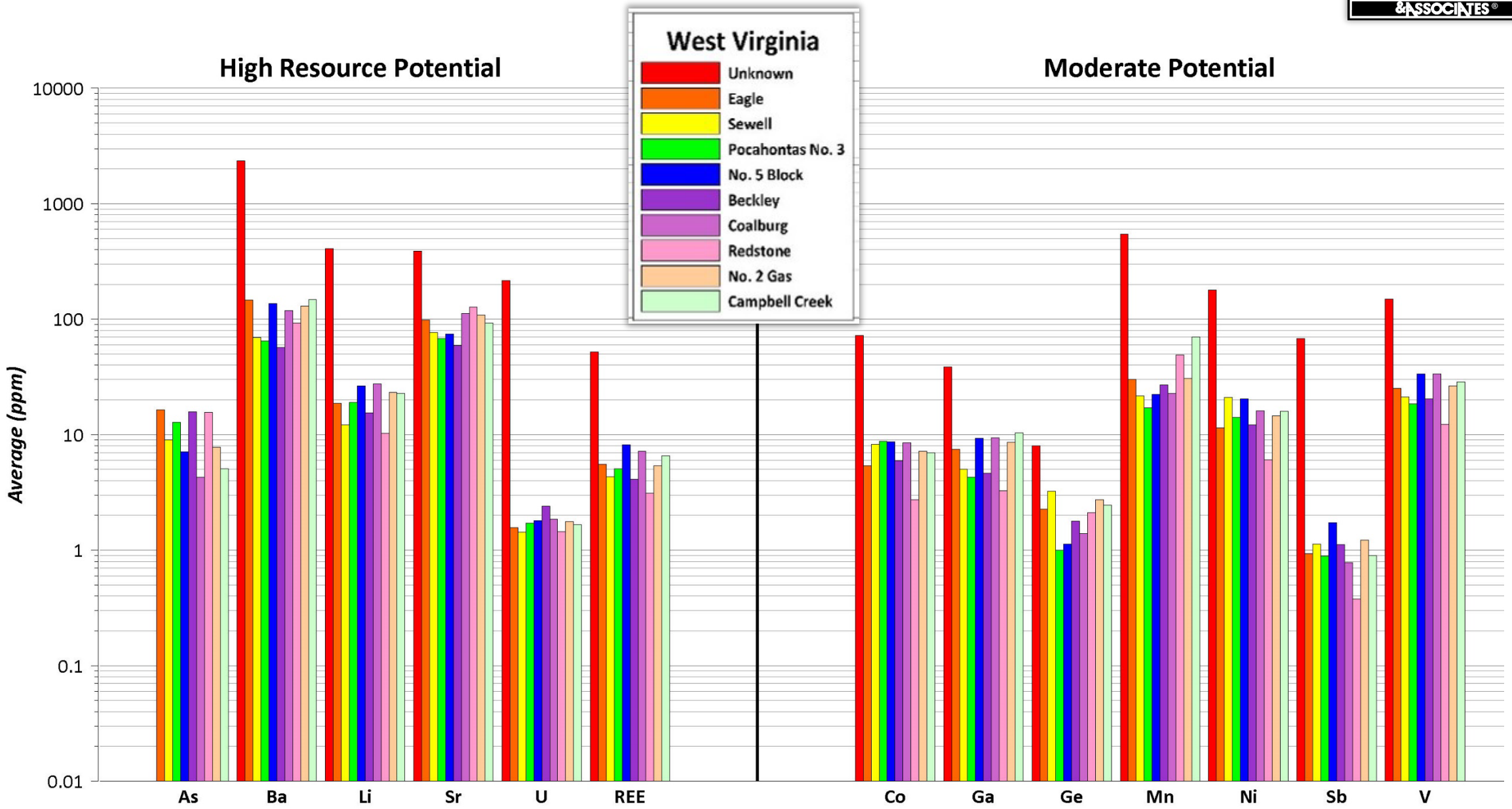
Data Review – Coal Seams - Virginia



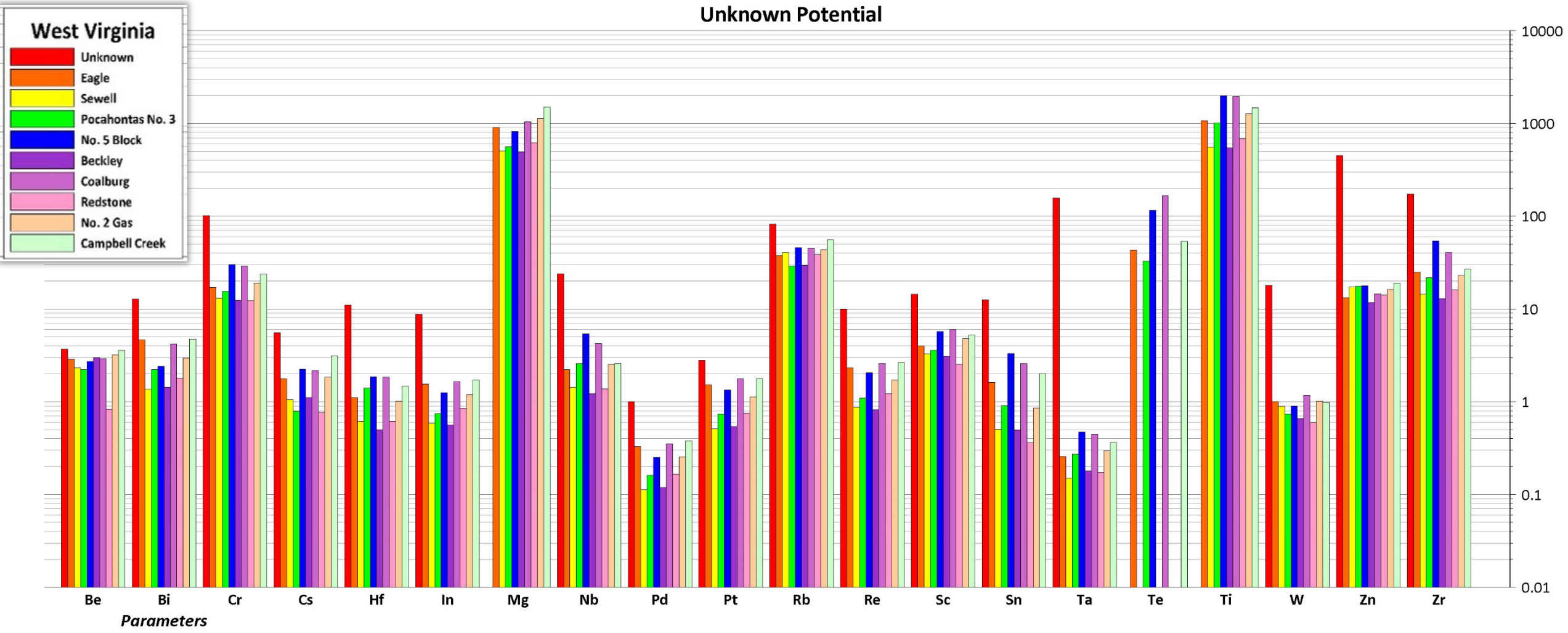
Data Review – Coal Seams - Virginia



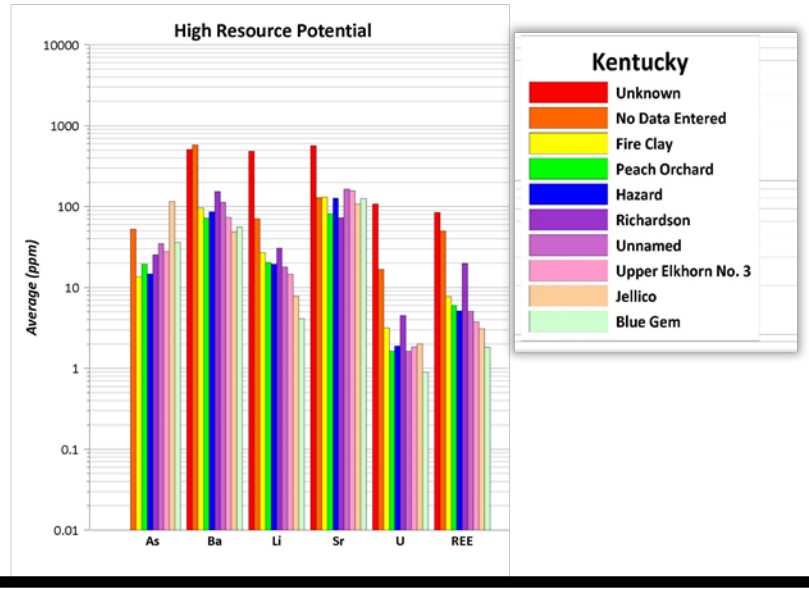
Data Review – Coal Seams – West Virginia

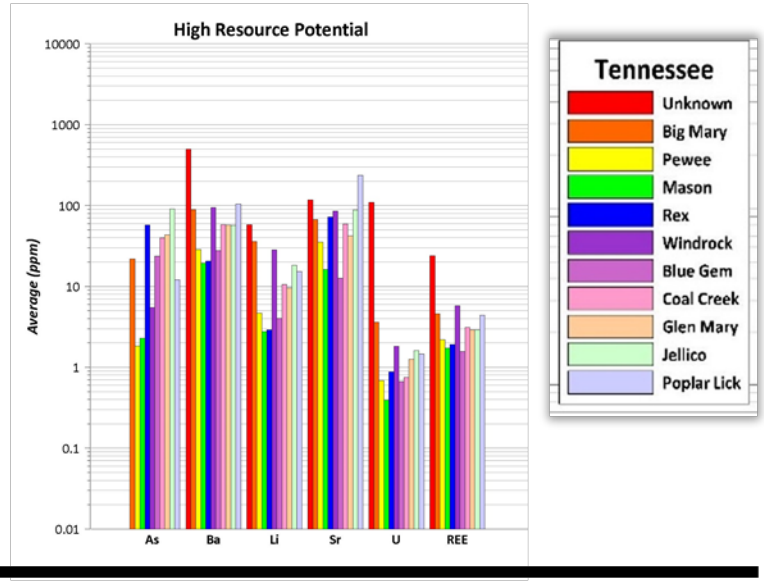


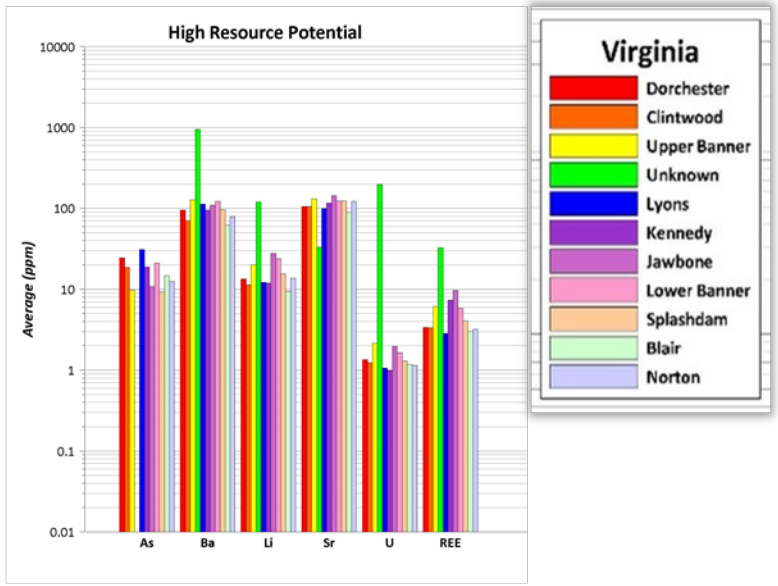
Data Review – Coal Seams – West Virginia

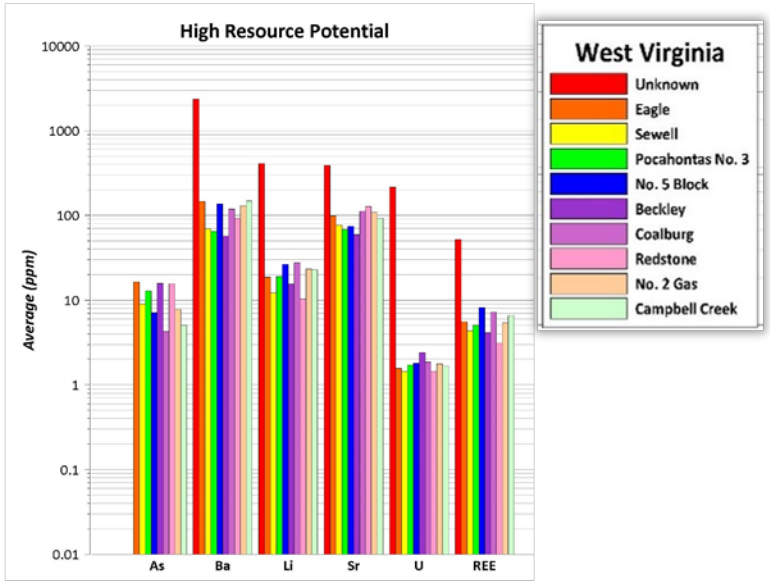


Data Review – Coal Seams – High Resource







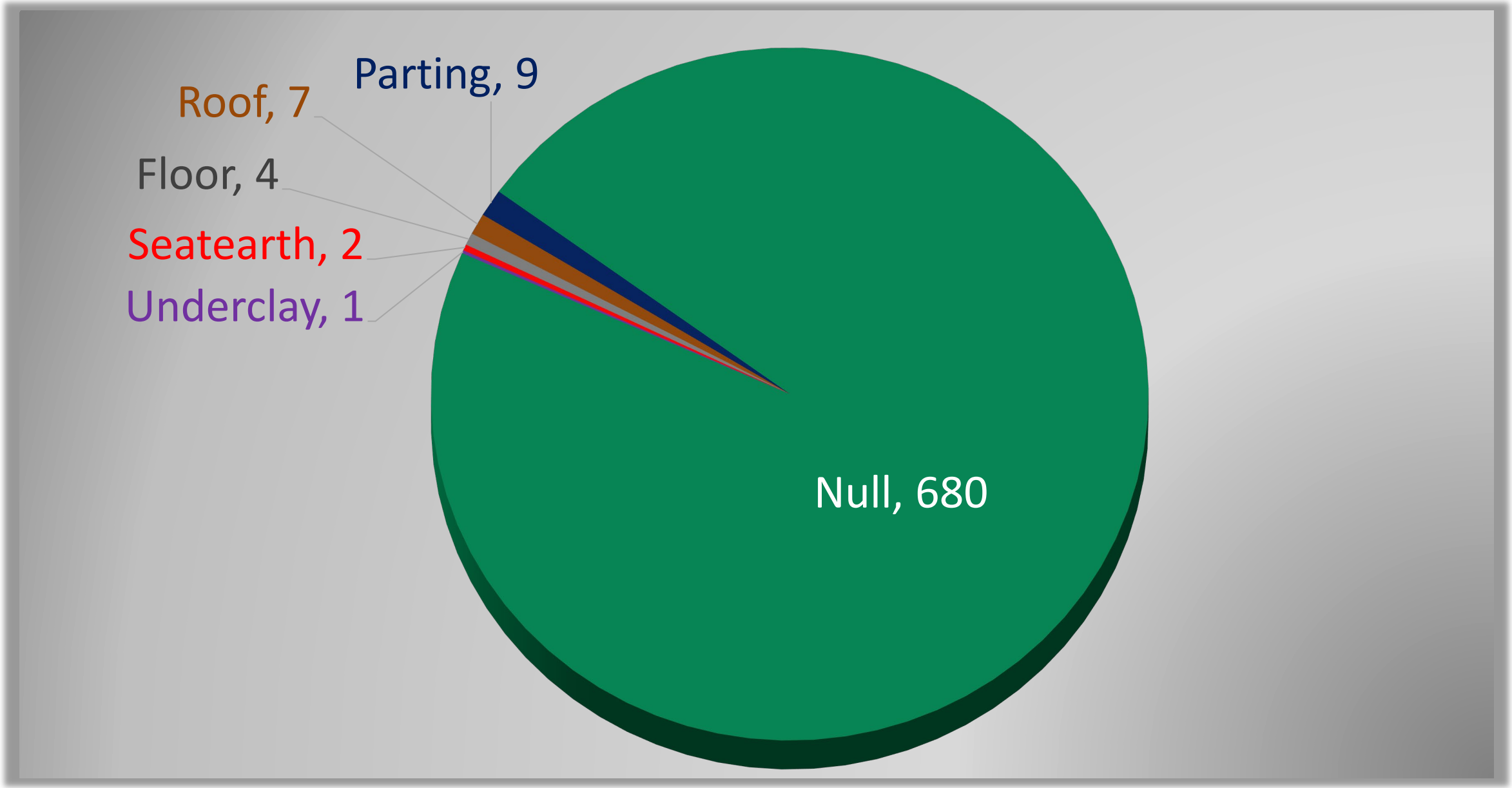


Unknown Coal Bed Data: Non-Coal Samples

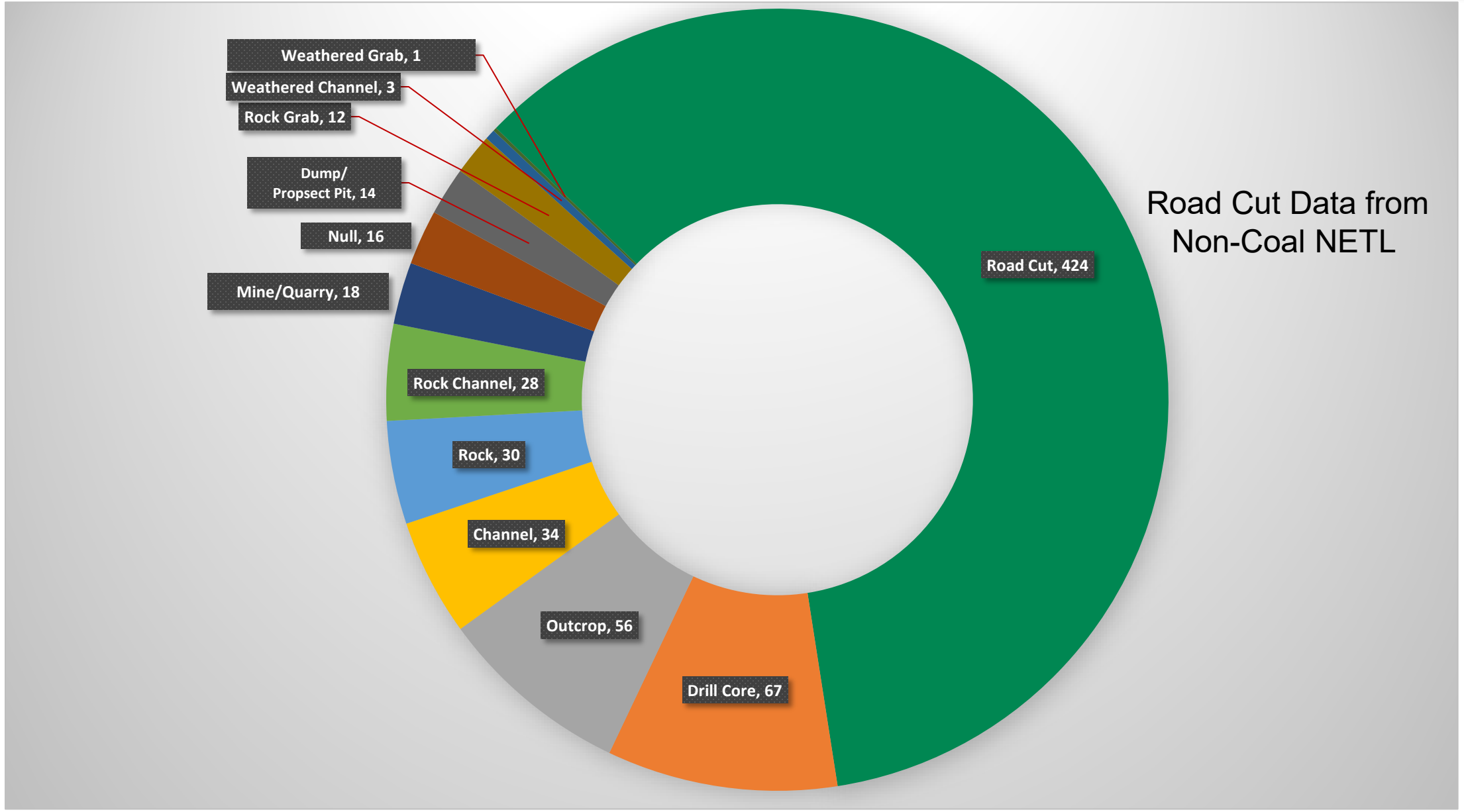
Data Review
Material Types for Unknown Coal Bed Data

Material	Count	Material	Count	Material	Count	Material	Count
Alluvium	1	Clay	61	Mud	18	Siltstone	1
Barite Nodules	6	Clay and Powdered Shale	36	Mud Pebble Conglomerate	1	Silty Sandstone	1
Bituminous Coal	50	Clayey Siltstone	1	Nodule	2	Silty Shale	2
Bituminous Rock	2	Claystone	36	Null	133	Silty Claystone	10
Black Shale	20	Core of Nodule	2	Ohio Shale	12	Tonstein	98
Brecciated Ironstone	1	Diatreme Breccia	1	Phosphatic Claystone	4	Trachyte	1
Brecciated Limestone	1	Fault Gouge Limestone Coal	1	Rock	6	Tuff	3
Carbonaceous (Organic)	46	Ferruginous Claystone	2	Sandstone	4	Underclay	1
Carbonaceous Sandstone	3	Flintclay	45	Sandy Siltstone	3	Vitrinite	2
Carbonaceous Shale	1	Laminated Limestone	1	Semi Flintclay	3		
Carbonaceous Siltstone	2	Manganese Ore	16	Shale	43		
Carbonate - Dolomite	2	Micaceous Sandstone	3	Shale Pig	1		
Carbonaceous Claystone	1	Micaceous Siltstone	2	Sideritic Nodule	2		
Chert	4	Mineralized Limestone	2	Silicified Carbonaceous Shale	2		

Data Review – Unknown Seams Data



Data Review – Unknown Seams Data

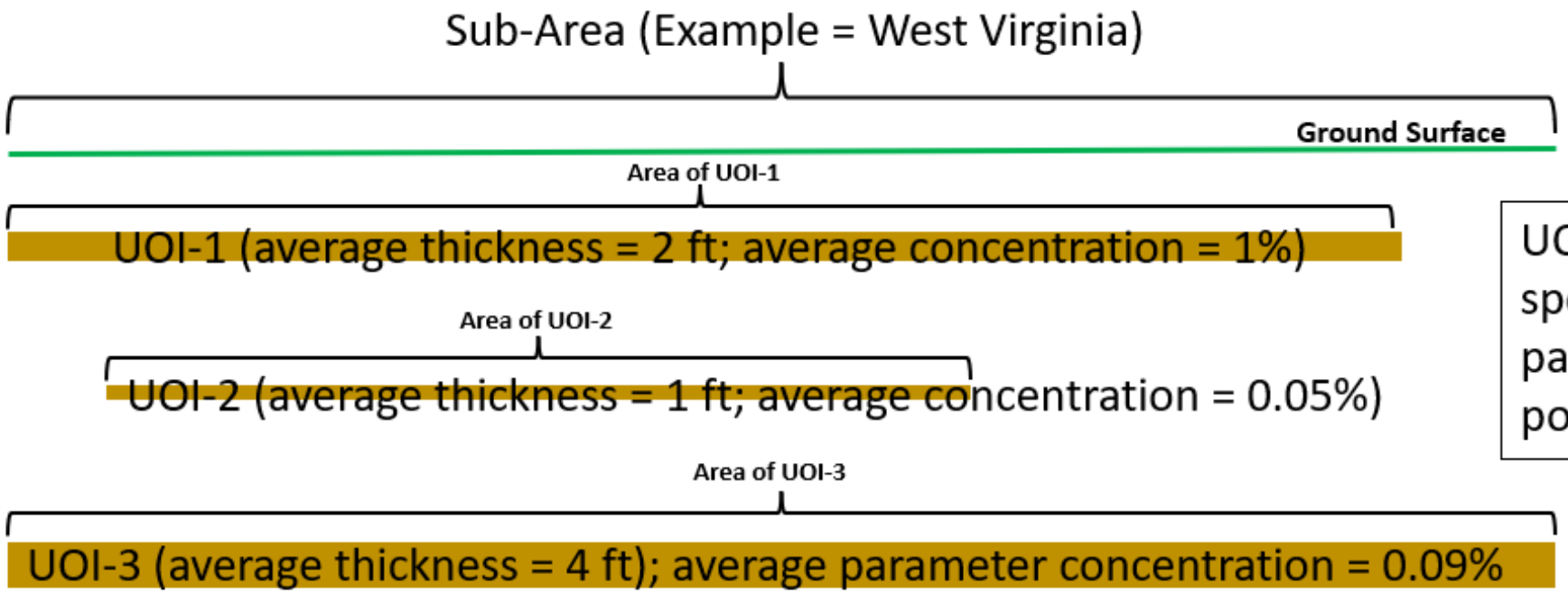


Road Cut Samples but the majority of the samples are in the same location

Sample Type	Number of Samples	Number of Individual Sampling Sites
Road Cut	424	92
Drill Core	67	9
Outcrop	56	22
Channel	34	28
Rock	30	4
Rock Channel	28	11
Mine/Quarry	18	13
None	16	6
Dump/Prospect Pit	14	1
Rock Grab	12	6
Weathered Channel	3	3
Weathered Grab	1	1

Preliminary Resource Assessment – Basic Methodology

2-Dimensional Conceptual representation of REE resource volume/tonnage estimate:



UOI = Unit of Interest (ex: specific floor clay, specific parting, etc. that is a potential source of REE)

Recovery Parameters Required!!

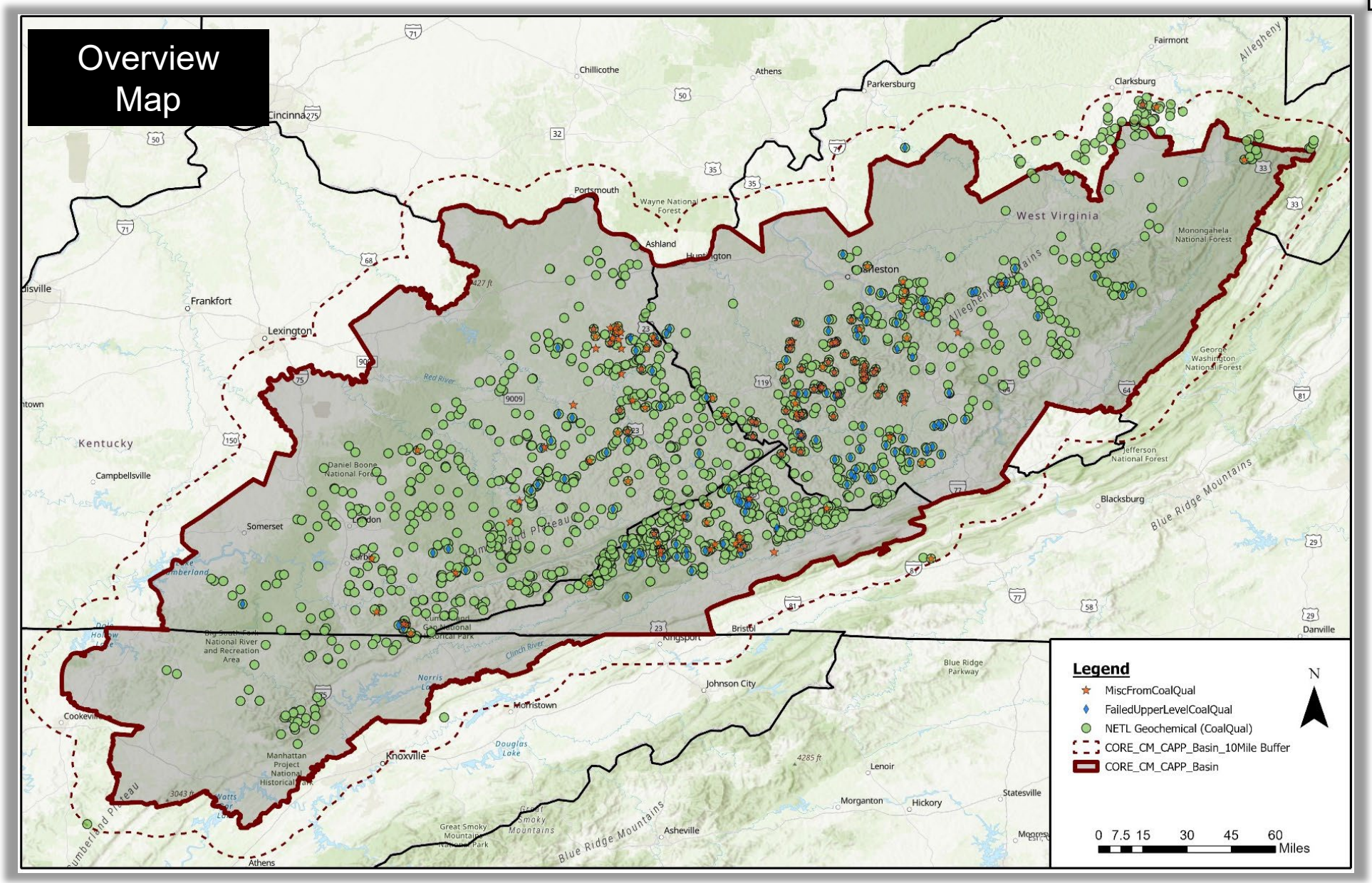
Preliminary Resource Assessment – Example #1

West Virginia

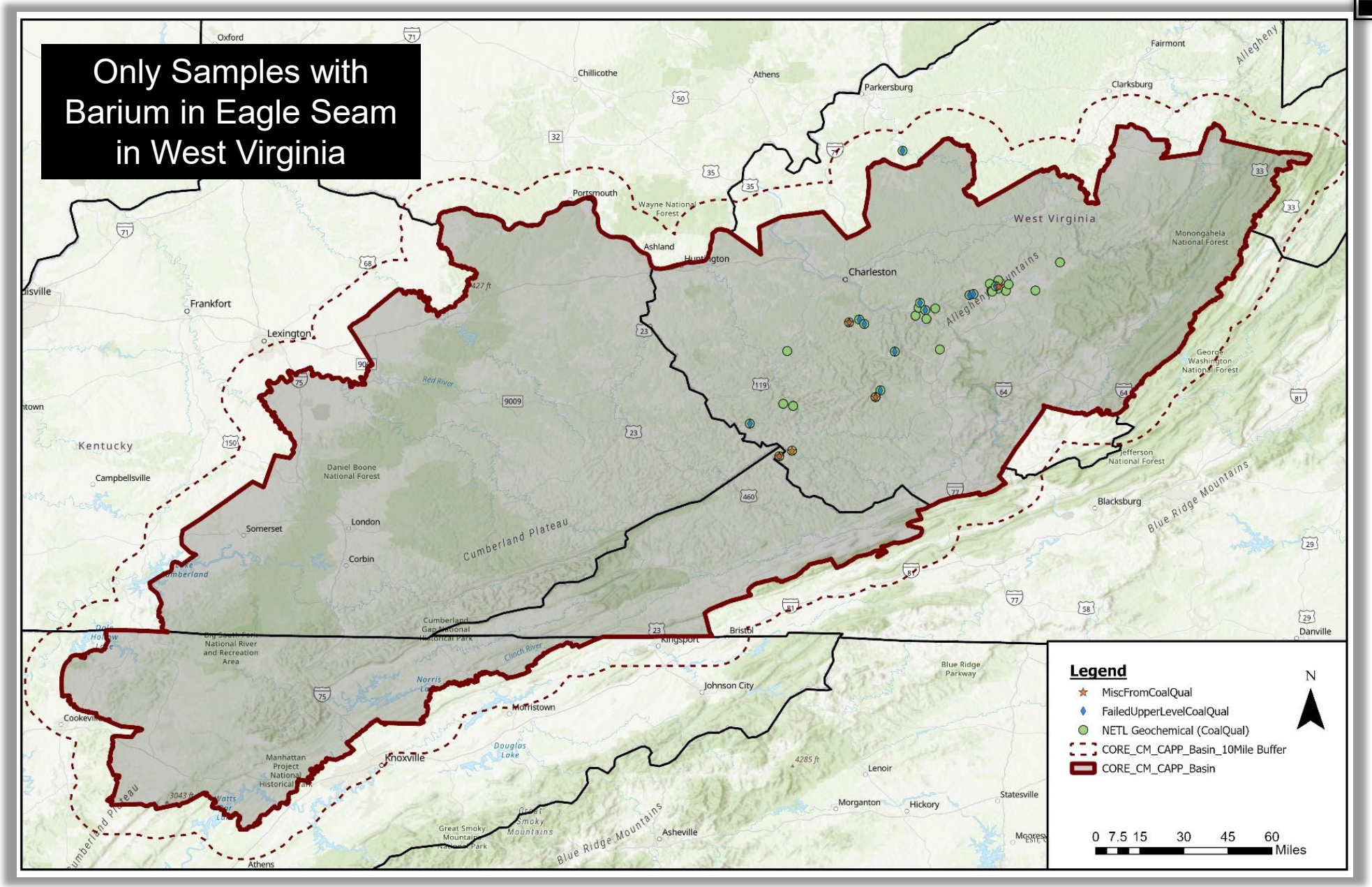
Eagle Coal Seam

Barium

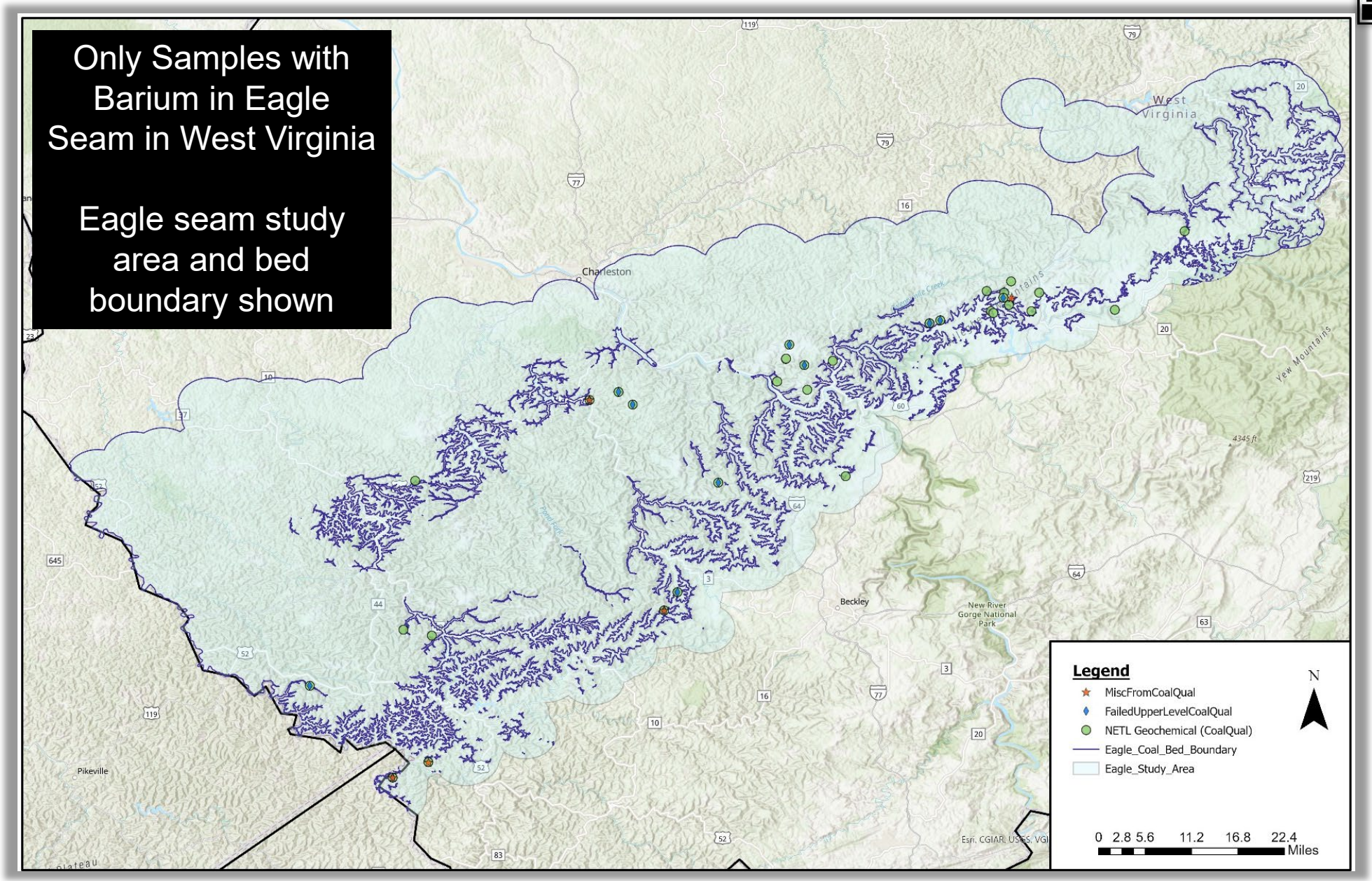
Preliminary Resource Assessment – Example #1



Preliminary Resource Assessment – Example #1



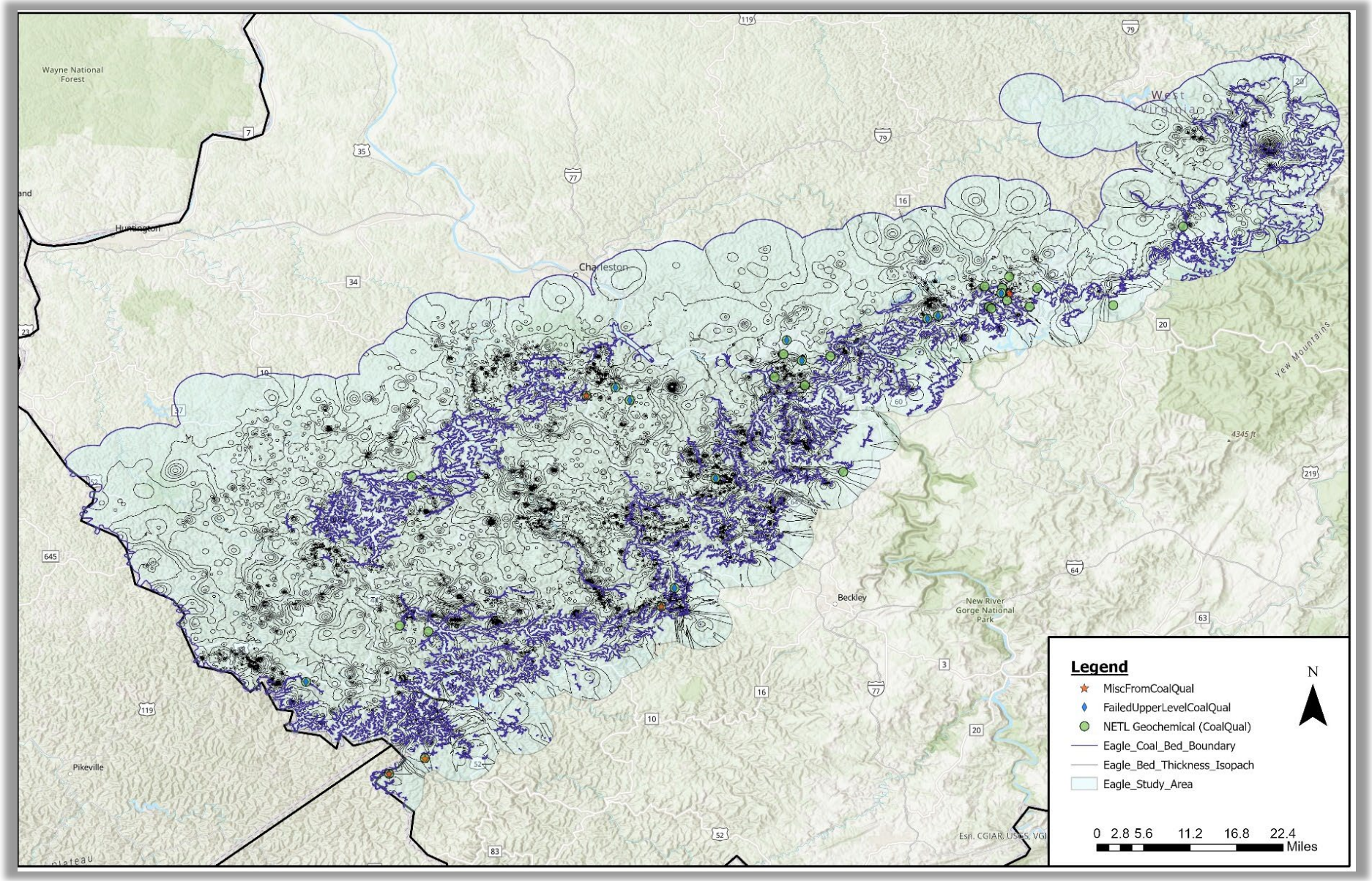
Preliminary Resource Assessment – Example #1



Preliminary Resource Assessment – Example #1

Only Samples with Barium in Eagle Seam in West Virginia

Eagle seam study area, bed boundary and thickness isopach shown

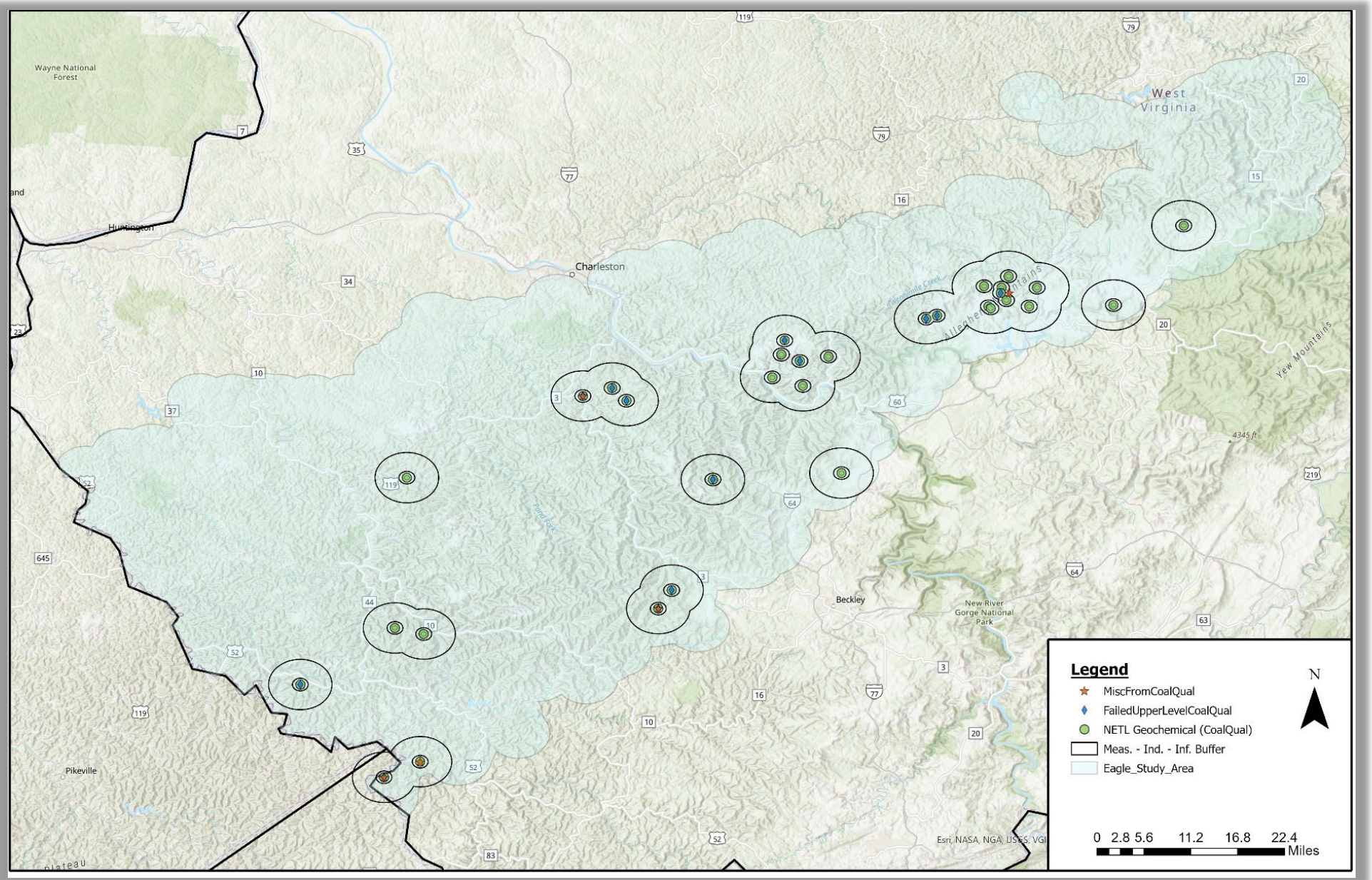


Preliminary Resource Assessment – Example #1

Only Samples with Barium in Eagle Seam in West Virginia

Eagle seam study area and measured, Indicated, Inferred buffers shown.

Measured – ¼ Mile
Indicated – ¾ Mile
Inferred – 3 Miles

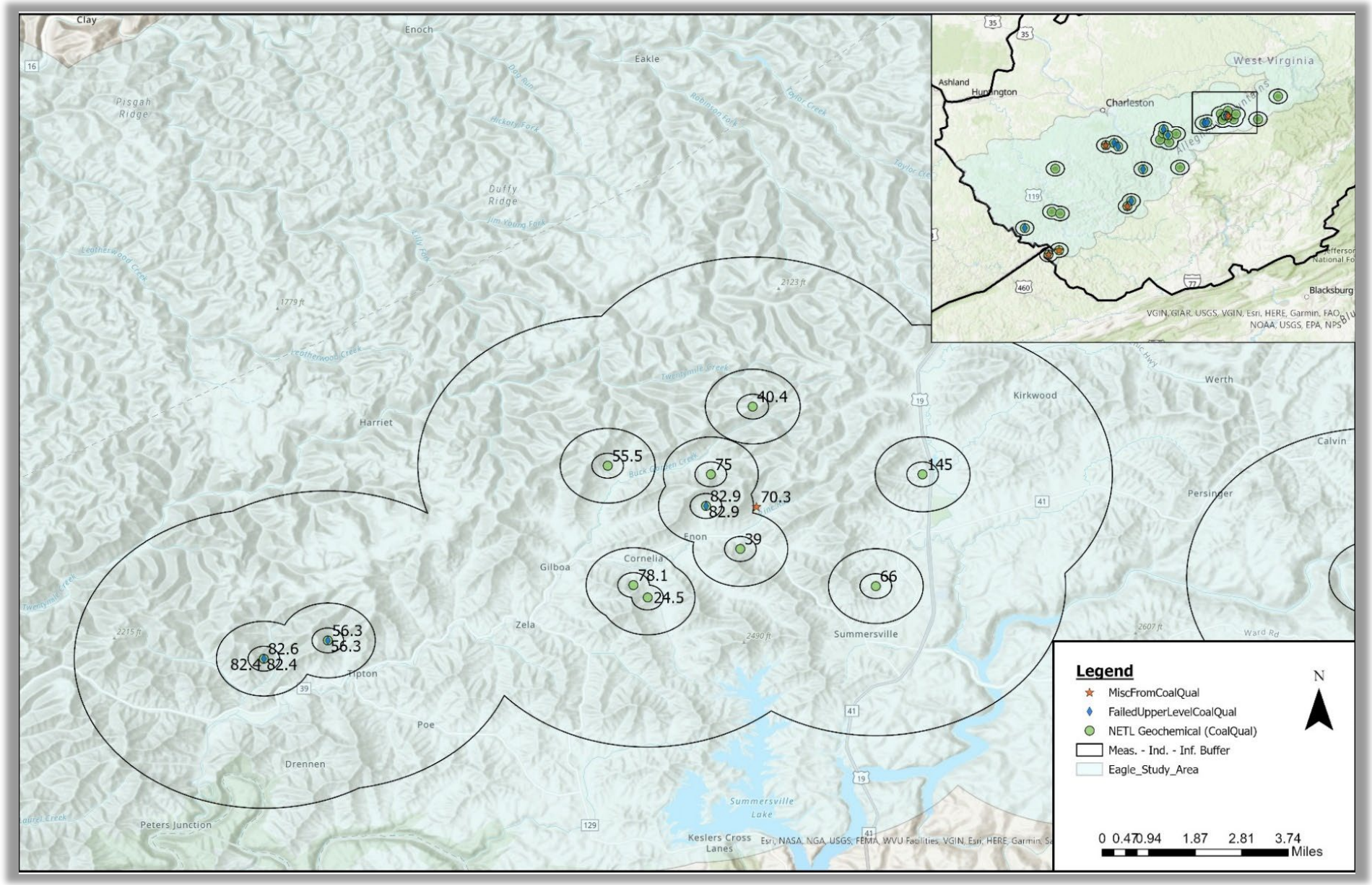


Preliminary Resource Assessment – Example #1

Only Samples with Barium in Eagle Seam in West Virginia

Eagle seam study area and measured, Indicated, Inferred buffers shown. Zoomed in view

Measured – ¼ Mile
Indicated – ¾ Mile
Inferred – 3 Miles



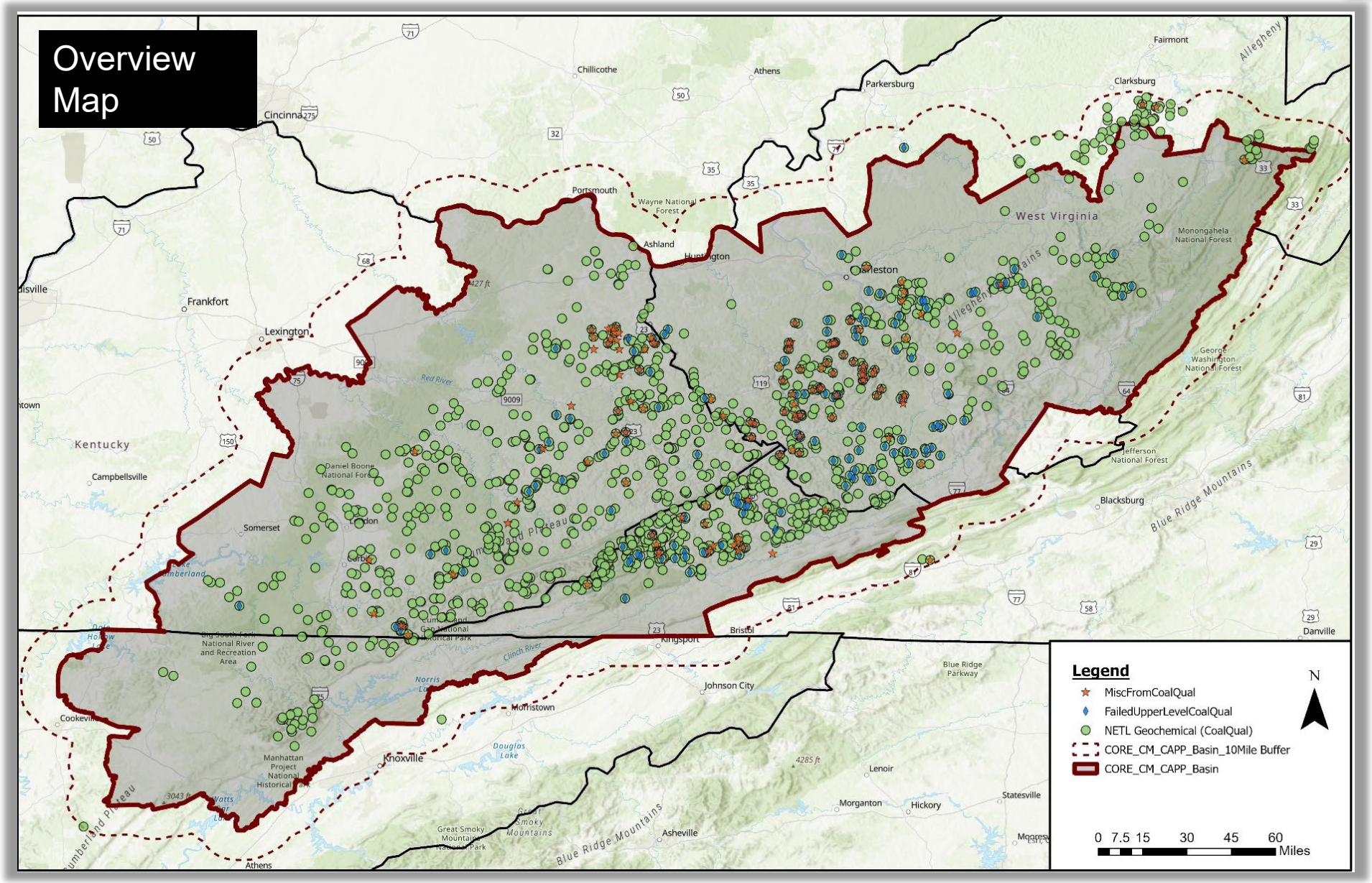
Preliminary Resource Assessment – Example #2

Kentucky

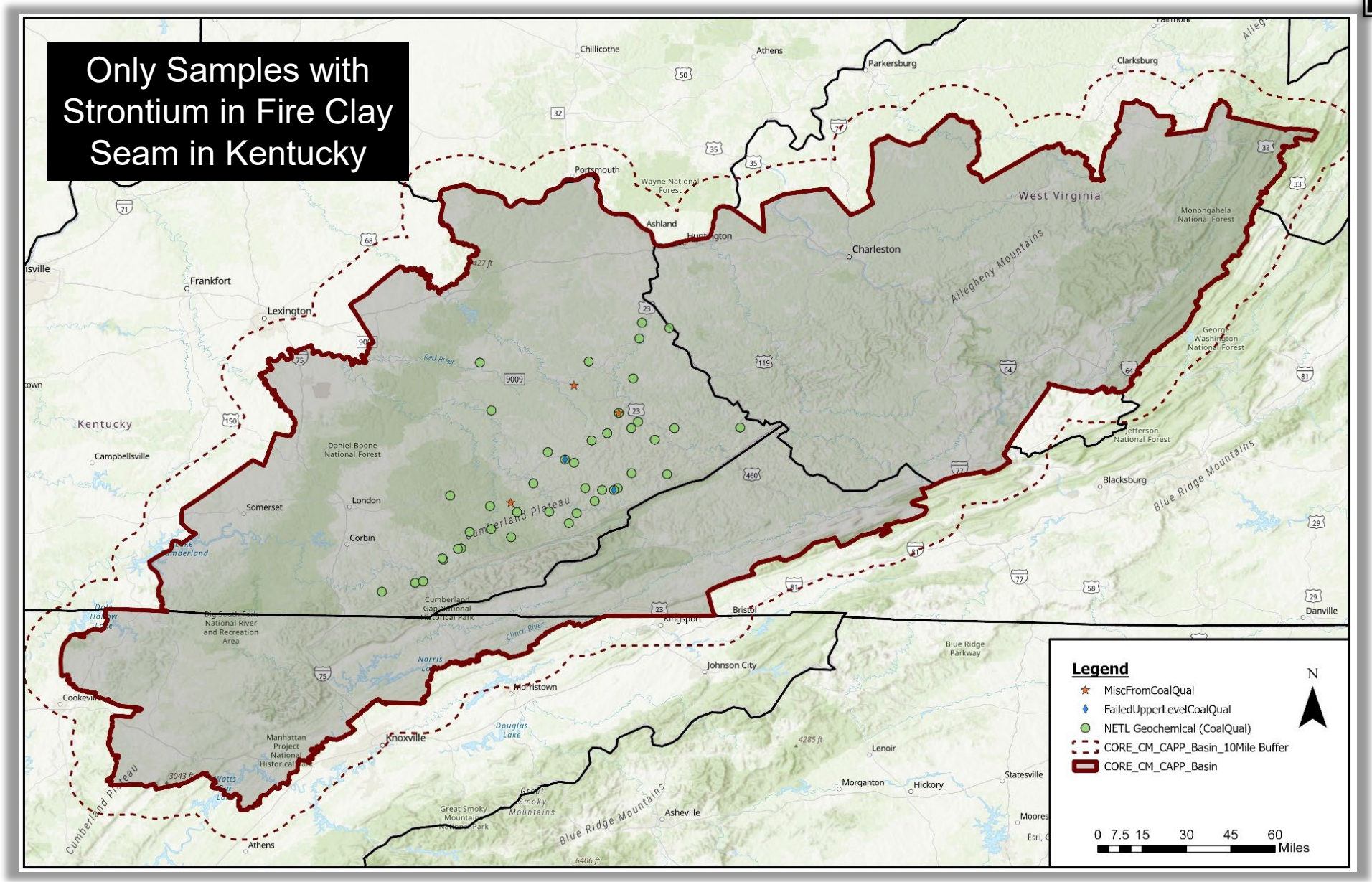
Fire Creek Coal Seam

Strontium

Preliminary Resource Assessment – Example #2



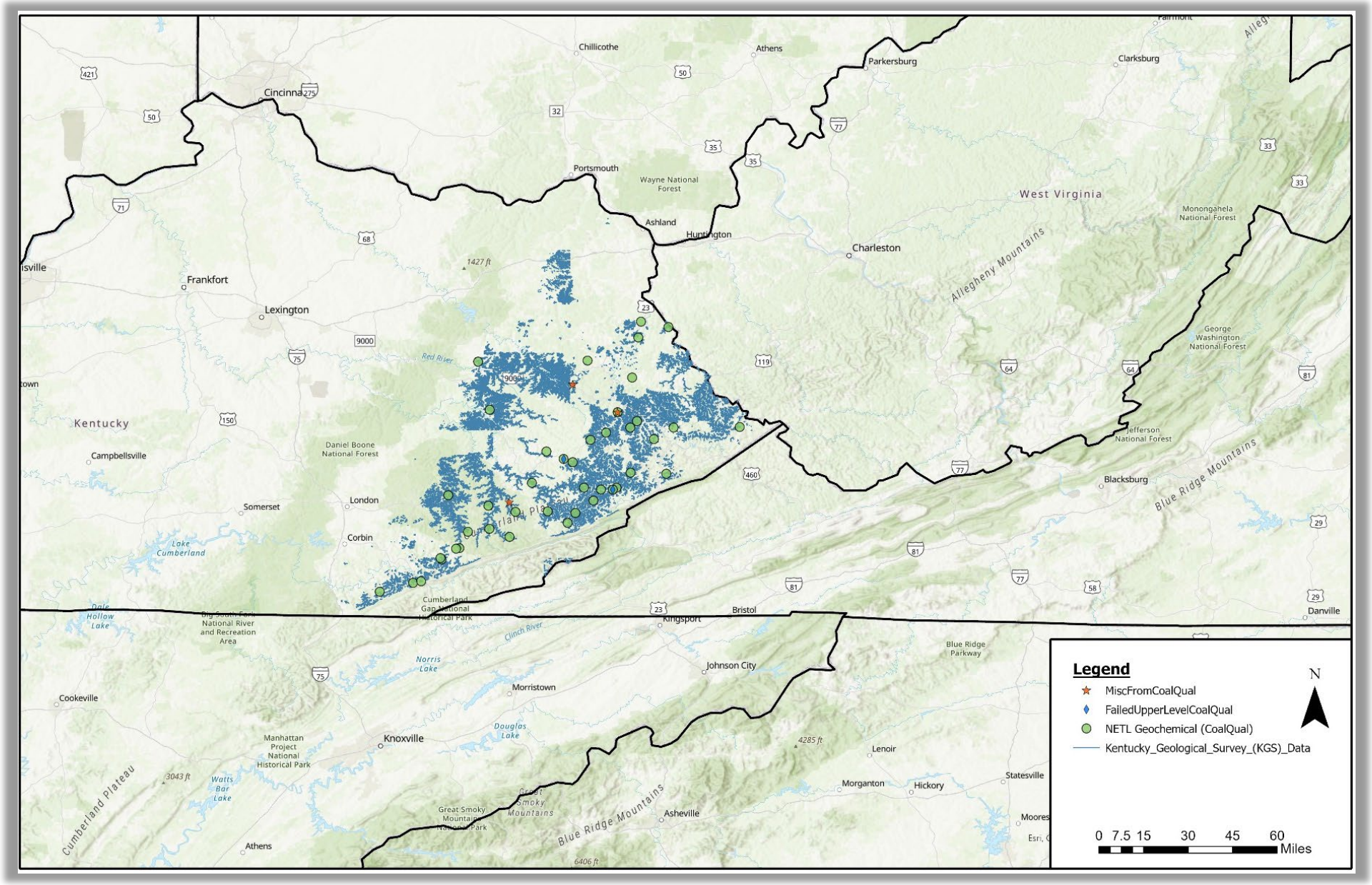
Preliminary Resource Assessment – Example #2



Preliminary Resource Assessment – Example #2

Only Samples with Strontium in Fire Clay Seam in Kentucky

Outcrop data for Fire Clay seam shown.

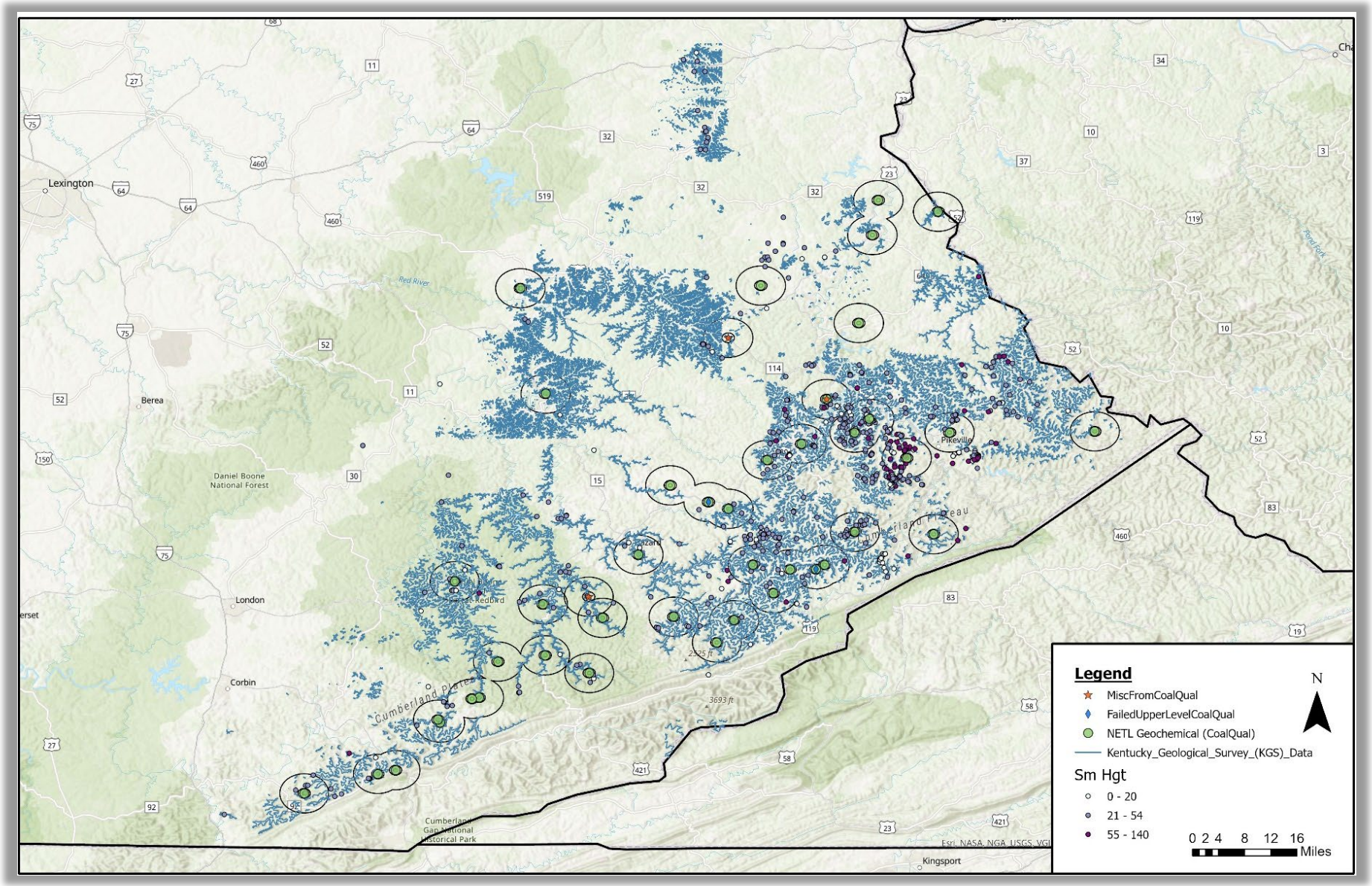


Preliminary Resource Assessment – Example #2

Only Samples with Strontium in Fire Clay Seam in Kentucky

Outcrop data, KY MMIS mine data locations with Fire Clay seam heights in inches and Measured, Indicated and Inferred buffers shown.

Measured – ¼ Mile
Indicated – ¾ Mile
Inferred – 3 Miles



Summary

- The work is very much ongoing.
- Classification of data is required.
- Development of sampling plan in progress.
- Development of resource classification criteria in progress.
- Gap Analysis is developing as work progresses.