# C. DATA COLLECTION

## 1. Data Sources

In order to begin the task of identifying at risk areas within the City of Pittston, a variety of sources were consulted, including existing mine maps, DEP/BAMR Inquiry Reports, OSM Emergency Projects and Construction Project Records.

### a. Mine Maps

OSM maintains a map repository containing the available mine maps or drawings, known as folios, for the Anthracite Region of northeastern Pennsylvania. These maps or copies of maps were originally prepared by the coal company performing the mining and were based on surveys of the workings during the time of coal removal. The availability, accuracy and quality of the maps vary widely, from non-existent in some areas to extremely detailed in other areas. The maps are keyed to an index map and are generally at a scale of 1 inch on the map representing 100 feet in the real world. The maps are approximately 2 feet by 3 feet in size and so represent an area of about 198 acres. The folios consist of a surface map, sometimes a top of rock map, followed by maps of each successively deeper underlying seam of coal that was mined. Thus, it is possible to identify a surface feature, such as a residence, and by then superimposing each successive page, determine what the mining conditions were under that residence. The folios often depict surface features such as roadways, residential structures, mining structures, railroads, rivers and streams, the location of vertical shafts, exploratory boreholes and other information that the particular mining company felt was germane to their operation. The vein maps depict the extent of the mining for the particular vein of coal, the location of pillars left in place or subsequently removed, gangways, chambers and notations concerning dates, survey points, elevations, names of vertical shafts, tunnels or slope entries to the surface or between coal veins and other mining related notations.

**FIGURE NO. 4** represents a stylized version of a vein map and some of the information that one may find on a typical drawing. **FIGURE NOS. 12, 13, 14 and 15** are copies of actual mine maps, albeit at a smaller scale, that indicate the extent of the mining in each of the shallow veins within the Pittston City limits.

## b. Inquiry Reports

When BAMR is notified of a possible mine-related problem, an investigator from both BAMR and OSM visit the site and make a determination as to whether the condition is mine-related or not. If the condition is adjudged to be mine-related, a determination is made as to whether the condition meets criteria to be declared an emergency. If it is, OSM begins the process of soliciting contractors to perform the necessary work. In any event, a report is prepared by the BAMR investigator detailing the findings. The information in these reports can be used to identify areas that are exhibiting an unusual number of active subsidence events. **FIGURE NO. 16**, Mine Subsidence Inquiry Location Map, depicts the Inquiries conducted in the City of Pittston, along with a brief description of the nature of the Inquiry. A more detailed report of what each individual Inquiry entailed can be obtained by contacting the Department of Environmental Protection, Bureau of Abandoned Mine Reclamation, 2 Public Square, 5th Floor, Wilkes-Barre, PA 18711, Telephone 570-826-2371. The information contained on this particular Figure will be explained in more detail later in this report.

## c. Drill Logs

The information collected during the drilling of boreholes provides a "snapshot" of the strata underlying the surface at the point at which the borehole is located. Add to this the data from surrounding boreholes and an understanding of the underlying strata for the general area will begin to emerge. The boreholes can assist in establishing the accuracy of the mine maps. The borehole data, taken in conjunction with the mine map data, will help to produce a reasonable picture of the underground conditions.

## d. Construction Project Records

The field records kept by the project inspector for both drilling and mine subsidence control projects provide first hand-knowledge of the nature and extent of the work done on the project. The amount of material injected underground through each borehole and into each vein not only indicates which void areas have been filled, but can be compared against current reports and data to determine how effective the flushing had been, and if any changes have occurred since the original work was performed.

## e. Light Detection and Ranging

Light Detection and Ranging (LIDAR) is a remote sensing system used to collect topographic data. Data is collected by using airplane mounted lasers. In flight, a narrow, high frequency laser beam is directed toward the earth. The reflected laser light from the ground is picked up by receivers on the airplane. The LIDAR system also uses a Global Positioning System (GPS) and a precise timing device. The time difference between the pulse being sent out and received coupled with the GPS results in a very accurate location and elevation of the point pulsed by the laser beam. As with aerial photography, the series of points collected can be used to produce a topographic contour map with a vertical accuracy of about 6 inches. Through the Department of Conservation and Natural Resources' 2006 LIDAR project, 21 counties in Southwestern Pennsylvania have been mapped as well as Luzerne County in northeastern Pennsylvania. A review of the LIDAR map for the City of Pittston revealed contour depressions indicative of surface subsidence. This information was used to help delineate the risk areas.

## 2. Geophysical Data Collection Methods

Geophysical methods to determine the extent of underground mining include Electrical Resistivity, Magnetic Resonance, Seismic and Ground Penetrating Radar (GPR). According to information provided during a presentation to BAMR staff by GTS Technologies, Inc. (GTS), each of the aforementioned methods has its strengths and limitations. GTS is a consulting firm that provides, among other engineering services, geotechnical and geophysical services. GTS characterizes Seismic and GPR as a minor use for mine void or passageway detection while Electrical Resistivity constitutes a major use. Each of these methods is used to detect anomalies underground that could then be further explored using conventional methods such as exploratory drilling or excavating test pits.

### a. Seismic

The Seismic method involves exploding a small charge, dropping a weight or hammering on a metal plate on the surface to produce sound waves that penetrate the subsurface that are then reflected or refracted to the surface to an array of evenly spaced geophones. The geophones record the travel times of the seismic waves after the waves encounter subsurface layers. The travel time of seismic waves can be interpreted to determine velocity and depth to the refracting layer. This method is better suited to delineate larger features or layers. It is difficult to get good geophone contact in loose soils and thin layers and voids are difficult to image. Obviously the use of blasting to generate the seismic waves in a residential area would be prohibitive.

### b. Electrical Resistivity

Electrical Resistivity involves the installation of electrodes into the ground and then introducing a low voltage electrical current between the various pairs of electrodes. The loss of potential (resistivity) between the electrodes is then measured and a subsurface profile is generated. Multiple setups would be required over a given area in order to create a three-dimensional subsurface profile that must be interpreted to reveal any subsurface features of interest. Results are affected by underground metal pipes and electrical cables. Generally though, this method has a high success rate at a reasonable cost.

### c. Magnetic Resonance

Magnetic Resonance directs magnetic energy into the ground and records disruptions in the magnetic field to identify subsurface features. Magnetic Resonance is only good for depths less than 15 feet and is most efficient at identifying buried pipes and utilities. It is a relatively inexpensive, fast method that could be used for an initial assessment of the area of interest.

### d. Ground Penetrating Radar

A Ground Penetrating Radar (GPR) system transmits a series of radio waves into the subsurface and then measures the waves reflected back by subsurface features, primarily identifying any anomalies. GPR does not work well in conductive areas, such as clay soils and its penetration depth tends to be shallow, somewhere in the order of 15 to 20 feet. It can be used to establish the depth to bedrock provided the bedrock falls within the depth range stated earlier. Any underground mine voids would also have to be within the depth range in order to be detected.

All of the above methods rely on driving electrodes or geophones into the ground. This approach is non-destructive and non to minimally invasive. Geophysical methods can be combined to further refine the results.

All of the methods discussed above require a certain amount of interpretation and are subject to verification by more conventional methods.

# D. DATA EVALUATION

## *1. Procedures*

The purpose of this study was to identify areas within the City of Pittston that may exhibit a high potential for subsidence. The first step in this process was to define the criteria that would identify an area as having a high potential for subsidence. BAMR's past experience with subsidence events, exploratory drilling and subsidence control projects were used in the formulation of the following risk categories:

**Potential Risk Area** – This is a rather broad term that describes any area within the Anthracite Coal Fields that has been deep mined. The process of mining creates void spaces where the coal has been extracted. These void spaces cause stresses to build up around the void that eventually can cause failure of the coal pillars left in place or the surrounding rock. The rock roof of the mine may begin to crack and spall off into the mine workings. This fracturing and collapse of the rock may then propagate upwards to the surface and manifest itself as a depression in the ground, a cone-shaped settlement or an opening that extends all the way down to the first underlying coal bed. The factors that determine the severity of a collapse are related to the depth of the mining from the surface, the thickness of rock over the coal seam and the type and depth of soil over the rock. Subsidence problems occur most often if the conditions involve very shallow mining of a thick vein of coal, little or no rock cover and a very cohesionless soil, such as sand, separating the mining from the surface and any structures on the surface.

**Low Risk Area** – An area where the top of the first underlying mined coal vein has 46 feet or more of total cover and there is 26 feet or more of rock.

**Medium Risk Area** – An area where the top of the first underlying mined coal vein has 45 feet or less of cover and there is between 16 and 25 feet of rock.

**High Risk Area** – An area in which the mined coal vein outcrops near the surface or the rock strata is comparatively thin in relation to the wash and depth of the vein. For the purposes of this study, a high-risk area was defined as any area where the top of the first underlying mined coal vein has 35 feet or less of total cover and has 15 feet or less of rock.

The above areas generally describe the degree of risk of subsidence based primarily on depth and the amount of rock cover over the first underlying mined coal vein. Such variables as the type and competency of the rock, the type of wash material (sand, clay, soils, coal refuse, or ash), the number and depth of other underlying mined coal veins, the existence and elevation of the mine pool, ground water levels and other geomorphic phenomena all become factors that could increase or decrease the risk.

## 2. Data Evaluation

The above criteria were used in reviewing the available data, making it possible to begin the process of identifying the boundaries of the various risk areas. The first step was to glean whatever information was available from the mine maps and augment that with the information provided by the various drilling activities in the City of Pittston. The location of each borehole was plotted on the mine maps along with the soil and rock depths as determined by the drilling. Next, the location of the mine-related inquiries (**FIGURE NO. 16**) and the location of OSM emergency projects (**FIGURE NO. 11**) were also plotted on the mine maps. Finally, the LIDAR map was examined to determine the location of any significant contour depressions. Taking all of this information into consideration, the boundaries of the high-risk areas were denoted based on the definitions provided in the Procedures section above and the actual occurrence of subsidence events. The areas were color-coded to further aid in identification. The results are depicted on **FIGURE NOS. 17**, Surface Map with High Risk Areas, **18**, Checker Vein High Risk Area, **19**, Bottom Checker Vein High Risk Area, **20**, Pittston Vein High Risk Area and **21**, Marcy Vein High Risk Area. Not surprisingly, the majority of the high risk areas are situated along the crop line of the various coal seams and above the Checker Vein in the area bounded approximately by Church, Butler, Hunter and Center Streets. The backup information used to develop **FIGURE NOS. 17, 18, 19, 20** and **21** are somewhat voluminous and for that reason are not included in the report but are available for inspection at the Wilkes-Barre District Office of the Bureau of Abandoned Mine Reclamation.

# E. CONCLUSIONS AND RECOMMENDATIONS

This study has identified areas within the City of Pittston that warrant further investigation and justifies the need for additional action in the form of subsidence control projects. It should be noted that the conclusions drawn were based on mine maps whose accuracy cannot be guaranteed and other documents that may be subject to varying degrees of interpretation. For that reason, it should not be assumed that the boundaries of the risk areas as depicted on the Figures are definitive. They merely represent the best estimate using engineering judgment and are subject to reevaluation should other information become available.

Those areas are as follows:

## *1. Checker Vein High Risk Areas*

**Mill Street Area**

This is a residential area located east of downtown Pittston (Area 1C). The Checker vein averages 7 feet thick and lies relatively flat, with some outcropping into the sandy wash at the southern and eastern limits of the vein. Coal was mined during the years 1940-1942 using the room and pillar method, with no second mining to remove the pillars performed according to historical mine maps. The mine maps also show crosshatched areas that indicate culm and refuse material may have been placed into the workings by the coal company to reduce the possibility of subsidence. Rock cover measures between 3 feet and 25 feet. Depth of wash ranges from 2 – 90 feet. Numerous inquiries relating to possible mine subsidence were located in this area from the early 1940s to the present day. A subsurface investigation was performed utilizing rotary drilling in March of 1979 under Project No. SL 470-101.5. The data was analyzed and the results led to a subsidence control (mine flushing) project (Project No. OSM 40(511-83)101.1, Pittston II - Phase I) during the years 1983 to 1985. The project flushed the Checker, Pittston and Marcy veins. Additional exploratory drilling was conducted in this area in 2005. In December of 2005, an 80 -100 year old sewer line collapsed on Mill Street between Searle and Church Streets, causing closure of Mill Street. This sewer line was recently repaired and the street opened in July of 2007.

This high-risk area encompasses approximately 32 acres roughly bounded by Center, Church, Butler and Hunter Streets.

**Other Areas**

There are seven small areas affected by mining in the Checker vein that are possible high risk areas.

They are:

1) Area east of the intersection of Hill Park Avenue and Church Street (Area 2C). It measures approximately 0.1 acre. Coal was mined in the early 1940s with pillar removal performed in 1942 according to historical mine maps. Rock cover measures 25 feet, with depth of wash measuring 6 feet. No inquiries were investigated in this area.

2) The 100 block of North Main Street between the Fort Jenkins Bridge and Lambert Street (Area 3C). It measures approximately 1 acre. No date of first mining. No pillar removal indicated on the mine maps. Rock cover measures 21 feet to 25

feet, with depth of wash measuring 6 – 25 feet. One mine-related inquiry was investigated nearby in 1993.

3) The 200 block of North Main Street near Parsonage Street (Area 4C). It measures approximately 0.6 acre. Mining occurred in the 1920s. No pillar removal indicated on the mine maps. Rock cover measures 13 feet to 25 feet, with depth of wash measuring 60 – 80 feet. No inquiries were investigated in this area.

4) Area northeast of Panama Street (Area 5C). This area parallels Panama Street along the cropline and measures approximately 1 acre. Mining and pillar removal occurred in the 1920s. Rock cover measures 14 feet to 25 feet, with depth of wash measuring 40 – 90 feet. No inquiries were investigated in this area.

5) Area of North Main Street at the intersection of Curtis Street (Area 6C). It measures approximately 2 acres. Mining was conducted in 1945. Pillar removal was performed the same year on the west side of the Lehigh Valley Railroad (now Reading, Blue Mountain and Northern Railroad) tracks. On the east side of the tracks, crosshatched areas indicate material may have been placed into the workings for subsidence control. Rock cover measures 12 feet to 25 feet, with depth of wash measuring 40 – 100 feet. One mine-related inquiry was investigated nearby in 2000.

6) Area of New Street near Bolin Street (Area 7C). It measures approximately 16 acres. The room and pillar method was utilized to extract the coal during the years 1918-1920 with pillar removal, according to historical mine maps. Rock cover measures 12 feet to 25 feet, with depth of wash measuring 15 – 110 feet. One mine-related inquiry was investigated in this general area in 2000.

7) Area of North Main Street between Wood Street and the city boundary (Area 8C). Measuring 11 acres, this area includes the Twin Shaft and an unnamed air shaft.

Room and pillar method of mining was also utilized during the years 1956-1957. No pillar removal is indicated on the mine maps. Rock cover measures 2 feet to 25 feet, with depth of wash measuring 30 – 60 feet. Five mine-related inquiries were investigated in this general area between 1988 and 2005.

## 2. *Bottom Checker Vein High Risk Areas*

**Plank Street**

This area measures 5 acres along the south side of Plank Street (Area 9BC). The Bottom Checker vein averages 6 feet thick and dips to the southwest, with the outcrop paralleling Plank Street. Room and pillar method of mining was utilized (no date) with pillar removal. Rock cover varies between 2 feet and 23 feet. Depth of wash ranges from 35 – 68 feet. Two mine-related inquiries were investigated in this area in 1996 and 2005.

**Landon and Winter Streets**

This area measures 0.3 acre along the outcropping of the Bottom Checker vein (Area 10BC). Room and pillar method of mining was conducted in the 1910-1915 era with pillar removal during the year 1917. Rock cover varies between 2 feet and 23 feet. Depth of wash ranges from 35 – 68 feet. There have been no mine-related inquiries in this area.

**Oregon Section**

There are three high risk areas in this section of Pittston located on a hill overlooking the Susquehanna River. Project ASP-17 conducted mine flushing in this section in 1977.

The first area measures 1 acre and includes portions of Johnson and Cleveland Streets (Area 11BC). The Bottom Checker vein averages 6 feet thick and outcrops into the alluvium across Johnson Street. Mining was conducted in the mid 1930s. No pillar removal was indicated on the mine maps. Rock cover varies between 8 feet and 20 feet. Depth of wash ranges from 5 – 13 feet. No inquiries were investigated in this area.

The second area measures 2 acres and is located along a bluff overlooking the Susquehanna River west of River Street (Area 12BC). The Bottom Checker vein averages 5 feet thick. Mine maps are very sketchy in this area and show some workings with the pillars intact. A few slopes and tunnels as well as the Tompkins Shaft are indicated on the mine maps. Rock cover varies between 16 feet and 25 feet. Depth of wash ranges from 2 – 13 feet. One mine-related inquiry was investigated nearby this area.

The third area measures 8 acres and includes portions of Elizabeth, Oak, Tompkins, Johnson and Pine Streets and Columbus Avenue (Area 13BC). The Bottom Checker vein averages 6 feet thick and dips to the north, outcropping into the alluvium along Elizabeth Street. Room and pillar method of mining was utilized during the years 1941-1943. No pillar removal was indicated on the mine maps. The mine maps also indicate "Old Workings" in some locations. Rock cover varies between 3 feet and 25 feet. Depth of wash ranges from 14 – 38 feet. Several mine-related inquiries have been investigated in this area between 1979 and 2004.

## 3. Pittston Vein High Risk Areas

**South Pittston Area (Welch Hill)**

This is a residential area south of the downtown measuring 14 acres. The area includes portions of South Main, La Grange, Oak, Vine, Railroad (Columbus Avenue), Frothingham, Swallow and Nafus streets (Area 14P). The Pittston vein averages 6 feet thick and dips slightly to the north. Mine maps are very sketchy in this area, only indicating outcrop lines. ASP-17 drilling indicated un-mined coal as well as voids.

Mining may have been conducted earlier with no known documentation. Project ASP-17 also conducted mine flushing in this area. Rock cover varies between 6 feet and 25 feet. Depth of wash ranges from 6 – 50 feet. There have been several mine-related inquiries investigated in this area between 1976 and 1996.

**Downtown Area**

This is a commercial and residential area of downtown Pittston measuring 19 acres. The area includes portions of South Main, Spring, Market, Pine, Kennedy Boulevard and Wharf Streets (Area 15P). The Pittston vein averages 6 feet thick and dips slightly to the north. Mine maps do not indicate any workings in this area; however, five core drillings in 1973 under Project No. ASP-17 indicate un-mined coal. Other drillings east of the area indicate voids in the Pittston vein. It appears mining may have been conducted earlier in the downtown areas with no known documentation at this time. Rock cover varies between 0 feet and 25 feet. Depth of wash ranges from 50 – 90 feet. Mine-related inquiries were investigated in this area in 1980, 1990, 1995 and 2003.

**Broad Street Area**

This is a residential area east of the downtown measuring 2 acres. The area includes portions of Broad Street between Foundry and Connell Streets, with a small area on William Street (Area 16P). Mine maps are very sketchy in this area and show some workings with the pillars intact. Mining may have been conducted earlier with no known documentation. Rock cover is estimated to be between 9 feet and 25 feet. Depth of wash ranges from 80 – 110 feet. Two mine-related inquiries were investigated in this area.

**North Main Street**

This 2-acre site lies between North Main Street and the Reading, Blue Mountain and Northern Railroad tracks next to the Fort Jenkins Bridge (Area 17P). The Pittston vein averages 14 feet thick and outcrops in this area. Mine maps indicate that coal was mined in 1940; it also indicates that the pillars are intact. The maps also show that culm and refuse material may have been placed into the workings by the coal company for subsidence control. Rock cover is 20 feet. Depth of wash ranges from 40 – 50 feet. One mine-related inquiry was investigated in this area in 1991. Though not strictly meeting the wash and rock cover criteria, the fact that the vein outcrops in this area places it into the high-risk category.

**Area East of Curtis Street**

These are two areas measuring 0.5 and 0.6 acres on opposite sides of an anticline 660 feet west of the end of Curtis Street (Area 18P). The vein thickness is unknown. Mine maps indicate that coal was mined in 1923-1924 and that the pillars were removed. Rock cover is estimated to be between 11 feet and 24 feet. Depth of wash ranges from 110 – 130 feet. No inquiries were investigated in this area.

**Cornelia Street**

This 0.5-acre site lies near the intersection of Cornelia and Wood Streets (Area 19P). The vein thickness is unknown. Mine maps indicate that coal was mined in 1920 and pillar removal followed. Rock cover is 24 feet. Depth of wash ranges from 30 – 45 feet. Three possible subsidence inquiries were investigated in this area in 1986, 1999 and 2000. Though not strictly meeting the wash and rock cover criteria, the fact that there were mine-related inquiries places this area into the high-risk category.

**Lackawanna River**

This is a 4-acre open area along the north side of North Main Street between North Main and the Lackawanna River (Area 20P). Mine maps are very sketchy in this area. Rock cover is estimated to be between 9 feet and 24 feet. Depth of wash ranges from 48 – 72 feet. One mine-related inquiry was investigated on North Main Street in 1999.

## 4. Marcy Vein High Risk Areas

**John Street**

This area measures 5.7 acres of the Marcy vein under John, Curran and Connell Streets (Area 24M). The vein is approximately 4-5 feet thick and dips to the northeast. Room and pillar method of mining was conducted (no dates shown on mine maps) with no pillar removal noted. Rock cover varies between 3 feet and 23 feet. Depth of wash ranges from 48 – 154 feet. One mine-related inquiry was investigated near this area in 1996.

**Other Areas**

Three small areas measuring 0.2, 0.7 and 0.4 acres are possible high risk areas. The first is between Nafus and Swallow Streets (Area 21M), the second is near the southwest corner of Vine and Oak Streets (Area 22M), and the third is at the corner of Vine and Pine Streets (Area 23M). Room and pillar method of mining was conducted (no dates shown on mine maps) with no pillar removal noted. Rock cover varies between 17 feet and 22 feet. Depth of wash averages 30 – 40 feet in the western two areas, with an average of 100 feet at the Vine Street site. One mine-related inquiry was investigated in the area of Vine and Oak streets in 1986. Though not strictly meeting the wash and rock cover criteria, the fact that there was a mine-related inquiry in the vicinity places this area into the high-risk category.

## 5. Areas Selected For Further Evaluation

Given the above and based on the number of incidents involving either mine-related inquiries or OSM emergency projects, it is recommended that the area bounded by Church, Butler, Hunter and Center Streets, hereafter known as the Mill Street Area (Area 1C), be the first portion of the City considered for further remedial action.

Other areas that warrant further investigative efforts are as follows:

- The area bounded by Nafus, Vine, Pine and LaGrange Streets (Areas 14P, 21M and 22M).
- The area bounded by River, Garfield, Elizabeth and East Streets (Areas 12BC and 13BC).
- The area bounded by South Main, Pine, La Grange and Charles Streets (Area 15P).
- The area bounded by Pine, Curran, Market and Vine Streets (Areas 23M and 24M).

The remaining areas meeting the definition of a high-risk area are either outside developed commercial or residential areas or have not exhibited a pattern of mine-related problems at this time. These areas could become problematic sometime in the future, but for the purposes of this study, their inclusion into the high-risk category should serve as a cautionary note for anyone considering future development in these areas. However, no other action is recommended at this time for those areas.

## 6. Mill Street Sanitary Sewer

On August 28, 2006, a meeting was held to discuss mine subsidence incidents plaguing the Mill Street area of the City. Among those in attendance were Congressman Paul Kanjorski, Pittston City Mayor Joseph Keating, Mike Amato, Pasonick Engineering, consultant for Pittston City and representatives from OSM and DEP. The discussion revolved around the City-owned combined sewer line on Mill Street. The existing line is brick-lined and shaped like an inverted egg. The line is about 16 inches wide at the bottom, 38 inches wide at the top and 51 inches high. A portion of the line just upstream of a manhole located in front of 99 Mill Street had collapsed. A visual inspection of the collapse revealed a void extending out an unknown distance from both sides of the line. Given the depth of the line, it was determined that this void area was in fact the abandoned underground mine workings of the Checker vein. When flowing full, the combined sewer has a capacity estimated to be about 7,500 gallons per minute. It is believed that this volume of water may have displaced some of the flush material previously placed by both the mining company and during DEP's 1985 flushing project. OSM issued emergency contracts to conduct exploratory drilling in the vicinity of the sewer collapse and to inject material into the mine voids. During this work, the sewer line was also repaired. Details of the work conducted by OSM, including drill reports for the boreholes and a summary of the amount and type of material injected into the mine voids, can be obtained by contacting OSM.

Mr. Michael Amato of Pasonick Engineering has indicated that the entire length of the combined sewer line on Mill Street between Church and Searle Streets has been visually inspected and adjudged to be intact and functioning with no further water loss to the underground mine workings.

## 7. Mill Street Area Recommendations

**FIGURE NO. 22** depicts the Mill Street area surface features layered over the Checker Vein mining features. Much of the outcrop of the vein, which tends to be where the mining is the shallowest, occurs on private property. In order to address these outcrop areas, easements would have to be secured from all of the affected property owners in order for the Department or its agents to gain access and perform the necessary work. To that end, the first step would be to schedule a public meeting to present the proposed project, answer questions about what work would have to be done in order to fill any of the underground abandoned mine workings and the importance of obtaining everyone's cooperation in securing easements. To minimize any disturbance on private property, at least initially, the Department intends to utilize its existing Professional Design Services Agreements to have the consultants submit Task Implementation Plans for the performance of non-destructive testing, such as magnetic resonance and/or electric resistivity, to better define the edges of the mined area. This would help to minimize the number of private properties that may need to be accessed to perform exploratory drilling and subsequent injection of material underground to provide surface support. The difficulties of being able to access the most advantageous locations for boreholes, have been detailed earlier in this report. Both horizontal and angular drilling may be necessary to intersect the mine voids to allow further study and eventual injection of material. Borehole cameras could be utilized in an attempt to record the conditions underground. Carnegie Mellon University has developed a borehole sensor in the form of a laser scanner that could be lowered into a borehole to produce a 3-D model of the interior surfaces of subterranean voids. All of these tools could be employed in order to gain a better understanding of the extent and conditions underground. With this data in hand, specifications and drawings could be developed for a subsidence control project to stabilize the Mill Street area. The time frame for all of this work to be accomplished would be measured in terms of years.

# F. LIST OF FIGURES

# G. APPENDICES

## 1. Appendix A – Mining Terminology

Acid Mine Drainage - Generally meant to describe any flow of water from the abandoned underground mine voids. The quality of the water is often compromised because it picks up minerals, metals and other pollutants during its stay underground. Usually characterized by the reddish discoloration caused by the precipitation of the iron contained in the water once it makes contact with the oxygen in the atmosphere.

Borehole - A small diameter hole drilled from the surface down through the various layers of wash, rock and coal used to gather information on the strata. Could also be utilized to inject material into the underground void spaces.

Breaker - A multi-story building with crushers, separators and a series of screens used to segregate rock, slate and other unwanted materials from the coal and to produce various sizes of coal for use in furnaces.

Coal Vein or Coal Seam - Coal is a fuel substance formed from plant matter and is composed largely of carbon with varying amounts of mineral matter. The plant matter was deposited in layers and accumulated over time. Layers of sediment and rock over the plant matter produced pressure, metamorphosing the plant matter into the rock coal.

Chamber - A void space created during the mining process.

Daylight - Removal of the wash material and rock from above a coal seam or underground mine workings, thus exposing the coal to the light of day. Also, the act of removing the coal in the vein all the way to the surface.

Flush Material - Generally composed of mine refuse that has been crushed and screened to produce a graded material with no particle larger than one-half inch in size.

Flushing - The act of injecting a slurry consisting of water and an inert graded material into the abandoned underground mine voids from the surface through boreholes. The slurry may be injected by gravity alone or under pressure.

Gangway - Main haulage route in room and pillar mining.

Mine Pool - Water that has collected in the abandoned underground mine workings.

Mine Refuse - Waste product from a coal processing facility such as a breaker.

Mining - The act of removing mineral deposits from the earth.

Outcrop - Coal seam that extends to or very near to the ground surface.

Pillar - A column of coal left intact to provide support to the roof of an underground mine.

| | |
|---|---|
| Robbing | - The act of completely removing a pillar. |
| Room | - Essentially a chamber. |
| Shaft | - A vertical opening that generally starts at the surface and intersects the various underlying coal seams. A shaft could be used specifically for ventilation, removing the mined coal or transporting the miners between the surface and the work area. A shaft may consist of a single compartment or multiple compartments depending on its size. |
| Slope Entry | - An opening from the surface to the underground mine workings constructed at an angle somewhere between the horizontal (a Tunnel) and the vertical (a Shaft). Oftentimes a slope would follow a coal seam that dipped downward from an outcrop at the surface. |
| Subsidence | - A depression or collapse of the ground surface as a result of caving in underground voids. |
| Tunnel | - A horizontal opening extending from the surface to the underground mine workings to provide access. Like a Slope Entry, a Tunnel may follow a coal seam or it may be constructed through rock to reach or connect the coal seams. |
| Wash | - Unconsolidated material located above the bedrock. Consists of organic materials, soil (dirt), glacial materials and stones. |

## 2. Appendix B – Compact Disk Containing Drillers Reports