

SECTION III: Underground Bituminous Coal Mining During the 3rd Assessment Period

III.A - Overview

The determination of impacts began by ascertaining what lands were undermined by bituminous coal mines between August 21, 2003 and August 20, 2008. The University accomplished this by collecting and analyzing the 6-month mining maps that are part of every mine's permit files and by company supplied digital maps. Fifty mines were identified as active during this period and their mining extents were determined and sorted by the type of mine, mining method, coalbed, overburden, size, and location. It should be noted that throughout this report, maps show only those areas undermined during the 3rd assessment period and not the total subsidence boundary.

III.B – Mines in Operation during the 3rd Assessment Period

The identity of the mines that operated during the 3rd assessment period were determined with PA DEP assistance, using coal production records, 6-month mine maps, and BUMIS records. Areas within individual mines where active mining operations took place were determined from 6-month mining maps and through digital maps obtained from the mine operators. In many cases, the digital maps included additional details which made it easier to determine the extent of mining that occurred during the period. For some mines, it was difficult to determine the exact location of production faces based on available maps. In these cases, the approximated mining location was determined by interpolating between points with known dates. A list of all active mines is provided in Appendix A and their locations are displayed on Plate 1.

III.B.1 – Room-and-Pillar Mines

Ten companies operated 36 underground room-and-pillar mines during the 3rd assessment period (Table III-1). The percentage of mines operated by the ten companies is shown in Figure III-1. The largest company was Rosebud Mining, followed by AmFire, TJS, and Roxcoal. These four companies accounted for 81-pct of the room-and-pillar mines. Six other companies operated the remaining 19-pct of the mines. Many of the room-and-pillar operations were locally owned.

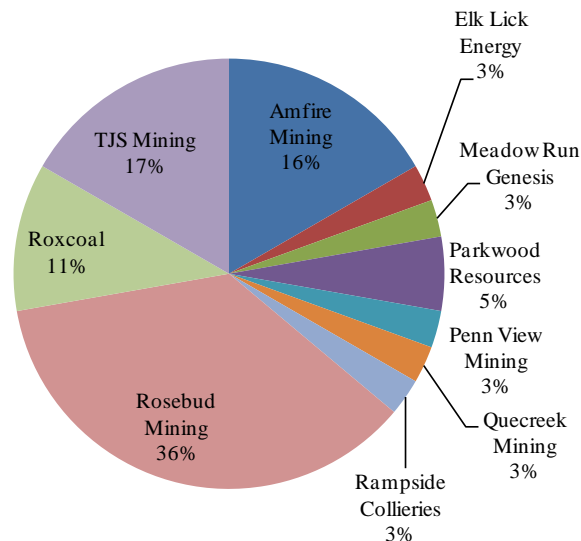


Figure III-1 - Percentage of room-and-pillar mines operated by ten different companies.

Table III-1 - Active room-and-pillar mines sorted by mining company.

Company	#	Mine Name
AmFire Mining Co.	6	Dora No.8, Gillhouser Run, Madison, Ondo, Ridge, Triple K No.1 ¹
Elk Lick Energy Inc.	1	Roytown
Meadow Run Genesis Inc	1	Genesis No.17
Parkwood Resources Inc.	2	Cherry Tree, Parkwood
Penn View Mining Inc.	1	Penn View
Quecreek Mining Inc.	1	Quecreek No.1
Rampside Collieries Inc.	1	Rampside No.1
Rosebud Mining Co.	13	Beaver Valley, Clementine No.1 ² , Josephine No.3, Little Toby, Penfield, Toms Run ³ , Tracy Lynne, Twin Rocks, Windber No.78, Dutch Run, Keystone East, Logansport, Stitt
Roxcoal Inc.	4	Agustus, Geronimo, Miller, Sarah
TJS Mining Inc.	6	Darmac No.2, Darmac No.3, Rossmoyne No.1, TJS No.4, TJS No.5, TJS No.6

¹ - Formerly Mears Enterprises Inc.; ² - Formerly McVilleville Mining Co.; ³ - Formerly Burrell Mine owned by Pennamerican Coal LP

III.B.2 – Room-and-Pillar Mines with Pillar Recovery

Six additional room-and-pillar mines employing the pillar recovery mining methods were active during the 3rd assessment period (Table III-2). These mines were operated by three companies: AmFire, Cobra Mining, and Dana Mining. In all six operations, pillar recovery occurred in relatively small mining blocks, typically less than 1000-ft in length. These areas were mostly within production panels but occasionally occurred along main entries as the mines retreated from their reserves.

Table III-2 – Active room-and-pillar mines with pillar recovery sorted by mining company.

Company	Number	Mine Name
AmFire Mining Co.	1	Nolo
Dana Mining Co. of Pennsylvania Inc.	4	Crawdad No.1, Dooley Run, Titus, 4 West
Cobra Mining LLC	1	Dunkard No.2

III.B.3 – Longwall Mines

Eight longwall mines were active during the 3rd assessment period (Table III-3). The Shoemaker mine operated largely in the state of West Virginia but a small portion of its reserve crossed over into Washington County. These eight mines were owned by three large companies: Consol Energy, Alpha Resources (formerly Foundation Coal), and UMC Energy (a part of Murray Energy Corp.). Many of these longwall operations were among the most productive underground coal mines in the nation.

Table III-3 – Active longwall mines sorted by mining company.

Company	Number	Mine Name
Consol Energy	5	Bailey, Blacksville No.2, Enlow Fork, Mine Eighty-Four, Shoemaker
Foundation (now Alpha Resources)	2	Cumberland, Emerald
UMCO Energy	1	High Quality

III.C – Mining in Different Coalbeds (Stratigraphic Influences)

The Commonwealth of Pennsylvania has significant reserves of coal. This resource is arranged in beds contained within the Pennsylvanian and Permian Systems. No Permian Coalbeds were mined in PA using underground methods during the 3rd assessment period. Rocks within the Pennsylvanian System range from 299 to 318-million years old (Anon, 2007) and range in thickness from 1,300 to 1,500-ft (Edmunds, et. al, 1999). In this region, the Pennsylvanian System contains six formations named:

- Uniontown Formation – late Pennsylvanian shales, sandstones, and thin coalbeds
- **Pittsburgh Formation** – **minable coalbeds**, shales, sandstones, and limestones
- Casselman Formation - claystones, shales, sandstones, and thin limestones
- Glenshaw Formation – claystones, shales, sandstones, and thin limestones
- **Allegheny Formation** – **minable coalbed**, shales, claystones, sandstones, and limestones
- Pottsville Formation – early Pennsylvania shales and sandstones

The Casselman and Glenshaw Formations combine to form the Conemaugh Group and the Pittsburgh and Uniontown Formations form the Monongahela Group. The Pottsville Formation and the Conemaugh Group, sometimes referred to as the lower and middle barren formations, are typically void of minable coalbeds. The two prominent coal bearing formations are the Allegheny and the Pittsburgh. The older Allegheny Formation contains the Freeport and Kittanning Coalbeds while the younger Pittsburgh Formation contains the Pittsburgh and Sewickley Coalbeds (Figure III-2).

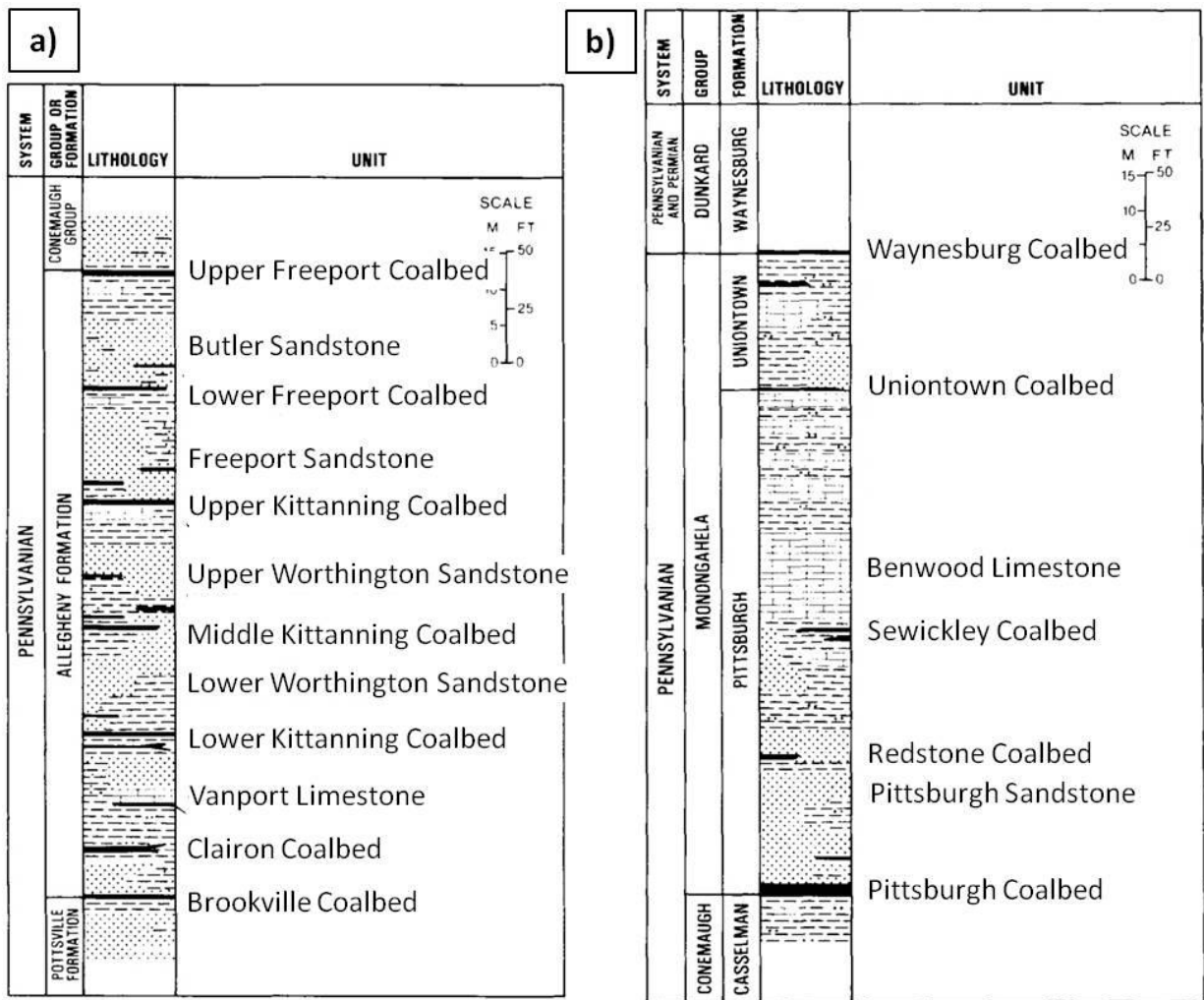


Figure III-2 - Generalized stratigraphic sections of the a) Allegheny and b) Pittsburgh Formations of western Pennsylvania (Edmunds, et. al, 1999).

III.C.1 – Coalbeds Mined

Six coalbeds were mined during the 3rd assessment period. Four of the coalbeds are contained within the Allegheny Formation and two within the Pittsburgh Formation (Table III-4). The Allegheny Formation contains 36 mines while the Pittsburgh Formation has 14 mines. The Allegheny Formation ranges from 270 to 330-ft thick so the distance between the Lower Kittanning and Upper Freeport Coalbeds is relatively moderate (Edmunds, 1999). The Pittsburgh Formation averages 240-ft thick with the distance between the Pittsburgh and Sewickley Coalbeds averaging 125-ft. The Allegheny and Pittsburgh Formations are separated by the Conemaugh Group that ranges in thickness from 520-ft in western Washington County to 890-ft in Somerset County (Edmunds, 1999). This more significant vertical separation has coalbeds associated with these two formations outcropping in different areas. It is logical, for comparison sake, to group and analyze these coalbeds by formation.

Table III-4 - Coalbeds with active mines, listed by number and Formation.

Formation	Coalbed	Number of Mines
Pittsburgh	Sewickley	5
	Pittsburgh	9
Allegheny	Upper Freeport	14
	Lower Freeport	2
	Upper Kittanning	8
	Lower Kittanning	12

The number of mines that operated in a particular coalbed was not necessarily a good indicator of the total area that was undermined. Figure III-3 shows the relationship between the areas mined by a particular coalbed versus the number of mines operated in this coalbed. The nine mines in the Pittsburgh Coalbed were, with the exception of the Ridge Mine, all large longwall operations and their corresponding footprint on the surface was equally large. On the other end of the spectrum were the 14 mines in the Upper Freeport Coalbed. These mines were generally very small room-and-pillar mines that were limited by the number and extent of mineable blocks of coal.

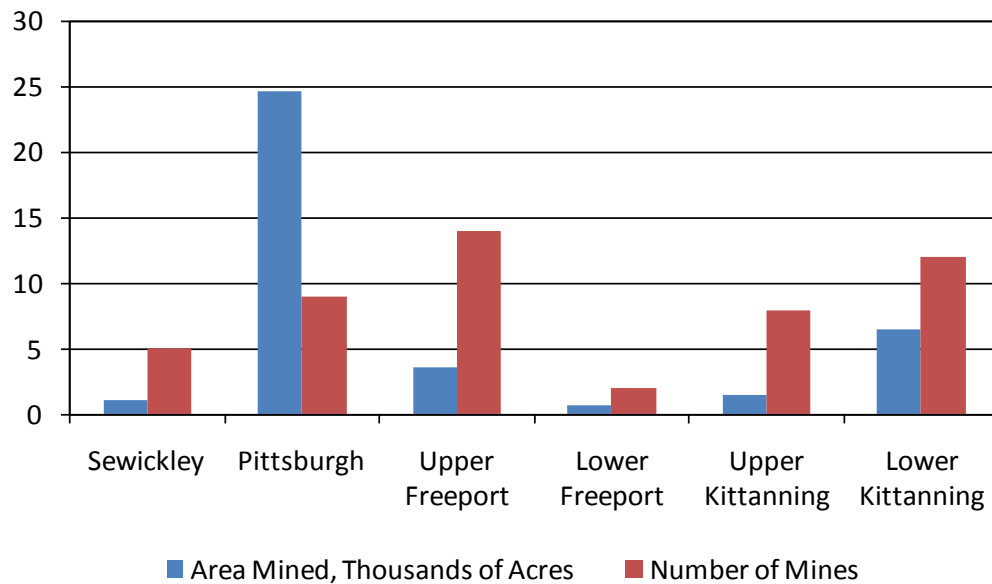


Figure III-3 - Distribution of areas mined by coalbed.

III.C.2 – Allegheny Formation Coalbeds (Freeport and Kittanning Coalbeds)

Because the Allegheny Formation Coalbeds are lower in the stratigraphic section than Pittsburgh Formation Coalbeds, they occur under larger areas of surface land. The broad lateral expression of the Allegheny Formation Coalbeds is due to a combination of factors, including erosional history, structural setting, depositional environment and stratigraphic position. Figure III-4 is a map of the extensive surface area underlain by the Upper Freeport Coalbed in western Pennsylvania. The Lower Freeport and Kittanning Coalbeds, to the extent they are present, are found beneath the same general areas.

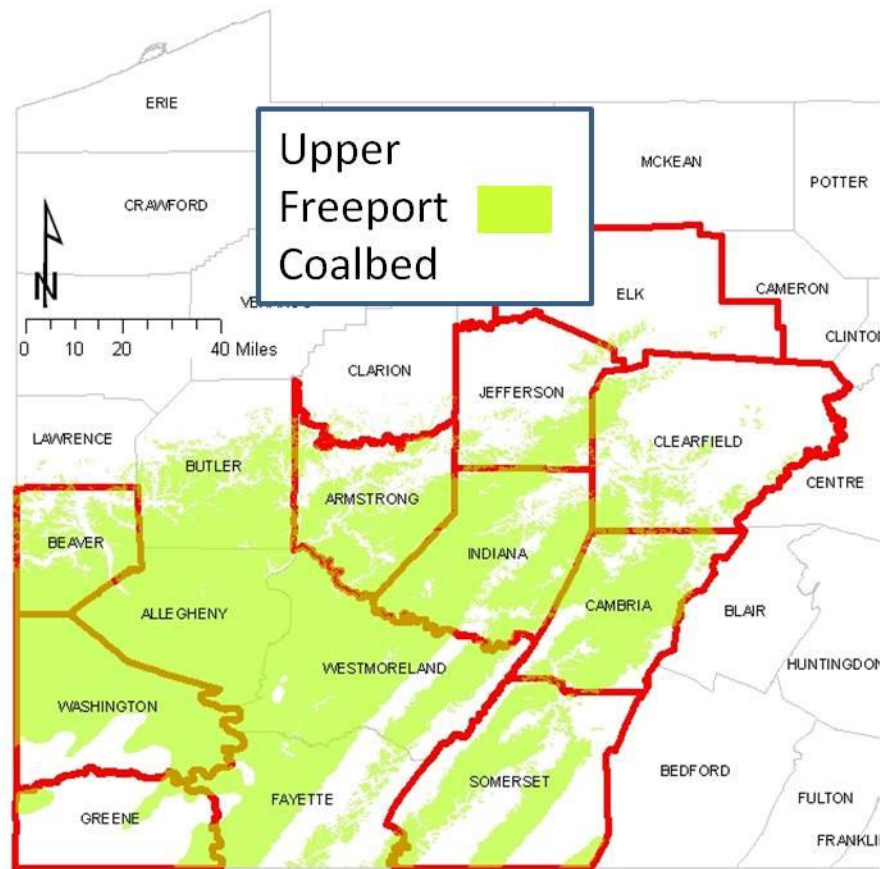


Figure III-4 - Areas underlain by the Upper Freeport Coalbed. Note - The footprint of the Freeport approximates the areas underlain by other Allegheny Formation Coalbeds.

Since the coal basin dips gently to the southwest, the Allegheny Formation Coalbeds mainly crop out along a belt from Beaver County through Butler, Armstrong, Indiana and Cambria Counties and finally bends southward through Somerset and Fayette Counties (Figure III-5). Mines in these areas tend to be less than 500-ft below the surface. Mineable blocks of coal are segmented by outcropping of the coalbed or by areas of un-mineable coal thickness, i.e. less than 3-ft. In addition, these same areas have witnessed significant mining in the past. Further to the southwest into western Washington and Greene Counties, the Allegheny Coalbeds are under significant overburden (approaching 2,000-ft in some areas). These areas represent future mining prospects.

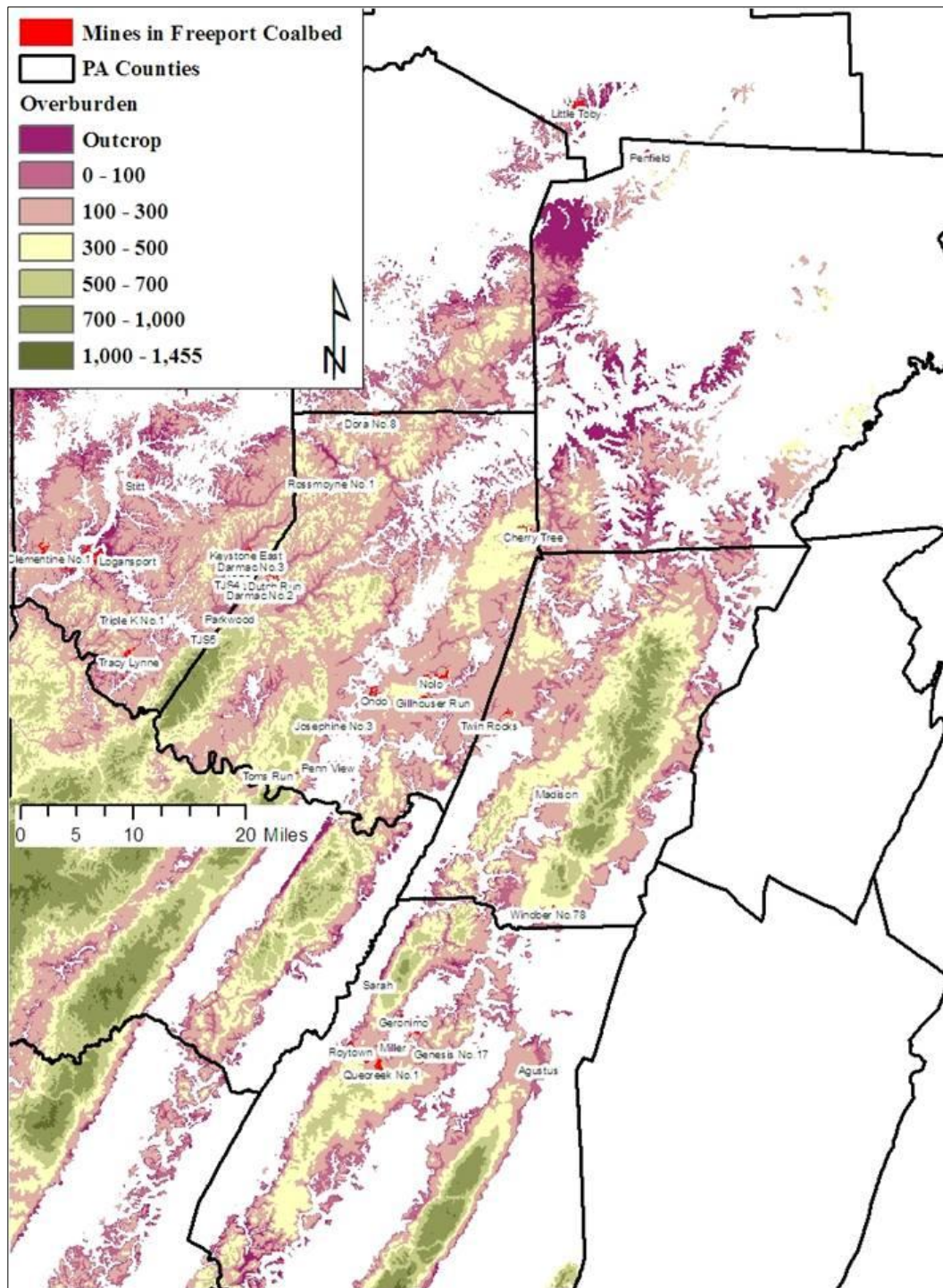


Figure III-5 –The overburden of the Upper Freeport Coalbed and the locations of the 36 mine operated in Allegheny Formation Coalbeds.

III.C.3 – Pittsburgh Formation Coalbeds (Pittsburgh and Sewickley)

Pittsburgh Formation Coalbeds are found in eight counties (Figure III-6). The vast majority of the current, and future, mining in the Pittsburgh Formation Coalbeds is located in Greene and

Washington Counties where the coal is relatively continuous and, for the most part, relatively deep (400 to 2,000-ft). Allegheny, Fayette, and Westmoreland Counties also have continuous deposits of the Pittsburgh Coalbed, however, the shallow depth (< 400-ft) of the coal made it easily accessible for underground mining and it is now largely mined out.

In Armstrong, Indiana and Somerset Counties, the Pittsburgh Coalbed occurs in a few relatively small basins remote from the main group of Pittsburgh Coalbed mines that operated during the reporting period. Only one operation, the Ridge Mine in Armstrong County, mined in an isolated small pocket of yet un-mined Pittsburgh Coalbed with an overburden less than 200-ft.



Figure III-6 - Areas underlain by the Pittsburgh Coalbed. Note - While current mining in the Pittsburgh Coalbed is largely limited to Greene and Washington Counties, drift and shaft mining have occurred in Allegheny, Armstrong, Fayette, Indiana, Somerset and Westmoreland Counties over the last 100 years.

The current mining in Pittsburgh Formation Coalbeds primarily occurred as:

- Large longwall mine in the Pittsburgh Coalbed within Greene and Washington Counties, and
- Small room-and-pillar mining with some pillar recovery in the Sewickley Coalbed within Greene County.

The overburden above the Pittsburgh Formation increases steadily to the southwest (Figure III-7). Current longwall mining occurred at depths ranging from greater than 400-ft to

approximately 1,000-ft. The one exception to this is the High Quality Mine where the depth of cover ranged from 195 to 560-ft. Most of the un-mined coal reserves lie within the central portion of the basin where the overburden is between 700 and 1,400-ft (Figure III-7). Conversely, the Sewickley Coalbed was mined towards the eastern margin of the Pittsburgh Formation extent where overburdens ranged between 300 and 500-ft. These operations typically mined isolated, relatively small, blocks of coal.

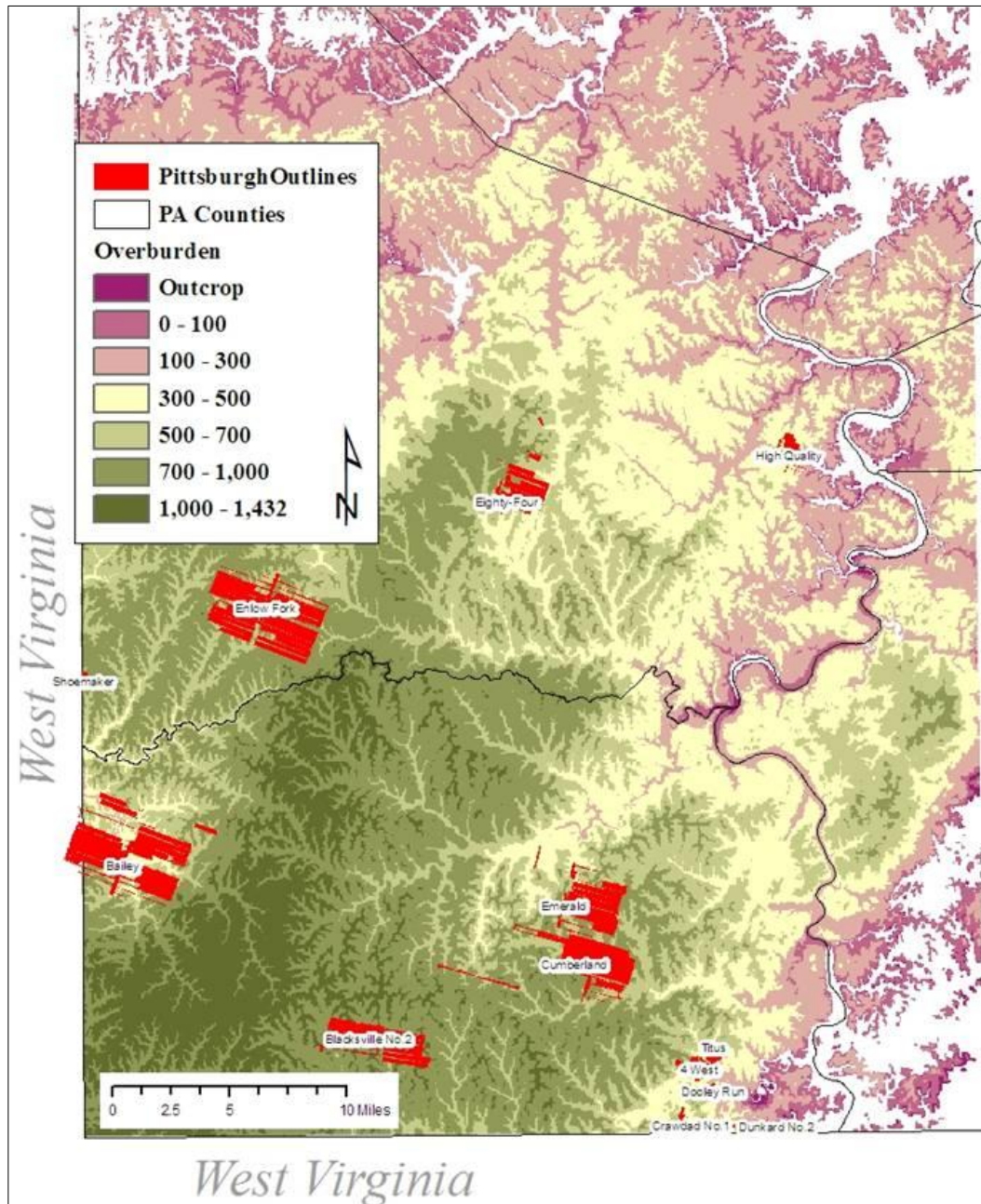


Figure III-7 - The overburden of the Pittsburgh Coalbed and the location of 13 mines that operated in Pittsburgh Formation Coalbeds. The 14th Pittsburgh Formation Coalbed mine is located to the north of this map view in Armstrong County.

III.D – Area and Surface Properties Undermined Organized by the Type and Method of Mining

As the data in Section III.C.1 indicate, the operations with the largest areas mined during the study period are longwall mines in the Pittsburgh Coalbed. Conversely, operations with the smallest areas mined were room-and-pillar operations in the Freeport and Kittanning Coalbeds. This section makes a more detailed comparison between the areas mined, surface properties undermined, type of mines, and mining methods.

Of the three types of mines, longwall mines comprised 64.3-pct of the total area, followed by room-and-pillar mines with 30.2-pct, and room-and-pillars mines with pillar recovery with 5.5-pct (Table III-5). A total of 3,587 properties were undermined during the 3rd assessment period. Room-and-pillar mines undermined 1,738 (48.5-pct) of the total surface properties and longwall and pillar recovery mines 1,572 (43.8-pct) and 277 (7.7-pct) respectively. The average size of properties above room-and-pillar mines was 6.7 acres while properties over longwall mines averaged 15.7 acres.

*Table III-5 - Acres of the three **mine types** during the 3rd assessment period.*

Type of Mine	Area Mined, Acres	Percentage	Properties Undermined	Percentage
Room-and-pillar	11,552	30.2	1,738	48.5
Room-and-pillar with pillar recovery	2,097	5.5	277	7.7
Longwall	24,607	64.3	1,572	43.8

When areas mined were compared by the *mining method*, a different trend was observed. For an explanation of the different mining methods used during this reporting period, refer to Section I-C. Room-and-pillar mining (including the longwall gate road developments) accounted for 53.3-pct with longwall mining (panels only) at 46-pct (Table III-6). This was not surprising since every longwall panel was surrounded by a section of the main entry and gate road developments. These areas were designed to maintain stability by supporting a portion of the overlying strata.

*Table III-6 – Acres of the three **mining methods**.*

Mining Method	Area Mined, Acres	Percentage
Room-and-pillar	20,375	53.3
Pillar recovery	276	0.7
Longwall	17,605	46

The entire area where pillar recovery mining occurred accounted for only 0.7-pct of the total area undermined (Table III-6). Perhaps the mining companies purposely avoided using pillar recovery beneath properties with structures and water supplies.

III.D.1 – Area and Surface Properties Undermined by Room-and-Pillar Mines

Thirty-six room-and-pillar mines operated during the 3rd assessment period. These mines extended under 11,552 acres of land and 1,743 surface properties. Room-and-pillar mines had mining developments in all six coalbeds listed (Table III-7).

Table III-7 - Areas undermined by room-and-pillar mines.

Coalbed	Areas Mined, Acres	Properties Undermined
Pittsburgh	85	36
Upper Freeport	3,642	520
Lower Freeport	714	160
Upper Kittanning	1,556	235
Lower Kittanning	5,555	787
Total	11,552	1,738

The thirty-six room-and-pillar mines ranged in area mined from a maximum of 1,149 acres at the Clementine No.1 Mine to a minimum of 3 acres at the Rampside No.1 Mine (Figure III-8). The average room-and-pillar mine undermined 321 acres during the 3rd assessment period with an average mining rate slightly over 5 acres/month.

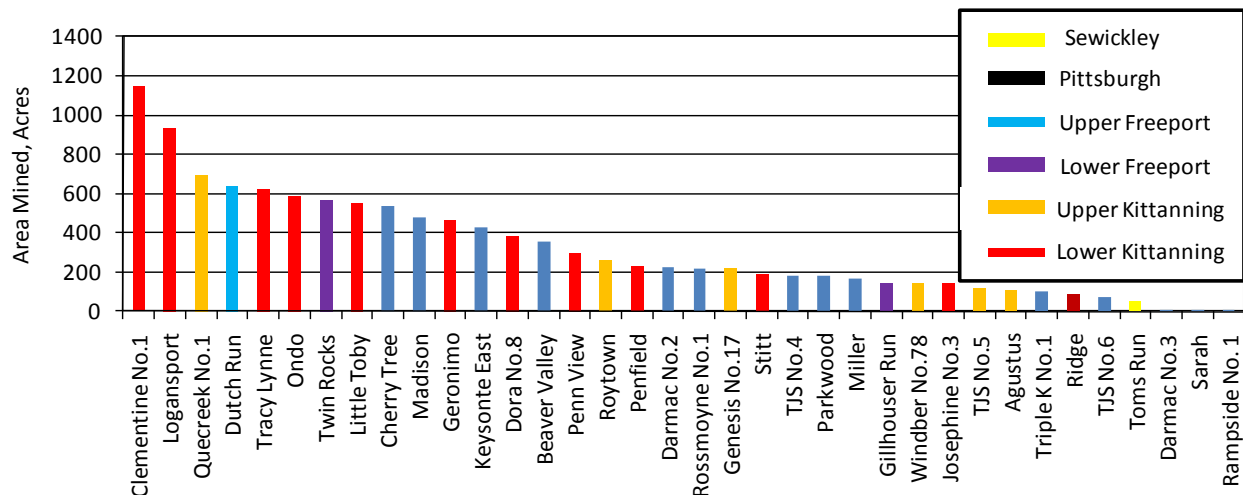


Figure III-8 - Areas mined and coalbeds for thirty-six room-and-pillar mines.

III.D.2 – Area and Surface Properties Undermined by Room-and-Pillar Mines with Pillar Recovery

Six room-and-pillar mines with pillar recovery undermined 2,097 acres and 277 surface properties (Table III-8). The average size of the pillar recovery areas was 46 acres representing about 15-pct of the total area mined.

Table III-8 - Areas undermined by room-and-pillar mines with pillar recovery.

Mine Name	Coalbed	Room and Pillar, Acres	Pillar Recovery, Acres	Total, Acres	Properties Undermined
Nolo	Lower Kittanning	880	50	930	177
Crawdad No.1	Sewickley	326	86	412	18
4 West	Sewickley	407	9	416	45
Titus	Sewickley	187	73	260	18
Dooley Run	Sewickley	21	9	30	7
Dunkard No.2	Sewickley	0	49	49	12
Total		1,821	276	2,097	277

III.D.3 – Area and Surface Properties Undermined by Longwall Mines

Eight longwall operations mined below 24,607 acres of land and 1,572 surface properties (Table III-9). These operations had a combination of room-and-pillar and longwall mining methods. The average percentage of room-and-pillar mining was 28.5-pct. The eight longwall mines ranged in area mined from maximum of 6,339 acres at the Enlow Fork Mine to a minimum of 72 acres at the Shoemaker Mine. The average longwall mine, excluding the Shoemaker Mine where operations mainly occurred in West Virginia, undermined 3,505 acres with an average mining rate of a little more than 58 acres/month. This represented a ten-fold increase in area mined over the room-and-pillar mines. On any given day during the 3rd assessment period, longwall mining undermined an average of 13.5 acres of PA land.

Table III-9 – Amount of land and surface properties undermined by the eight longwall mines.

Mine Name	Longwall, Acres	Room-and-Pillar, Acres	Total, Acres	Percentage Longwall Acres	Properties Undermined
Enlow Fork	4,890	1,449	6,339	77.1	249
Bailey	4,529	1,782	6,311	71.8	238
Cumberland	2,322	1,343	3,665	63.4	212
Blacksville No.2	2,107	773	2,880	73.2	144
Emerald	1,973	882	2,855	69.1	244
Eighty-Four	1,562	422	1,984	78.7	209
High Quality	181	320	501	36.1	273
Shoemaker	41	31	72	56.9	3
Totals	17,605	7,002	24,607		1,572

III.E – Mining in Different Counties

As has been noted in the above subsections, the distribution of mining activity is not uniform across western Pennsylvania. Mining activity in any particular area is connected to three general factors:

- 1) The occurrence of coal bearing strata, i.e. the Allegheny and Pittsburgh Formations,

- 2) The coalbed overburden, i.e. at present very little coal greater than 1,000-ft deep is being mined in Pennsylvania, and
- 3) The economic value of the coalbeds, i.e. coal thickness, quality, accessibility, ownership, etc.

The unique reaction to the three mining factors listed above, produces a wide range of mining activity that is best characterized by counties (Figure III-9). Greene County had nearly double the area mined as Washington County and Washington County was nearly double that of Armstrong County. Longwall mines operated in Greene and Washington counties. The other eight counties accounted for only 33-pct of total areas undermined. In these counties room-and-pillar mines dominated.

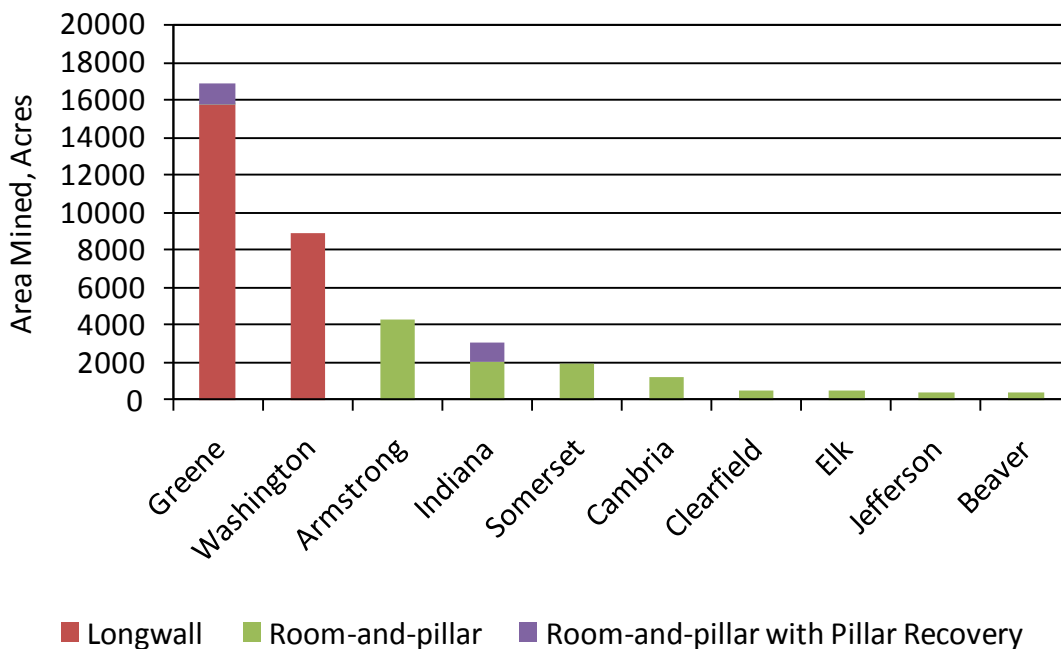


Figure III-9 - Areas undermined by County.

III.E.1 – Armstrong County

Nine mines were located in the southern half of Armstrong County (Figure III-10). All of these mines were room-and-pillar mines. During the 3rd assessment period, these nine operations mined under 4,292 acres of surface land with 833 surface properties.

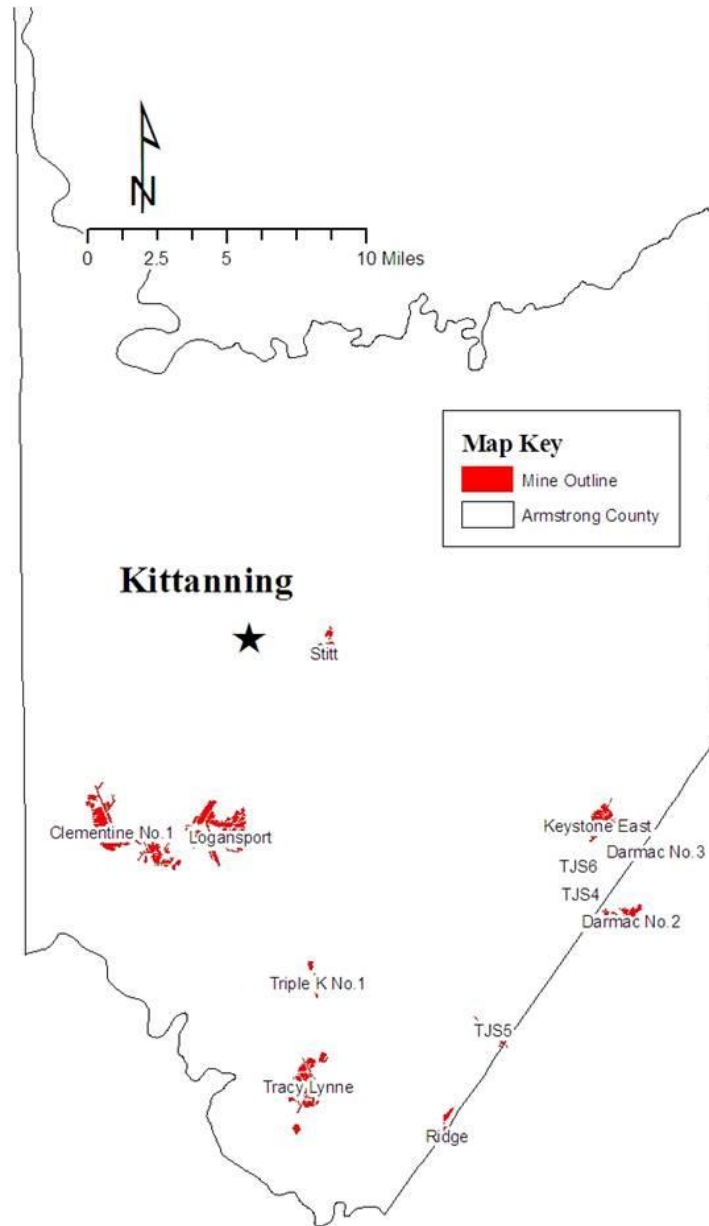


Figure III-10 - Nine mines operating in Armstrong County.

Most of the mining occurred in the Lower Kittanning Coalbed with 2,892 acres or 67-pct of the Armstrong County total (Table III-10). This was followed by the Upper Freeport with 1,199 acres or 28-pct of the total. Very small areas were mined from the Pittsburgh, 85 acres, and the Upper Kittanning, 116 acres.

Table III-10 - Area mined in Armstrong County by coalbed.

Coalbed	Area Mined, Acres	Percentage
Pittsburgh	85	2
Upper Freeport	1,199	28
Upper Kittanning	116	3
Lower Kittanning	2,892	67
Total	4,292	100

III.E.2 – Cambria County

Four mines were located in the southern half of Cambria County (Figure III-11). All of these mines were room-and-pillar mines. These four operations mined under 1,196 acres of surface land with 231 surface properties.

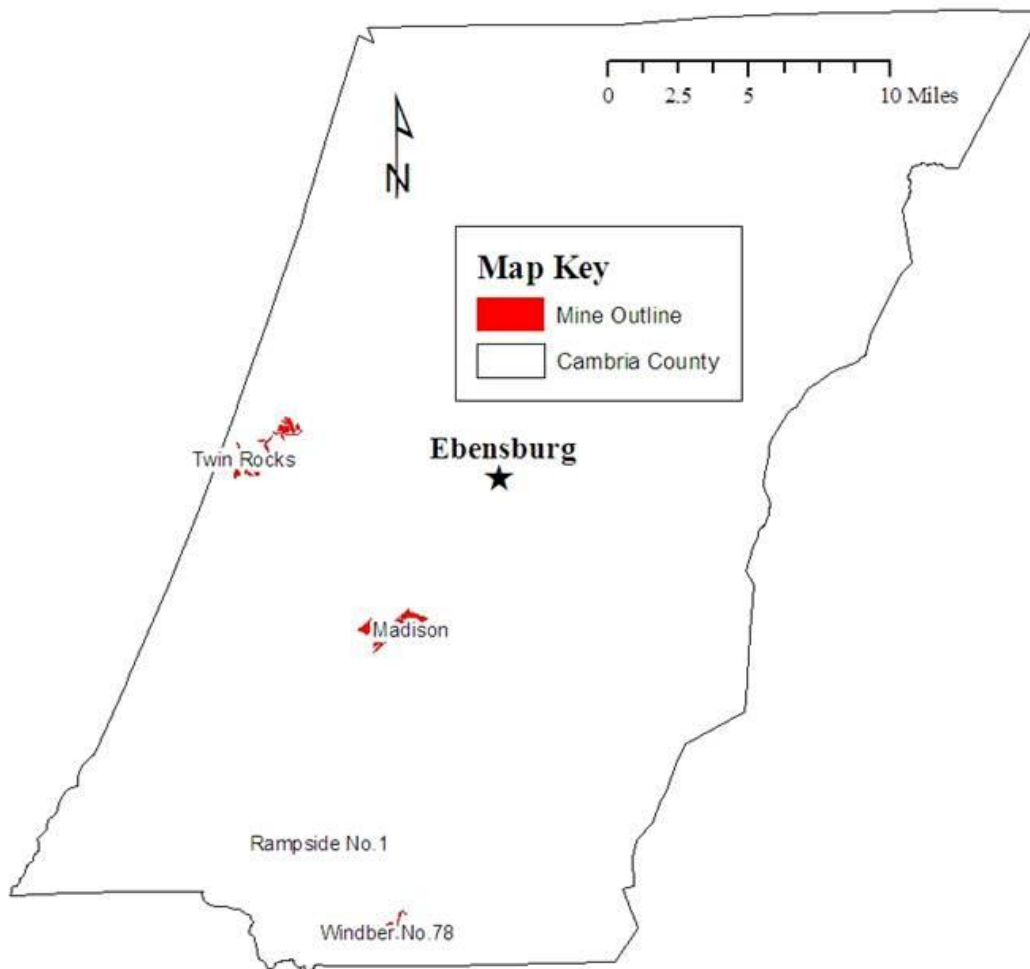


Figure III-11 - Four mines operating in Cambria County.

Most of the mining occurred in the Upper and Lower Freeport Coalbeds with 1,047 acres or 87-pct of the Cambria County total (Table III-11). A very small area was mined from the Upper Kittanning Coalbed, 146 acres.

Table III-11 - Area mined in Cambria County by coalbed.

Coalbed	Area Mined, Acres	Percentage
Upper Freeport	479	40
Lower Freeport	568	47
Upper Kittanning	146	12
Total	1,193	100

III.E.3 – Greene County

Nine mines were located in Greene County (Figure III-12). These mines were a combination of room-and-pillar with pillar recovery and longwall mines, undermining 16,878 acres of surface land with 915 surface properties.

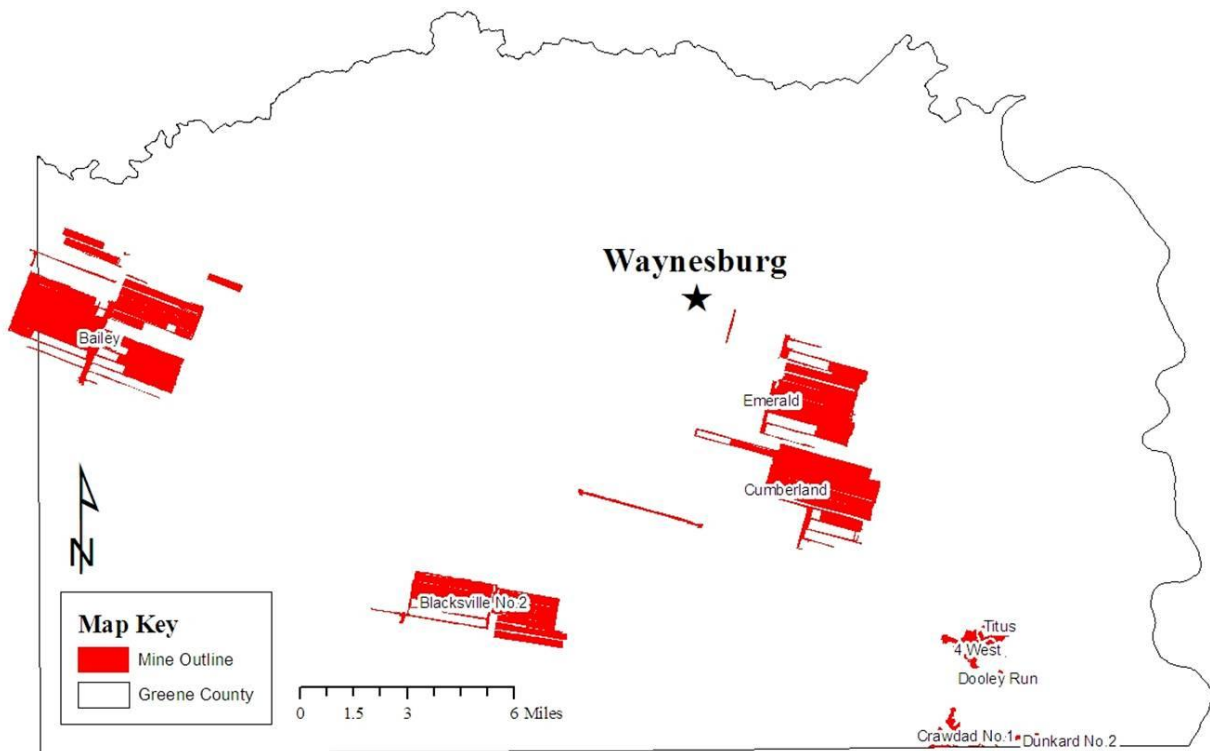


Figure III-12 - Nine mines operated in Greene County.

Most of the mining occurred in the Pittsburgh Coalbed with 15,711 acres or 93.1-pct of the Greene County total (Table III-12). In comparison, the Sewickley Coalbed accounted for 1,167 acres or just 6.9-pct of the total.

Table III-12 - Area mined in Greene County by coalbed and type of mine.

Coalbed	Type of Mine	Area Mined, Acres		Percentage	
		Coalbed	Type of Mine	Coalbed	Type of Mine
Sewickley		1,167		6.9	
Pittsburgh		15,711		93.1	
	R&P with Pillar Recover		1,167		6.9
	Longwall		15,711		93.1
Total		16,878	16,878	100	100

III.E.4 – Indiana County

Eight mines were located in Indiana County (Figure III-13). Seven of these mines were room-and-pillar and one was room-and-pillar mine with pillar recovery. During the 3rd assessment period, these eight operations mined under 3,020 acres of surface land with 429 surface properties. This total does not include acres and properties associated with the Cherry Tree Mine which was partially in Indiana and Clearfield Counties and the Darmac No.2 Mine which was partially in Indiana and Armstrong Counties.

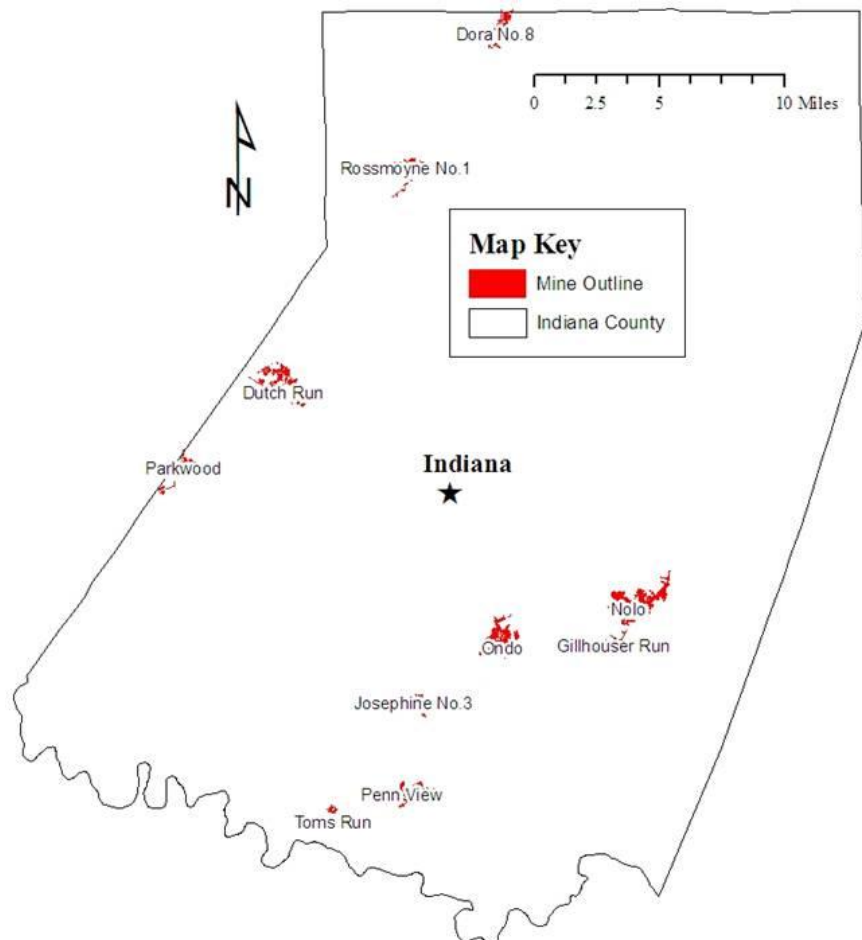


Figure III-13 - Twelve mines operating in Indiana County.

Most of the mining occurred in the Lower Kittanning Coalbed with 1,964 acres or 65-pct of the Indiana County total (Table III-13). Next was the Upper Freeport Coalbed accounting for 910 acres or 30-pct of the total followed by the Lower Freeport Coalbed with 146 acres. The one room-and-pillar mine with pillar recovery, the Nolo Mine, accounted for 930 acres, however, only a small percentage of this total was mined with the pillar recovery techniques.

Table III-13 - Area mined in Indiana County by coalbed and type of mine.

Coalbed	Type of Mine	Area Mined, Acres		Percentage	
		Coalbed	Type of Mine	Coalbed	Type of Mine
Upper Freeport		910		30	
Lower Freeport		146		5	
Lower Kittanning		1,964		65	
	Room-and-Pillar		2,090		69
	R&P with Pillar Recover		930		31
Total		3,020	3,020	100	100

III.E.5 – Somerset County

Seven mines were located in the central portion of Somerset County (Figure III-14). All of these mines were room-and-pillar mines. These seven operations mined under 1,916 acres of surface land with 254 surface properties.

Most of the mining occurred in the Upper Kittanning Coalbed with 1,291 acres or 67-pct of the Somerset County total (Table III-14). Next was the Lower Kittanning Coalbed with 461 acres, or 24-pct. A very small area was mined from the Upper Freeport Coalbed, 164 acres.

Table III-14 - Area mined in Somerset County by coalbed.

Coalbed	Area Mined, Acres	Percentage
Upper Freeport	164	9
Upper Kittanning	1,291	67
Lower Kittanning	461	24
Total	1,916	100

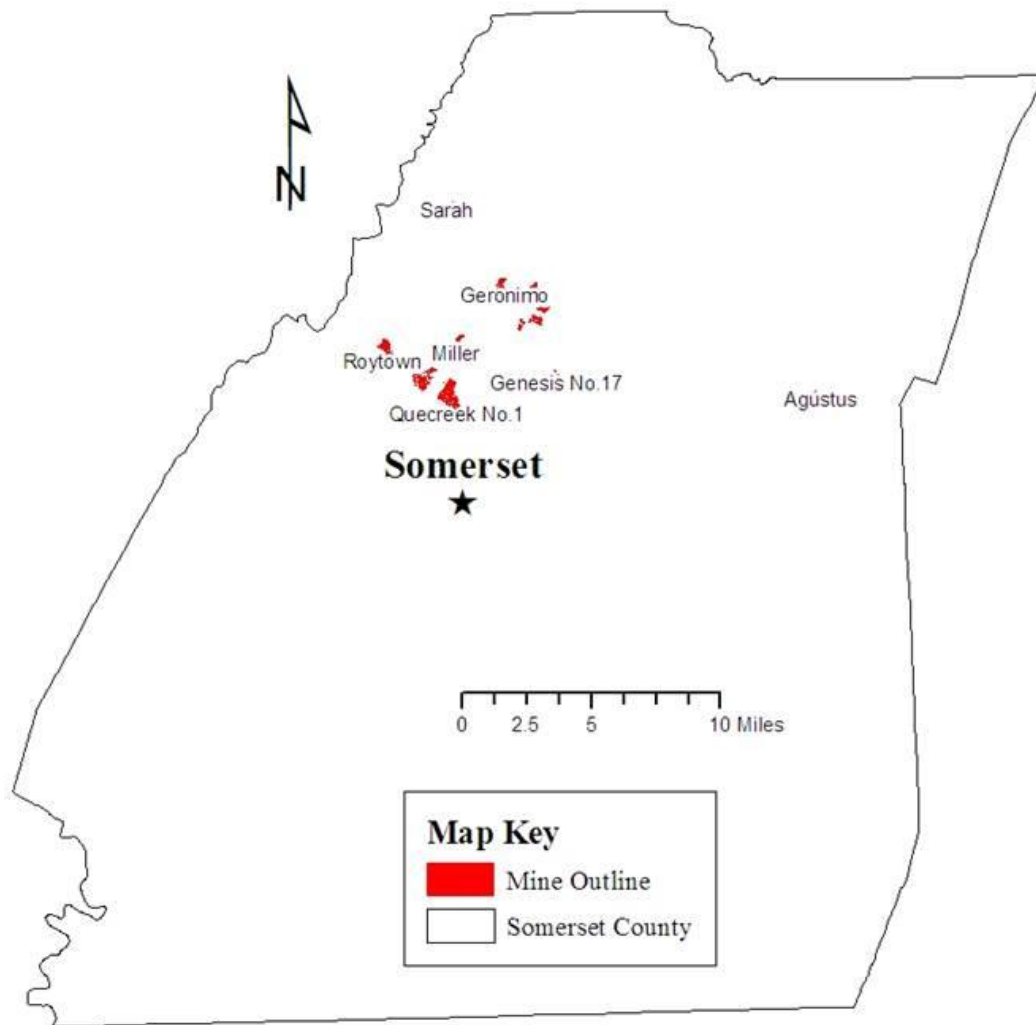


Figure III-14 - Seven mines operated in Somerset County.

III.E.6 – Washington County

Three mines were located in the southern portion of Washington County (Figure III-15). All of these operations were longwall mines within the Pittsburgh Coalbed. These three operations mined under 8,896 acres of surface land with 738 surface properties.

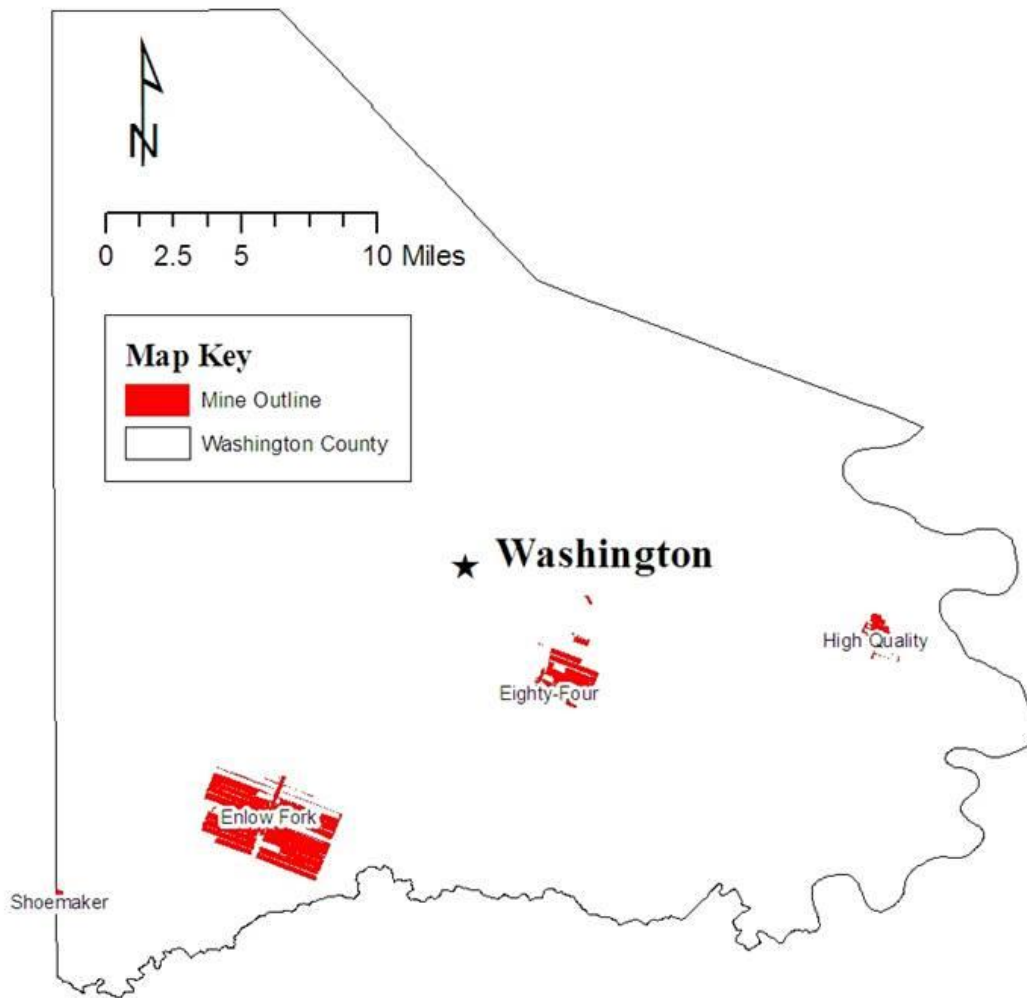


Figure III-15 - Four mines operated in Washington County.

III.E.7 – Beaver, Clearfield, Elk and Jefferson Counties

The remaining four counties, Beaver, Clearfield, Elk and Jefferson, had a combined area mined of 2,058 acres, representing just 5.4-pct of the total area mined (Table III-15). In addition, the five mines operating in these four counties undermined 155 surface properties.

Table III-15 - Area mined and properties undermined in Beaver, Clearfield, Elk and Jefferson Counties by coalbed.

County	Coalbed	Area Mined, Acres	Properties Undermine
Beaver	Upper Freeport	354	30
Clearfield	Upper Freeport	536	21
	Lower Kittanning	235	54
Elk	Lower Kittanning	552	29
Jefferson	Lower Kittanning	381	21
Total		2,058	155

III.F – Variations in Overburden

The variability in the overburden characteristics of the fifty mines studied is significant and important. The shallowest overburden at eighteen different mines was projected at less than 100-ft while four mines had maximum overburdens over 1,000-ft. These significant variations in overburden can affect land, structures, highways, water sources, streams, and wetlands in different ways.

III.F.1 – Overburden Categories

It is useful to categorize the relative overburden conditions associated with a mine or a mining method. To this end, the University measured the variable overburden and calculated the average, standard deviation, minimum, and maximum conditions for each mine. These conditions were grouped by mining type, producing three distinct overburden categories; shallow, average, and deep. The average overburden category comprised all mines whose values fell between one standard deviation of the mean. This accounted for approximately 2/3 of the mines. The other 1/3 were split between shallow or deep. The category shallow contained mines that had an average overburden greater than one standard deviation below the mean. Conversely, the category deep contains mines that had an average overburden greater than one standard deviation above the mean (Table III-16).

Table III-16 – Definitions of the overburden categories for the three mining types are shown. Ranges were based on the individual average overburdens measured for each mine.

Type of Mine	Overburden Category		
	Shallow, ft	Average, ft	Deep, ft
Room-and-Pillar (R&P)	Less than 185	185 to 397	More than 397
R&P with Pillar Recovery	Less than 283	283 to 473	More than 473
Longwall	Less than 525	525 to 850	More than 850

III.F.2 – Longwall Mine Overburden

The eight longwall mines varied in overburden from a minimum of 83-ft at the High Quality Mine to a maximum of 1,189-ft at the Blacksville No.2 Mine (Table III-17). The average longwall overburden was 687-ft with a standard deviation of 162-ft. Using the overburden categories discussed in Section III.F.1, six mines were average with one shallow and one deep (Table III-17).

Table III-17 – Overburden characteristics for longwall mines.

Mine	Avg.	SD*	Min.	Max.	Category
Bailey	648	130	311	1061	Average
Blacksville No.2	887	106	649	1189	Deep
Cumberland	739	88	559	1029	Average
Eighty-Four	627	109	362	885	Average
Emerald	725	109	356	999	Average
Enlow Fork	750	102	505	1036	Average
High Quality	338	71	83	544	Shallow
Shoemaker	784	61	661	936	Average
Total	687	162	83	1189	

* SD – Standard Deviation

The spread in the overburden distribution for each of the eight longwall mines is shown in Figure III-16. In this figure, the deep overburden conditions found within the Blacksville No.2 Mine were evident, as were the shallow conditions found at the High Quality Mine.

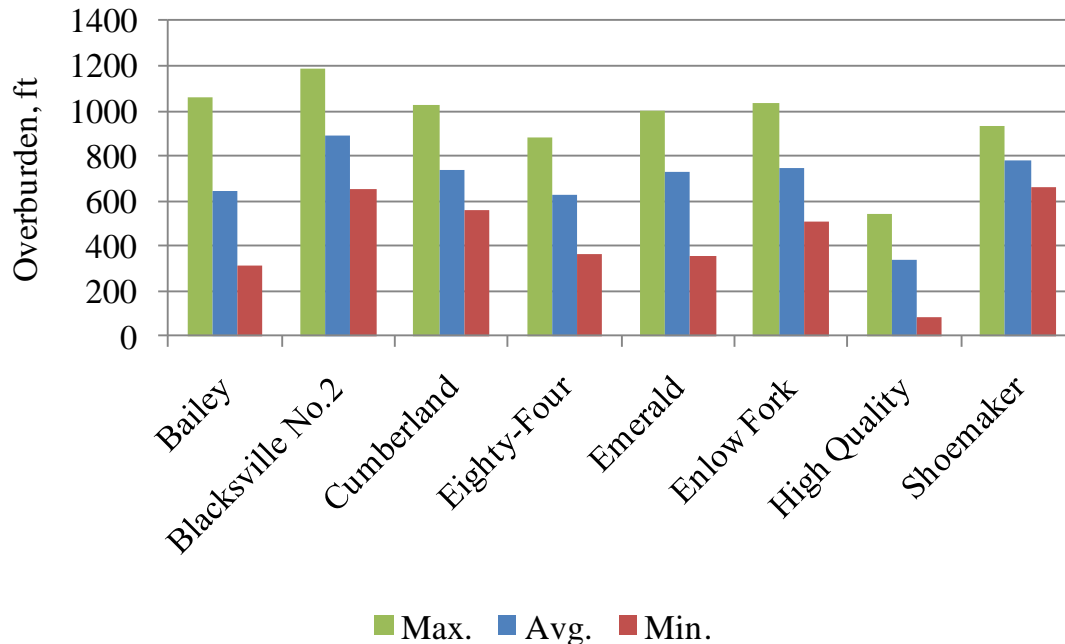


Figure III-16 –The distribution in overburden within each of the eight longwall mines.

III.F.3 – Room-and-Pillar Overburden

When compared to the eight longwall mines above, the 36 room-and-pillar mines had less overburden with an average of 291-ft and a standard deviation of 106-ft. The lowest overburden occurred at the Geronimo Mine 38-ft, and the highest at the Logansport Mine with 663-ft (Table III-18). Twenty-six mines were average with five shallow and five deep (Table III-18). The

shallow mines were Rampside, Ridge, Sarah, TJS No.4, and TJS No.6, while the deep mines are Clementine, Darmac No.2, TJS No.5, Toms Run, and Windber No.78.

The spread in the overburden distribution for each of the 36 room-and-pillar mines is shown in Figure III-17. In this figure, the two deepest mines, Toms Run and Windber No.78, were noticeably higher than some of the other deep mines. The opposite is true for the Rampside and TJS No.6 Mines. They were noticeably lower than some of the other shallow overburden mines (Figure III-17).

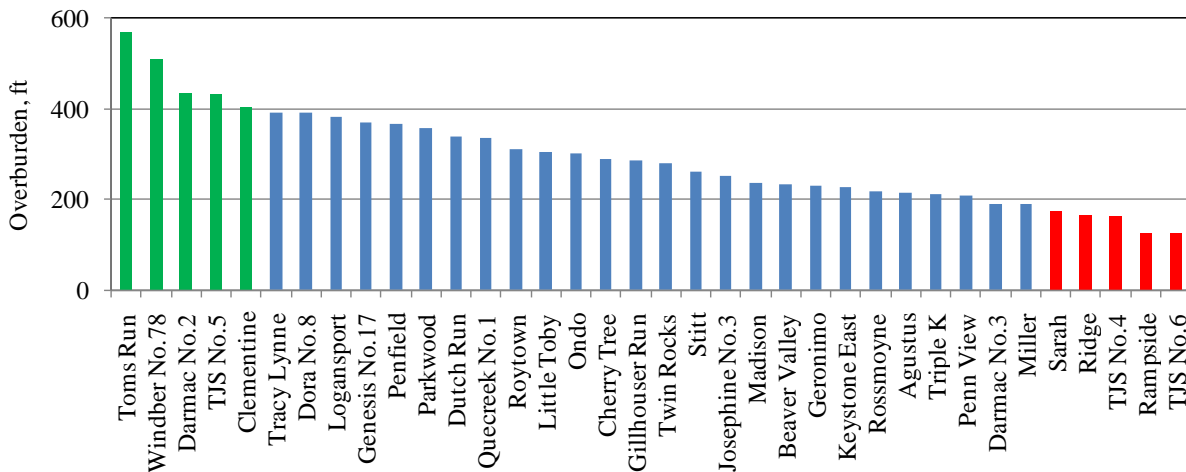


Figure III-17 –Distribution of average overburdens for the 36 room-and-pillar mines. Note green mines are classified as deep, blue mines are average, and red mines are shallow in overburden.

III.F.4 – Room-and-Pillar with Pillar Recovery Overburden

When compared to the 36 mines above, the 6 room-and-pillar mines with pillar recovery were higher in overburden with an average of 378-ft and a standard deviation of 95-ft. The lowest overburdens occurred at the Dooley Run and 4 West Mines with approximately 90-ft (Table III-19). The average overburden at Dooley Run was 221-ft, putting it well within the shallow category. The other four mines were average (Table III-19).

Table III-18 - Overburden characteristics for room-and-pillar mines.

Mine name	Avg.	SD	Min.	Max.	Category
Agustus	214	18	169	264	Average
Beaver Valley	232	55	100	420	Average
Cherry Tree	290	55	108	400	Average
Clementine	405	90	171	609	Deep
Darmac No.2	435	82	241	571	Deep
Darmac No.3	191	74	81	314	Average
Dora No.8	390	90	159	551	Average
Dutch Run	340	74	114	525	Average
Genesis No.17	370	65	201	515	Average
Geronimo	231	59	38	372	Average
Gillhouser Run	285	61	95	397	Average
Josephine No.3	251	24	182	307	Average
Keystone East	226	51	58	375	Average
Little Toby	304	47	118	433	Average
Logansport	383	103	160	633	Average
Madison	235	53	47	354	Average
Miller	191	36	69	262	Average
Ondo	300	76	124	461	Average
Parkwood	356	78	103	617	Average
Penfield	366	80	103	523	Average
Penn View	207	37	94	291	Average
Quecreek No.1	335	65	195	566	Average
Rampside	125	28	58	176	Shallow
Ridge	164	30	98	229	Shallow
Rossmoyne	216	70	99	382	Average
Roytown	310	69	100	552	Average
Sarah	174	32	94	245	Shallow
Stitt	261	72	94	423	Average
TJS No.4	161	36	93	237	Shallow
TJS No.5	431	153	78	734	Deep
TJS No.6	125	49	69	219	Shallow
Toms Run	570	18	518	601	Deep
Tracy Lynne	391	72	107	512	Average
Triple K	211	67	32	414	Average
Twin Rocks	280	50	163	363	Average
Windber No.78	509	31	433	565	Deep
Total	291	106	38	633	

* SD – Standard Deviation

Table III-19 – Overburden characteristics for room-and-pillar mines with pillar recovery.

Mine	Avg.	SD*	Min.	Max.	Category
Crawdad	445	91	225	655	Average
Dooley Run	221	48	96	304	Shallow
Nolo	458	52	250	576	Average
Titus	392	83	168	592	Average
4-West	444	136	89	728	Average
Dunkard No.2	306	70	187	474	Average
Average	378	95	89	728	

* SD – Standard Deviation

The overburden distribution for the six room-and-pillar mines with pillar recovery is shown in Figure III-18. The significant spread between minimum and maximum overburdens was evident, but it was most noticeable in the 4 West Mines. Large variations in overburden can produce deviations in mining conditions during pillar recovery.

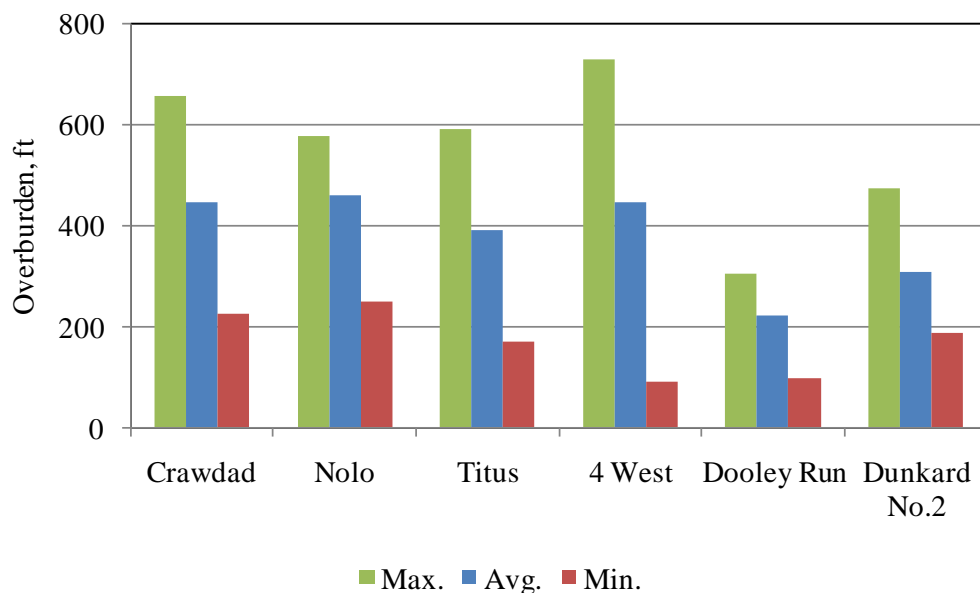


Figure III-18 - The distribution in overburden within each of the six room-and-pillar mines with pillar recovery mines.

III.G – Summary Points

Fifty mines operated during the 3rd assessment period and were classified as room-and-pillar, room-and-pillar with pillar recovery, or longwall. Thirty-six room-and-pillar mines, operated by ten companies, comprised 30.2-pct of the total area mined and 48.5-pct of the total surface properties undermined. They extended under 11,552 acres of land and 1,738 surface properties. The average room-and-pillar mine undermined 321 acres of surface land and mined at a rate of a little more than 5 acres/month. The average overburden for these mines was 291-ft. Based on

their overall overburden character, 26 mines were classified as average, five as shallow, and five as deep.

The six mines classified as room-and-pillar mines with pillar recovery comprised 5.5-pct of the total area mined and 7.7-pct of the total surface properties. They extended under 2,097 acres of land and 277 surface properties. The average size of the pillar recovery areas was 46 acres, representing about 15-pct of the total area mined for these six mines. The individual pillar recovery sections were general relatively small, typically less than 1000-ft in length. These areas were mainly contained within production panels with overburden averaging 378-ft.

Eight longwall mines were active and comprised 64.3-pct of the total area mined and 43.8-pct of the total surface properties. They extended under 24,607 acres of land and 1,572 surface properties. An average of 13.5 acres of land was undermined by a longwall mine every day. The average longwall mine undermined 3,505 acres of surface land and mined at a rate of a little more than 58 acres/month. This represented a ten-fold increase in area mined over the average room-and-pillar mine. Three large companies operated these mines: Consol Energy, Alpha Resources, and UMCO Energy. Several of these longwall operations were among the most productive underground coal mines in the U.S. The average longwall overburden was 687-ft. Six of these mines were classified as average overburden, with one shallow, and one deep.

When the actual mining method is examined, room-and-pillar mining (includes the longwall gate road developments) accounted for 53.3-pct of the total area mined. The actual longwall panels accounted for 46-pct and pillar recover only 0.7-pct of the total area mined. This data implied that a high percentage of impacts should be associated with the extensive areas mined by longwall panels. Conversely, few impacts should be expected with the very small areas mined with the pillar recovery method.

All of this mining occurred in six coalbeds contained within two formations. The Allegheny Formation contained 36 mines within the Upper and Lower Freeport and Upper and Lower Kittanning Coalbeds. The Pittsburgh Formation contained 14 mines within the Pittsburgh and Sewickley Coalbeds. The Pittsburgh Coalbed is well known for its consistency in thickness and quality, making it well suited for the eight longwall mines. Conversely, The Freeport and Kittanning Coalbeds are generally less continuous, making them better suited for room-and-pillar mining.

The highest concentration of underground mining occurred in Greene County where 16,878 acres of land and 915 surface properties were undermined. The second highest concentration occurs in Washington County where 8,896 acres and 738 surface properties were undermined. Greene and Washington Counties were dominated by longwall mining. Eight other counties had lesser amounts of mining, exclusively using the room-and-pillar and pillar recovery mining methods. Armstrong County led these counties where 14 operations mined 4,292 acres of land and 833 surface properties. Indiana, Somerset, and Cambria Counties were next in mining activity with 3,020, 1,916, and 1,196 acres of land undermined. Beaver, Clearfield, Elk and Jefferson Counties had a combined area mined of 2,058 acres.