

RESOURCE REPORT SIX - GEOLOGICAL RESOURCES	
SUMMARY OF COMMISSION FILING INFORMATION	
Information	Found in
1. Identify the location (by milepost) of mineral resources and any planned or active surface mines crossed by the proposed facilities. (§§380.12(h)(1) and (2))	Section 6.3
2. Identify any geologic hazards to the proposed facilities. (§380.12(h)(2))	Section 6.4
3. Discuss the need for and locations where blasting may be necessary in order to construct the proposed facilities. (§380.12(h)(3))	Section 6.2, Table 6.2-1
4. For LNG Projects in seismic areas, the materials required by "Data Requirements for the Seismic Review of LNG Facilities," NBSIR84-2833. (§380.12(h)(5))	Not Applicable
5. For underground storage facilities, how drilling activity by others within or adjacent to the facilities would be monitored, and how old wells would be located and monitored within the facility boundaries. (§380.12(h)(6))	Not Applicable

TABLE OF CONTENTS

	<u>Page</u>
6.0 RESOURCE REPORT 6 - GEOLOGICAL RESOURCES	6-1
6.1 GEOLOGIC SETTING	6-1
6.1.1 Topography	6-1
6.1.2 Geology.....	6-1
6.2 BLASTING	6-2
6.3 MINERAL RESOURCES	6-2
6.3.1 Hydrocarbon Resources	6-2
6.3.2 Coal Resources.....	6-2
6.3.3 Non-Fuel Resources	6-3
6.4 GEOLOGIC HAZARDS.....	6-3
6.4.1 Seismic Activity	6-3
6.4.2 Liquefaction.....	6-3
6.4.3 Landslides.....	6-3

TABLE OF CONTENTS (Continued)

	<u>Page</u>
6.4.4 Karst Terrain and Caves	6-4
6.4.5 Mine Subsidence.....	6-4
6.4.6 Unreclaimed Surface Mines	6-5
6.4.7 Volcanism and Igneous Activity	6-6
6.4.8 Flooding	6-6
6.4.9 Avoidance and Minimization of Adverse Effects.....	6-7
6.5 PALEONTOLOGY	6-8
6.6 LNG FACILITIES	6-8
6.7 UNDERGROUND STORAGE FACILITIES.....	6-8
6.8 REFERENCES	6-8

LIST OF TABLES

<u>Number</u>	<u>Title</u>
6.1-1	Surficial Geologic Formations Intersected by the Pipeline and Facilities
6.2-1	Areas that May Require Blasting Along the Pipeline

LIST OF FIGURES

<u>Number</u>	<u>Title</u>
6.4-1	2008 United States National Seismic Hazard Map

LIST OF APPENDICES

<u>Appendix</u>	<u>Title</u>
6-A	Recommended Site-Specific Blasting Plan

6.0 RESOURCE REPORT 6 - GEOLOGICAL RESOURCES

This Resource Report describes the geologic setting of the Project area. The report details geologic resources and hazards that may directly or indirectly affect the construction and operation of the facilities. Mitigative measures to reduce the impact of the Project on geological resources as well as measures to reduce the impact of geological hazards on the facilities are discussed.

6.1 GEOLOGIC SETTING

6.1.1 Topography

The proposed pipeline route and facilities cover various types of terrain, including rolling hills, both steep and gradual valleys, into lowlands within the 100-year floodplain. Lands affected by the Project include undeveloped forest, existing ROW, agricultural, old railroad grades, open land used for strip mining, and commercial land.

6.1.2 Geology

The surficial geology of the Project area is comprised of a very thin layers of unconsolidated material overlying rock on slopes and ridgetops and thicker layers in the valley bottoms. The surficial deposits of the Project area on slopes and hillsides are relatively thin soils derived from the breakdown and weathering of the underlying shale or sandstone bedrock. In the valleys, these deposits can reach thicknesses of 50 feet to 100 feet and are composed of fine to coarse grained deposits resulting from the deposition of water borne sediments.

The Project area lies within the Pittsburgh Plateau section of the Appalachian Plateaus Physiographic Province. Shallow bedrock in the Project area from highest to lowest is composed of the Pennsylvanian age Allegheny and underlying Pottsville Groups which unconformably overlie the Mississippian age Pocono Formation. The Allegheny Group rocks consist of alternating layers of shale, sandstone, siltstone, coal, clay, and minor limestone and include many of the important coal seams in the area while the Pottsville Group contains a few coals and has a much larger percentage of sandstone. The portion of the underlying Pocono Formation in the area that is above drainage is composed primarily of sandstone with lesser amounts of shale and minor claystones. See Table 6.1-1 for details regarding the surficial geologic formations crossed by the Project.

The Project area is between the Clearfield-McIntyre syncline to the northwest and the Laurel Hill anticline to the southeast. Both structures trend northeast-southwest, resulting in the overall rock dip in the area to being to the northwest and on the order of 200 feet to 400 feet per mile. There are several high-angle wrench faults exist in the area that generally trend northwest to southeast, basically paralleling the Project area.

Coal is the principal mineral resource in the area. The Pottsville Group of the Pennsylvanian system includes the Mercer Formation. The Mercer Formation generally includes three to five coals separated by clay, shale and sandstone. The coals are generally dirty, bony, and variable in thickness. The Allegheny Group includes Clarion, Lower Kittanning, Upper Kittanning, and Freeport Formations, each of which includes significant coal beds (Glover, 1970; and Edmunds, 1962).

6.2 BLASTING

The pipeline will be constructed using a six-inch diameter pipe. In areas of solid rock, trenching associated with construction of the pipeline will extend to approximately four to five feet below ground surface. The excavation depth will allow approximately six inches of fill below the pipe and approximately three feet of cover above the pipe. In the areas of steep topography and thin soil cover, ripping or blasting may be required along sections of the pipeline. Areas with a potential for blasting are listed in Table 6.2-1. These areas were determined based on areas where bedrock is less than 46 inches according to soil series limitations. Specific locations where blasting may be required will be determined during construction. A Recommended Site-Specific Blasting Plan is included in Appendix 6-A.

6.3 MINERAL RESOURCES

6.3.1 Hydrocarbon Resources

No oil or gas wells were identified near the proposed pipeline route on USGS topographic quadrangle mapping (Glover, 1970; and Edmunds, 1968). Historically, oil and gas wells drilled in the Project area have been non-productive.

6.3.2 Coal Resources

Coal is the principal mineral resource in the Project area. The Pottsville Group of the Pennsylvanian system includes the Mercer Formation. The Mercer Formation generally includes three to five coals separated by clay, shale and sandstone. The coals are generally dirty, bony, and variable in thickness. The Allegheny Group includes Clarion, Lower Kittanning, Upper Kittanning, and Freeport Formations, each of which includes significant coal beds (Glover, 1970).

Coal resources along the Project area were located using field reconnaissance, 7.5-minute quadrangle maps, aerial photographs, USGS surficial geology maps, and GIS data. Sky Haven Coal, Inc. (Sky Haven) is the primary coal company in the area. The company runs an active surface mine operation on tracts 1060M0900000001 and 1060M0900000002. The pipeline crosses these properties in areas where previous strip mining has occurred and the land has been reclaimed. Active surface mining is taking place west of the proposed pipeline location. No active mines are crossed by the Project.

6.3.3 Non-Fuel Resources

Other important mineral resources actively extracted within the area along the pipeline route include sandstone, shale, water, sand and gravel, and clay. The Project is currently being reviewed for information relating to underground mine workings, including clay mines. Information regarding underground mines will be provided to the Commission when it becomes available. Clays have been used in many of the local refractories for brick production and other clay products. Most commercially important clay resources occur in the Houtzdale quadrangle south of the Project area (Glover, 1970). No clay mines are crossed by the Project based on a field review.

6.4 GEOLOGIC HAZARDS

6.4.1 Seismic Activity

Seismic hazards are based on earthquake history, active fault zones, and surficial deposits. Seismic activity for the area around Clearfield includes two nearby earthquakes that took place in 1937 and 1938, respectively. The 1937 earthquake hypocenter occurred approximately 16 miles southeast of the Project area and caused little to no damage but was felt by many. The 1938 earthquake hypocenter occurred approximately 28 miles south of the Project area and was felt by all people in the area and caused slight damage to poorly built buildings and caused small amounts of plaster to fall in some buildings. It broke dishes and glassware in considerable quantities and caused fine cracks in plaster and chimneys. It moved furnishings of moderately heavy kind (Stover et al., 1981). According to the USGS National Seismic Hazard Map (Figure 6.4-1), the Project area has a low seismic hazard potential (Peterson et al., 2008).

6.4.2 Liquefaction

Liquefaction occurs when loose saturated sandy or silty soils are subjected to intense shaking. Such ground movement separates the water from the soil holding it causing the soil to behave like liquid. According to the The Modified Mercalli Intensity Scale, liquefaction does not occur below 6.9 on the Richter Scale. However, areas with saturated soils are limited to stream and river crossings and valley fill deposits. Based on such evidence, it is unlikely that a tremor felt in the vicinity of the proposed pipeline and Project facilities will cause liquefaction.

6.4.3 Landslides

Based on *Landslides and Related Features of the Clearfield, PA Quadrangle*, which covers the northern third of the Project area, landslide-prone areas exist near the Project but no landslide-prone areas are crossed by the Project.

Landslide-prone areas were described as strip mines with bench or furrowed areas with high walls, strip mines reclaimed by grading, and strip mines that have been regraded in

part but a high wall remains. The publication identified active landslide areas, old landslide areas, areas of colluvial slope, areas susceptible to debris flows and avalanches, areas susceptible to rockfall, and soil and rock susceptible to landsliding. Areas prone to landsliding were described as having soil and rock similar to that involved in landslides elsewhere in the map area; primarily areas underlain by claystone, mudstone, and shale associated with other rock types. These rocks weather rapidly on exposure forming clayey soils that are susceptible to sliding. This may occur in U-shaped shallow valleys containing thick layers of clayey soil that are susceptible to sliding where excavation breaks continuity of slope and where overloaded by artificial fill. Non-landslide-prone areas are described primarily as valley floors, ridge tops and broad benches but also include slopes where landslides are sparse.

No landslide information was available for the southern two-thirds of the Project area but it is assumed that conditions there would be similar to the northern third since the rock types and overall topography tend to be the same. Incidences along the pipeline could occur when areas underlain by claystone, mudstone, and shale are exposed to heavy rainfall or snowmelt, earthquake activity, or construction activity that changes some critical aspect of the local geology. These rocks weather rapidly on exposure forming clayey soils susceptible to sliding. Such soils and the rocks they are derived from are located within areas of proposed construction.

Sliding associated with these soils would not generally be a fast process but would rather be a slow earth movement or sloughing of the soils on a slope. The safety of heavy equipment operating in these areas should not be affected by any potentially unstable soils with the provision that the equipment is kept off of actively moving areas. Modification by excavation and fill may lead to local landslides. Areas least prone to landslides are primarily valley floors, ridge tops, and broad benches.

Blasting can have an effect on the potential for slope failure. The effect is most prominent where natural fracture and joint surfaces dip in the same direction as the land surface slope. The locations where blasting may increase landslide potential have not been identified. Appropriate slope stabilization methods will be employed prior to blasting according to the Recommended Site-Specific Blasting Plan provided in Appendix 6-A.

6.4.4 Karst Terrain and Caves

There are no potentially karstic units in the Project area.

6.4.5 Mine Subsidence

Underground mining in PA is associated with numerous coal seams and mine subsidence is the main hazard associated with it. The potential for surficial effects resulting from mine collapse is dependant on several conditions including the type of mining conducted, the thickness of the coal unit mined, the percentage of coal removed, the depth of the mine below ground surface and the competency of the overlying rock.

Areas of potential mine subsidence may be present along the proposed pipeline corridor. Seven coal and two clay mines are shown on geological maps of the Project area as being near (within 300 feet) or crossed by the Project; however, it is not known what the extent of underground mining may be in the area (Edmunds, 1962; and Glover, 1970). No mine shafts were identified during a field review of the Project. The Project is currently under review for additional information regarding deep mines. This information will be provided to the Commission when available.

Areas indicated as being current operations on or near the route will be considered to be areas of active mining and will be assumed to be total extraction mines. Such mining results in significant surface subsidence that could damage the pipeline. The mining companies will be contacted regarding scheduling and arrangements made to protect the pipeline during mining operations.

Areas where the depth to a mine is 100 feet or less to abandoned mine workings will be assumed to be room and pillar mines where the pillars were not removed. Such mining can develop localized sinkhole formations at the ground surface that could result in a localized loss of support to and possible exposure of the pipeline. Sinkhole formation in these conditions tends to be less likely where the rock overlying the mine is hard, competent rock, such as sandstone, and the mine depth is higher. Sinkhole formation is more likely where the rock overlying the mine is softer, less competent rock, such as shale or claystone, and the mine depth is lower.

The following should be considered in planning for pipeline construction and operation in areas of abandoned underground mining:

- Detailed mine information is not available but the overall stability of the openings (rooms, entries, haulageways) in the underground mines should not be detrimental nor affect the integrity of the pipeline as it is designed and installed properly. Much of the roof failures and possible subsequent subsidence typically occurs during or soon after mining. The remaining potential surface subsidence would occur from roof collapses into the existing openings. These openings are small, generally no more than 30 feet wide, and have reached an equilibrium condition where roof collapses would be infrequent and would occur randomly in the mine. Such equilibrium conditions typically provide for a lesser impact to surface and near surface areas (all of which is dependent upon the depth of the mine and geophysical overburden) and to a degree so as to be of minor concern to the integrity of a pipeline of this design.
- Monitoring of the areas over mines would be conducted as part of those requirements mandated by 49 CFR 192.705
- Roof collapses from abandoned underground mines tend to be expressed as sinkhole subsidence and such subsidence is limited to areas where the cover

over the underground mine workings is thin. Such occurrences will therefore tend to be most common where the pipeline crosses over the coal outcrop. If sinkhole subsidence occurs directly beneath the pipeline, it could result in the loss of support to a short (less than 25 feet) section of the pipeline that could expose a short portion of the pipeline but shouldn't damage the line.

- Standard procedures will be used to monitor the integrity of the pipeline and the safety of the workers during construction in areas underlain by abandoned underground mines. Surface subsidence resulting from roof failures in the mines does not occur quickly. It is a slow progressive process that can take days or weeks to develop which would allow adequate time for personnel and equipment to be removed from the area. If sinkholes created by mine subsidence are encountered, the holes can be filled or the pipeline realigned to avoid such areas, which would eliminate any related safety concerns.

6.4.6 Unreclaimed Surface Mines

The proposed Project is in the vicinity of known unreclaimed active surface mines. These areas were identified using USGS topography, aerial photographs, and a field review, and may include non-coal and surface coal mines, quarries, and pits. Pipeline construction will take place adjacent to an active surface mining operation and should not pass through unreclaimed areas. If future mining is proposed to cross the pipeline, T. W. Phillips will meet with the mining company, as necessary, to discuss mitigation measures.

The proposed Project is within 500 feet of one known surface coal mine with both active and reclaimed areas owned by Sky Haven. The pipeline, two extra work space areas, and two access roads cross reclaimed surface mine areas east of the active mining operation. Sky Haven was contacted and indicated that they currently have no future plans to extend their operations into the Project area. Therefore, construction of the Project is not anticipated to impact the surface coal mining operations currently or in the future.

6.4.7 Volcanism and Igneous Activity

Geologic structure and bedrock in PA indicate that no significant volcanism has occurred since the Precambrian age (540 million years ago).

6.4.8 Flooding

Resource Report 1 discusses the construction methods proposed for stream and river crossings, and Resource Report 2 discusses the surface water crossings in detail.

Portions of the pipeline route are located within 100-year floodplain areas as depicted by Q3 floodplain data. Intense rain and spring thaw events will generally result in flooding along these stream and rivers, especially within the confines of V-shaped

valleys or in areas where heavy development hinders infiltration of water into the ground. Provided that the pipeline is constructed with adequate protection, flooding should only pose a problem during construction. The construction of this Project is anticipated to be conducted from late spring to early summer, when water levels are generally low and the probability of flooding is decreased.

6.4.9 Avoidance and Minimization of Adverse Effects

The overall effects of construction and operation of the Project on topography and geology will be minor and impacts will be limited to construction activities. The primary effects of construction activities will include temporary disturbance to slopes along the proposed pipeline ROW resulting from grading and trenching. However, as much as practical, topography and associated drainage will be returned to pre-construction conditions after construction completion.

Materials excavated from the pipeline trench will be re-used as fill for the trenches where possible. Excess materials will be disposed of along the pipeline route and incorporated into the re-landscaping of the pipeline ROW to help redevelop a landscape similar to pre-construction conditions. Fill material imported to the site will be obtained from local commercial sources. Resource Report 1 contains additional information regarding planned site restoration efforts. Blasted material will not be used as trench backfill. However, it is assumed for the areas that may require blasting shown in Table 6.2-1, that much of the rock encountered will be weathered and relatively soft and can be excavated rather than blasted. The excavated rock will be used as trench backfill where it can be compacted as soil fill.

Padding material (where required) will be brought onto the site to limit damage to the pipe and coating system. This would be brought from other points along the pipeline or mainly purchased from vendors in the region, and appropriate amounts of material would be placed in the trench. Some of the site materials could be used afterward to complete the backfill with the inspector's approval.

In addition, construction specifications include:

- A six-inch sand (or equivalent) padding will always be required around the pipe.
- Rockshield will be required where the remaining ditch cannot be completed with a "select backfill" (i.e., a backfill void of rock of any size and/or quantity that may ultimately affect the integrity of the coating). A situation where rockshield will be required is where the ditch will consist completely of excavated/blasted rock.
- The contractor shall be required to install pipe on bags, with suitable six-inch padding (acquired from other portions of the ROW, or brought in from an off-site source). Rockshield will be required, given that the remaining ditch will be backfilled with the excavated rock.

Approved disposal sites will be found for the blasted material, as well as for the excess material generated by the trench excavation, which is not spread on the uplands within the ROW limits. This would include State highway storage lots with the State approval.

6.5 PALEONTOLOGY

There are no known significant paleontological resources in this area.

6.6 LNG FACILITIES

No LNG facilities will be constructed as part of this Project.

6.7 UNDERGROUND STORAGE FACILITIES

No underground storage facilities will be constructed as a part of this Project.

6.8 REFERENCES

Edmunds, W. E. 1968. *Geology and Mineral Resources of the Northern Half of the Houtzdale 15-Minute Quadrangle, Pennsylvania*. Commonwealth of Pennsylvania, Bureau of Topographic and Geologic Survey.

Edmunds, W. E. 1962. *Geologic Map of the Northern Half of the Houtzdale Quadrangle, Pennsylvania*. United States Geological Survey Atlas 85 A and B, Plate 1. Topographic and Geologic Survey.

Glover, A. D. 1970. *Geologic Map of the Southern Half of the Clearfield Quadrangle, Pennsylvania*. United States Geological Survey Atlas 84 C and D, Plate 1. Topographic and Geologic Survey.

Glover, A. D. 1970. *Geology and Mineral Resources of the Southern Half of the Clearfield 15-Minute Quadrangle, Pennsylvania*. Commonwealth of Pennsylvania, Bureau of Topographic and Geologic Survey. 139 pp.

Petersen, M. D., A. D. Frankel, S. C. Harmsen, C. S. Mueller, K. M. Haller, R. L. Wheeler, R. L. Wesson, Y. Zeng, O. S. Boyd, D. M. Perkins, N. Luco, E. H. Field, C. J. Wills, and K. S. Rukstales. 2008. *2008 United States National Seismic Hazard Maps: U.S. Geological Survey Fact Sheet 2008-3018*. 2 p.

Pomeroy, J. S. 1981. *Landslides and Related Features of the Clearfield, PA Quadrangle*. United States Geological Survey. Open File Map 81-238 (A-3).

Stover, C. W., B. G. Reagor, and S. T. Algermissen. 1981. *Seismicity Map of the State of Pennsylvania*. Miscellaneous Field Studies Map MF-1280 Seismicity, PA. Department of the Interior, United States Geological Survey, Reston, VA.

United States Department of Agriculture, Natural Resources Conservation Service's Soil Data Mart. Soil Survey Geographic Database (SSURGO) for Clearfield County, Pennsylvania. <http://soildatamart.nrcs.usda.gov>. Tabular data version, January 30, 2008.

United States Geological Survey. 2008. *Documentation for the 2008 Update of the United States National Seismic Hazard Maps*. Open-File Report 2008-1128.

United States Geological Survey. 2000. Lecontes Mills, PA 7.5-Minute Topographic Quadrangle.

United States Geological Survey. 1993a. Glen Richey, PA 7.5-Minute Topographic Quadrangle.

United States Geological Survey. 1993b. Wallaceton, PA 7.5-Minute Topographic Quadrangle.

United States Geological Survey. 1981. Clearfield, PA 7.5-Minute Topographic Quadrangle, revised 1993.

Table 6.1-1

**SURFICIAL GEOLOGIC FORMATIONS
 INTERSECTED BY THE PIPELINE AND FACILITIES**

Era/Period	Milepost		Symbol ¹	Formation	General Rock Type(s)
	Start	End			
Pennsylvanian	0.00	0.05	Plk	Lower Kittanning	Alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.
	0.05	0.37	Pcn	Clarion	Alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.
	0.37	1.05	Pm	Mercer	Alternations of sandstone and minor coals and clay.
	1.05	1.67	Pcn	Clarion	Alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.
	1.67	1.80	Plk	Lower Kittanning	Alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.
	1.80	1.97	Pmk	Middle Kittanning	Alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.
	1.97	2.64	Plk	Lower Kittanning	Alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.
	2.64	2.76	Pcn	Clarion	Alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.
	2.76	2.85	Pm	Mercer	Alternations of sandstone and minor coals and clay.
	Mississippian	2.85	2.95	Mp	Pocono
Pennsylvanian	2.95	3.11	Pm	Mercer	Alternations of sandstone and minor coals and clay.
	3.11	3.17	Pcn	Clarion	Alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.
	3.17	3.29	Plk	Lower Kittanning	Alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.
	3.29	3.35	Puk	Upper Kittanning	Alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.
	3.35	3.51	Pf	Freeport	Alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.
	3.51	3.59	Puk	Upper Kittanning	Alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.
	3.59	3.76	Pmk	Middle Kittanning	Alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.
	3.76	3.86	Plk	Lower Kittanning	Alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.
	3.86	3.92	Pcn	Clarion	Alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.
	3.92	5.05	Pm	Mercer	Alternations of sandstone and minor coals and clay.
Mississippian	5.05	5.38	Mp	Pocono	Alternations of sandstone and shale with variegated colors at the base.

Table 6.1-1 (Continued)

Era/Period	Milepost		Symbol ¹	Formation	General Rock Type(s)
	Start	End			
Pennsylvanian	5.38	5.42	Qal	Alluvium	-
Mississippian	5.42	6.07	Mp	Pocono	Alternations of sandstone and shale with variegated colors at the base.
Pennsylvanian	6.07	6.52	Pco	Connoquenessing	Alternations of sandstone and minor coals and clay.
Mississippian	6.52	6.64	Mp	Pocono	Alternations of sandstone and shale with variegated colors at the base.
Not Applicable	6.64	6.71	Qal	Alluvium	-
	6.71	6.77	W	Water	-
	6.77	5.78	Qal	Alluvium	-
Mississippian	6.79	6.81	Mp	Pocono	Alternations of sandstone and shale with variegated colors at the base.
Pennsylvanian	6.81	7.55	Pco	Connoquenessing	Alternations of sandstone and minor coals and clay.
Not Applicable	7.55	7.94	Qal	Alluvium	-

Note:

¹ From Edmunds, 1962; and Glover, 1970.

Table 6.2-1

AREAS THAT MAY REQUIRE BLASTING ALONG THE PIPELINE¹

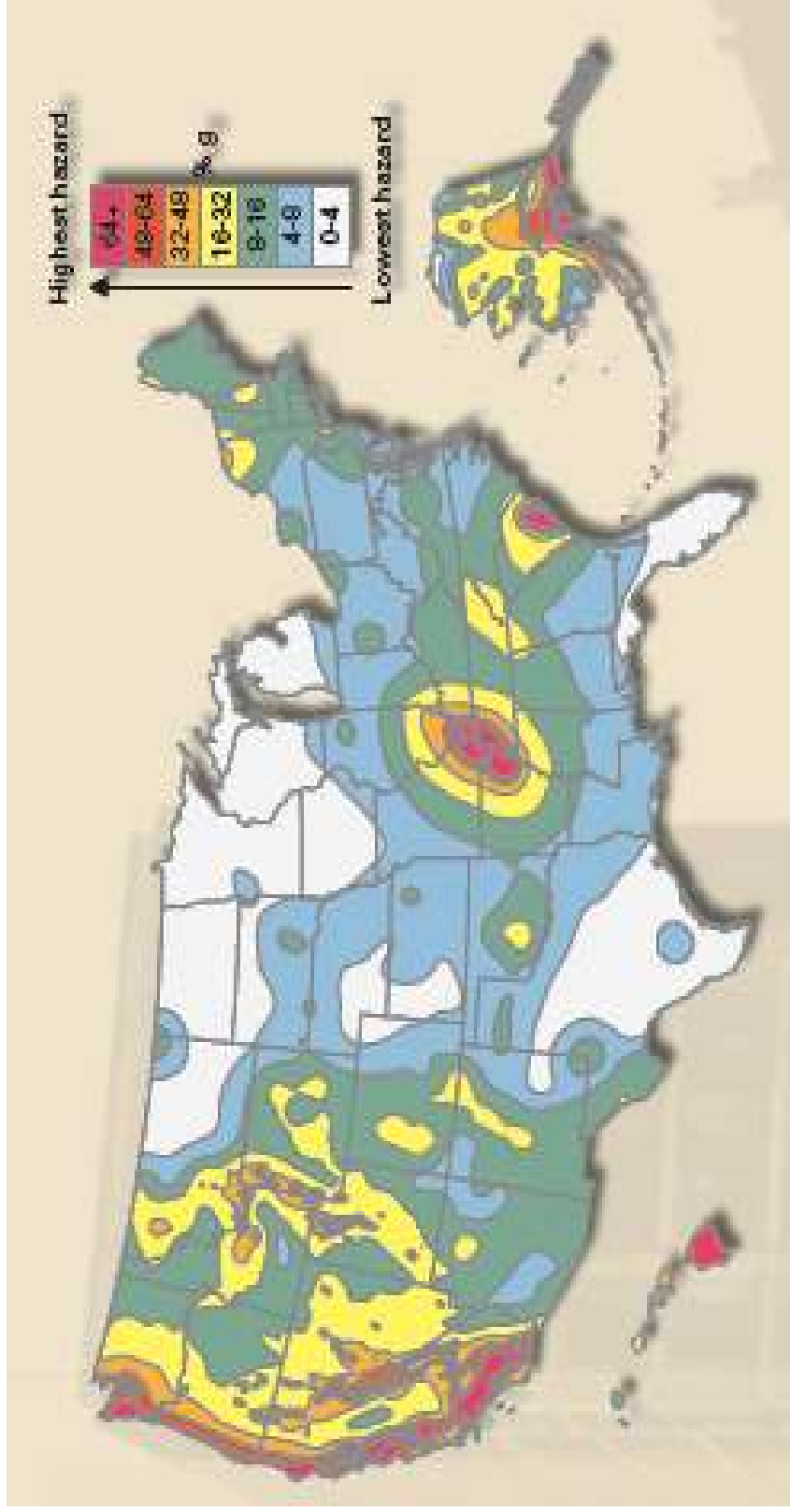
Soil Series Symbol	Milepost		Approximate Depth to Rock (inches) ²
	Start	End	
RcD	0.848	2.714	28 to 34
GIB	1.061	1.239	30 to 35
RcD	1.703	1.827	28 to 34
RcD	1.948	2.162	28 to 34
GIC	2.200	0.627	30 to 35
GIC	2.714	2.771	30 to 35
RcD	3.006	3.029	28 to 34
RcD	3.068	3.130	28 to 34
GIC	3.468	3.477	30 to 35
GIB	3.634	3.640	30 to 35
GIC	3.640	3.808	30 to 35
RcD	4.201	4.245	28 to 34
RcD	4.301	4.728	28 to 34
GIC	5.715	5.949	30 to 35
GIC	6.136	6.329	30 to 35
RcD	6.329	6.408	28 to 34

Notes:

- ¹ Information on soils was taken from USDA, NRCS, Soil Data Mart, Soil Survey Geographic Database (SSURGO) for Clearfield County, Pennsylvania. <http://soildatamart.nrcs.usda.gov>. Tabular data version, January 30, 2008.
- ² Limitations with a trench depth minimum of approximately 46 inches or less to bedrock.

FIGURE 6.4-1

2008 UNITED STATES NATIONAL SEISMIC HAZARD MAP



Note:

- 1 Colors on this map show the levels of horizontal shaking that have a 2-in-100 chance of being exceeded in a 50-year period. Shaking is expressed as a percentage of g (g is the acceleration of a falling object due to gravity).

Figure 6.4-1

2008 UNITED STATES NATIONAL SEISMIC HAZARD MAP

APPENDIX 6-A
RECOMMENDED SITE-SPECIFIC BLASTING PLAN

TABLE OF CONTENTS

	<u>Page</u>
APPENDIX 6-A RECOMMENDED SITE-SPECIFIC BLASTING PLAN	6A-1
6A.1 INTRODUCTION	6A-1
6A.2 PROJECT DESCRIPTION	6A-1
6A.3 GEOLOGY.....	6A-1
6A.4 PRE-BLAST INSPECTION.....	6A-2
6A.5 MONITORING OF BLASTING ACTIVITIES	6A-2
6A.5.1 Stream Blasting.....	6A-3
6A.6 BLASTING SPECIFICATIONS	6A-4
6A.6.1 General Provisions.....	6A-4
6A.6.2 Storage Use at Sites	6A-5
6A.6.3 Pre-Blast Operations.....	6A-5
6A.6.4 Discharging Explosives	6A-7
6A.6.5 Waterbody Crossing Blasting Procedures.....	6A-8
6A.6.6 Disposal of Explosive Materials.....	6A-8
6A.6.7 Blasting Records	6A-8
6A.7 POST-BLAST INSPECTION	6A-10

APPENDIX 6-A RECOMMENDED SITE-SPECIFIC BLASTING PLAN

6A.1 INTRODUCTION

T. W. Phillips Pipeline Corp. (T. W. Phillips) is a wholly owned subsidiary of TWP INC. This Blasting Plan describes the blasting program that will be implemented during construction of the Bionol Clearfield Pipeline Project (Project).

Information for blast and rip characteristics of the bedrock may be evaluated at least in a general sense, and applied toward an appropriate bedrock excavation method. The bedrock in the Project area is sedimentary; therefore, the predominant method of excavation will be to rip in rocky areas. If ripping is not feasible, blasting will be considered.

If variations from this Blasting Plan are required based on field conditions, T. W. Phillips will consult with FERC prior to implementation.

6A.2 PROJECT DESCRIPTION

The Project area is a rural landscape comprised of a mosaic of forest, agricultural, and open land cover, with few residences, except in the Borough of Clearfield. Clearfield is a mixed industrial, residential, and commercial area. The proposed Project will include:

- construction of approximately eight miles of six-inch diameter, coated steel, natural gas pipeline;
- construction of three main line valves;
- construction of a metering station in Boggs Township; and
- construction of a regulating station in the Borough of Clearfield.

Construction of the Project is planned to start in April 2009, with an in-service date of July 2009.

6A.3 GEOLOGY

A description of the bedrock geology that occurs in the areas affected by the Project is provided in Resource Report 6 - Geological Resources. In addition, the occurrence of soil hazards associated with the Project is provided in the Resource Report 7 - Soils.

The surficial geology of the Project area is comprised of a very thin layer of unconsolidated material overlying bedrock of the subsurface geology. Surficial deposits of the Project area are derived from the breakdown and weathering of the underlying shale or sandstone bedrock.

Bedrock in the upper, subsurface geology underlying the Project area is mapped by the Pennsylvania Geological Survey as Mississippian-age and Pennsylvanian-age systems. The formations found within these groups include the Pocono Formation of the Mississippian system, and the Pottsville and Allegheny Groups of the Pennsylvanian system. These formations consist mainly of alternations of shale, sandstone, siltstone, coal, clay, and minor limestone.

6A.4 PRE-BLAST INSPECTION

As required by FERC, T. W. Phillips' contractor shall conduct pre-blast surveys, with landowner permission, to assess the conditions of structures, wells, springs, and utilities within 150 feet of proposed blasting areas. The pre-blast survey will include the following:

- informal discussions to familiarize the adjacent property owners with blasting effects and planned precautions to be taken on this Project and determination of the existence and location of site-specific structures, utilities, septic systems, and wells; and
- sampling of well or spring water quality and flow rate, as feasible, for wells or springs used for human consumption that are within 150 feet of proposed blasting areas.

The pre-blast survey may also include the following:

- detailed examination, photographs, and/or video records of adjacent structures and utilities; and
- detailed mapping and measurement of large cracks, crack patterns, and other evidence of structural distress.

The results will be summarized in a condition report that may include photographs and be completed prior to the commencement of blasting.

6A.5 MONITORING OF BLASTING ACTIVITIES

During blasting, T. W. Phillips' contractors will take precautions to minimize damage to adjacent areas and structures. Precautions include:

- backfilling with subsoil (no topsoil to be used) or blasting mats to prevent fly rock;
- blast warning in congested areas, in shallow water bodies, or near structures that could be damaged by fly rock;
- posting warning signals, flags, and barricades;
- following procedures for safe storage, handling, loading, firing, and disposal of explosive materials; and
- manning adjacent pipelines at valves for emergency response.

T. W. Phillips' blasting contractor's blasting standards will meet or exceed applicable federal, state and local requirements covering the use of explosives. Excessive vibration will be controlled by limiting the size of charges and by using charge delays, which stagger each charge in a series of explosions.

If the contractor has to blast near buildings, septic systems or wells, a qualified contractor will inspect those structures within 150 feet of the blast area prior to blasting, and with landowner permission. Post-blast inspections by the contractor's representative may be performed as warranted. All blasting will be performed by registered blasters and monitored by certified blasting inspectors. Recording seismographs will be placed by the contractor at selected monitoring stations under observation of T. W. Phillips' personnel. During blasting, the contractor may monitor ground vibrations at the nearest structure or well that is within 150 feet of the blast site.

To maximize its responsiveness to the concerns of affected landowners, T. W. Phillips will evaluate all complaints of well, septic system or structural damage associated with construction activities, including blasting. In the unlikely event that blasting activities temporarily impair well water, T. W. Phillips will provide alternative sources of water or otherwise compensate the owner. If well or structural damage is substantiated, T. W. Phillips will either compensate the owner for damages or arrange for a new well to be drilled.

6A.5.1 Stream Blasting

If blasting in streams is necessary, T. W. Phillips will require the blasting contractor to minimize impacts to the stream resource. Blasting in streams will be conducted using delays of a fraction of a second per hole and stemming in which rock is placed into the top of the borehole to damp the shock wave reaching the water column. The nature of the material that will require blasting, the limited areas where this will be required, and the short duration of this activity will combine to minimize the amount of fine-grained material that will be released into the water column.

An approved, licensed blaster who shall conduct all blasting will direct blasting operations and no charge will be detonated without his/her approval. Misfires will be handled in accordance with all federal, state, and/or local requirements.

6A.6 BLASTING SPECIFICATIONS

The potential for blasting along the pipeline to affect structures, wells, springs, or utilities will be minimized by controlled blasting techniques and by using mechanical methods for rock excavation as much as possible. The following text presents details of procedures for blasting.

6A.6.1 General Provisions

The blasting contractor will provide all personnel, labor, and equipment to perform necessary blasting operations related to the work. The contractor will provide a permitted blaster possessing all permits required by the states in which blasting is required during construction, and having a working knowledge of state and local laws and regulations that pertain to explosives.

The contractor shall be responsible for securing and complying with all necessary permits required for the transportation, storage, and use of explosives. The contractor shall be responsible for all damages or liabilities occurring on or off the right-of-way (ROW) resulting from the use of explosives. When the use of explosives is necessary to perform the work, the contractor shall use utmost care not to endanger life or adjacent property, and shall comply with all applicable laws, rules, and regulations governing the storage, handling, and use of such explosives.

Blasting activities will strictly adhere to all local, state, and federal regulations applying to controlled blasting and blast vibration limits in regard to structures and underground utilities. Typically, local regulations require copies of the blasting contractor's certificate of insurance and license. In some jurisdictions, a certificate of bond will also be required, as well as a qualified person hired to oversee the blasting.

T. W. Phillips' Chief Inspector (CI) or designated representative shall have the opportunity to witness all rock excavations or other use of explosives. The contractor shall conduct all blasting operations in a safe manner which will not cause harm to the existing pipelines and structures in the vicinity.

Any failure to comply with the appropriate law and/or regulations is the sole liability of the contractor. The contractor and the contractor's permitted blaster shall be responsible for the conduct of all blasting operations, which shall be subject to inspection requirements.

Affected landowners within 150 feet of blasting locations will be contacted prior to any blasting activities.

6A.6.2 Storage Use at Sites

Explosives and related materials shall be stored in approved facilities according to federal, state, and local regulations. The handling of explosives may be performed by the person holding a permit to use explosives or by other employees under his or her direct supervision provided that such employees are at least 21 years of age. While explosives are being handled or used, smoking shall not be permitted, and no one near the explosives shall possess matches, open light, or other fire or flame within 50 feet of the explosives, in accordance with OSHA requirements. Suitable devices for lighting safety fuses are exempt from this requirement. No person shall handle explosives while under the influence of intoxicating liquors or narcotics at any time during construction of the Project. Suitable containers shall be used for taking detonators and other explosives from storage magazines to the blasting area. Partial reels of detonating cord do not need to be in closed containers unless transported over public highways. Containers of explosives shall not be opened in any magazine or within 50 feet of any magazine. In opening kegs, or wooden cases, no sparking metal tools shall be used; wooden wedges and either wood, fiber or rubber mallets shall be used. Non-sparking metallic slitters may be used for opening fiberboard cases.

No explosive materials shall be located or stored where they may be exposed to flame, excessive heat, sparks, or impact.

Explosives or blasting equipment that are obviously deteriorated or damaged shall not be used. Explosive materials shall be protected from unauthorized possession and shall not be abandoned.

No attempt shall be made to fight a fire if it is determined that the fire cannot be contained or controlled before it reaches explosive materials. In such cases, all personnel shall be immediately evacuated to a safe location and the area shall be guarded from entry by spectators or intruders.

No firearms shall be discharged into or in the vicinity of a vehicle containing explosive materials or into or in the vicinity of a location where explosive materials are being handled, used, or stored.

6A.6.3 Pre-Blast Operations

The contractor is required to submit a planned schedule of blasting operations to the CI or his designated representative for approval, prior to commencement of any blasting or pre-blast operation, which indicates the maximum charge weight per delay, hole size, spacing, depth, and blast layout. The contractor shall provide this schedule to the CI at least two working days prior to any pre-blast operation for approval and use. Where residences are within 50 feet of the blasting operation the CI may require notification in excess of five days. The blasting schedule is to include the blast geometry, drill hole dimensions, type and size of charges, stemming, and delay patterns and should also include a location survey of any dwelling or structures that may be affected by the

proposed operation. Face material shall be carefully examined before drilling to determine the possible presence of unfired explosive material. Drilling shall not be started until all remaining butts of old holes are examined with a wooden stick for unexploded charges, and if any are found, they shall be refired before work proceeds. No person shall be allowed to deepen the drill holes that have contained explosives.

Drill holes shall be large enough to permit free insertion of cartridges of explosive materials. Drill holes shall not be collared in bootlegs or in holes that have previously contained explosive materials. Holes shall not be drilled where there is a danger of intersecting another hole containing explosive material. Charge loading shall be spread throughout the depth of the drill hole or at the depths of rock concentration in order to obtain the optimum breakage of rock.

Loading and firing shall be performed or supervised only by a person possessing an appropriate blasting permit. All drill holes shall be inspected and cleared of any obstruction before loading. No holes shall be loaded except those to be fired in the next round of blasting. After loading, all remaining explosives shall be immediately returned to an authorized magazine.

Tamping shall be done only with wood rods without exposed metal parts, but non-sparking metal connectors may be used for jointed poles. Plastic tamping poles may be used, provided they have been approved by the authority having jurisdiction. Violent tamping shall be avoided.

Recommended stemming material shall consist of crushed stone, which will not bridge over like dirt and will completely fill voids in the hole.

When safety fuse is used, the burning rate shall be determined and in no case shall fuse lengths less than 120 seconds be used. The blasting cap shall be securely attached to the safety fuse with a standard ring type cap crimper.

Pneumatic loading of blasting agents in blast holes primed with electric blasting caps or other static-sensitive initiation systems shall comply with the following requirements:

- a positive grounding device shall be used for the equipment to prevent accumulation of static electricity;
- a semi-conductive discharge hose shall be used; and
- a qualified person shall evaluate all systems to assure that they will adequately dissipate static charges under field conditions.

No blasting caps or other detonators shall be inserted in the explosives without first making a hole in the cartridge for the cap with a wooden punch of proper size or standard cap crimper.

After loading for a blast is completed, all excess blasting caps or electric blasting caps and other explosives shall immediately be removed from the area and returned to their separate storage magazines.

6A.6.4 Discharging Explosives

Persons authorized to prepare explosive charges or conduct blasting operations shall use reasonable precautions. Precautions may include, but are not limited to, warning signals, flags, barricades, or woven wire mats to ensure the safety of the general public and workmen.

The contractor shall obtain T. W. Phillips' approval to blast and provide T. W. Phillips 24-hour notice prior to the use of any explosives. The contractor shall comply with local and state requirements for pre-blast notifications.

Whenever blasting is being conducted in the vicinity of gas, electric, water, fire alarm, telephone, telegraph and steam utilities, the blaster shall notify the appropriate representatives of such utilities at least 24 hours in advance of blasting. In an emergency, this time limit may be waived by the local authority issuing the original permit.

Blasting operations, except by special permission of the authority having jurisdiction, shall be conducted during daylight hours.

When blasting is done in congested areas or in proximity to a significant natural resource, structure, railway, or highway or any other installation that may be damaged, the blast shall be backfilled before firing or covered with a mat, constructed so that it is capable of preventing fragments from being thrown. In addition, other possible precautions may be taken to prevent damage to livestock and other property and inconvenience to the property owner or tenant during blasting operations. All reasonable attempts will be made to prevent fly rock from leaving the construction ROW. All reasonable means shall be taken to return any rock scattered outside the ROW during blasting operations.

No blast shall be fired until the blaster in charge has made certain that all surplus explosive materials are in a safe place, all persons and equipment are at a safe distance or under sufficient cover, and that an adequate warning signal has been given.

Only the person making leading wire connections in electrical firing shall fire the shot. All connections should be made from the bore hole back to the source of firing current, and the leading wires shall remain shorted until the charge is to be fired. After firing an electric blast from a blasting machine, the leading wires shall be immediately disconnected from the machine and short-circuited. If there are any misfires while using cap and fuse, all persons shall remain away from the charge for at least one hour. If electrical blasting caps are used and a misfire occurs, this waiting period may be reduced to 30 minutes. Misfires shall be handled under the direction of the person in

charge of the blasting and all wires shall be carefully traced in search for the unexploded charges.

Explosives shall not be extracted from a hole that has once been charged or has misfired unless it is impossible to detonate the unexploded charge by insertion of a fresh additional primer.

6A.6.5 Waterbody Crossing Blasting Procedures

To facilitate planning for blasting activities for waterbody crossings, rock drills or test excavations may be used in waterbodies to test the ditch-line during mainline blasting operations to evaluate the presence of rock in the trench-line. The excavation of the test pit or rock drilling is not included in the time window requirements for completing the crossing. For testing and any subsequent blasting operations, streamflow will be maintained through the site. When blasting is required, the FERC timeframes for completing in-stream construction begin when the removal of blast rock from the waterbody is started. If, after removing the blast rock, additional blasting is required, a new timing window will be determined in consultation with the Environmental Inspector. If blasting impedes the flow of the waterbody, the contractor can use excavation equipment to restore the stream flow without triggering the timing window. The complete waterbody crossing procedures are included in the E&SCP (Appendix 1-C).

6A.6.6 Disposal of Explosive Materials

All explosive materials that are obviously deteriorated or damaged shall not be used and shall be destroyed according to applicable local, state, and federal requirements.

Empty containers and packages and paper on fiberboard packing materials that have previously contained explosive materials shall not be reused for any purpose. Such packaging materials shall be destroyed by burning at an approved outdoor location. All personnel shall remain at a safe distance from the disposal area.

All other explosive materials will be transported from the job site in approved magazines per local and/or state regulations.

6A.6.7 Blasting Records

A record of each blast shall be made and submitted, along with seismograph reports, to the blasting inspector. The record shall contain the following minimum data for each blast:

- name of company or contractor;
- location, date and time of blast;
- name, signature and license number of contractor and of blaster in charge;

- type of material blasted;
- number of holes, depth of burden and stemming, and spacing;
- diameter and depth of holes;
- volume of rock in shot;
- types of explosives used, specific gravity, energy release, pounds of explosive per delay, and total pounds of explosive per shot;
- delay type, interval, total number of delays and holes per delay;
- maximum amount of explosives per delay period of 17 milliseconds or greater;
- power factor;
- method of firing and type of circuit;
- direction and distance in feet to nearest dwelling house, public building, school, church, commercial or institutional building neither owned or leased by the person conducting the blasting;
- weather conditions;
- type and height or length of stemming;
- if mats or other protection were used; and
- type of detonators used and delay periods used.

The person taking the seismograph reading shall accurately indicate exact location of the seismograph if used, and shall also show the distance of the seismograph from the blast.

Seismograph records, where required, should include:

- name of person and firm operating and analyzing the seismograph record;
- seismograph serial number;
- seismograph reading; and
- maximum number of holes per delay period of 17 milliseconds or greater.

6A.7 POST-BLAST INSPECTION

The condition of structures within 150 feet of the blast area may be examined by the blasting contractor, with landowner permission, after completion of blasting operations to identify changes in the conditions of these properties or confirm any damages noted by the landowner. If requested by the landowner, a resampling of wells or springs within 150 feet of the construction area will be conducted by the independent contractor. Should any damage occur to these properties during the blasting operations, an additional survey of the affected property may be made.