

Resource Report 6- Geological Resources

Table 6.3-1

Summary of Geologic Conditions

AES Sparrows Point Project

Facilities & Location	Physiographic Province <i>Sections or Regions</i>	Mile Post (MP)	Geologic Description			Potential Geologic Hazards	
			Age	Geologic Group	Map Unit Description	(MP)	Hazard
Sparrows Point LNG Terminal <i>Baltimore, MD MP 0.0</i>	Coastal Plain Province <i>Western Shore Lowlands Region</i>	0.0-3.0	Quaternary	Lowland Deposits	af- artificial fill composed of homogeneous material such as rock, unconsolidated sediment and slag. Qtc- poorly-sorted, poorly-bedded quartz silt with clays.	0.0	Soil Liquefaction ²
		3.0-4.1		Talbot Formation	Qts- poorly sorted quartz, silts, kaolinite.	3.0-4.1	Soil Liquefaction ²
Mid-Atlantic Express Pipeline <i>Baltimore, MD MP 0.0-22.2</i>	Dominant topography form includes very low relief with flat upper surfaces, shallow valleys and surficial deposits of unconsolidated or poorly consolidated gravels, sands, silts and clays.	4.1-17.6	Lower Cretaceous*	Section generally composed of clays, sands and gravels from the Patapsco Formation (Kpc, Kps), Arundel Formation (Kac), and Patuxent Formation (kxs, kxc) with some areas of Artificial Fill (af) and *Alluvium (Qal) present at or near water bodies (often confined to oxidizing conditions).	Kpc- clay facies, buff mottled kaolinitic clay with variable amounts of quartz, sand and silt. Kps- sand facies, well-sorted medium to fine quartz sand with locally abundant gravel. Kac- clay facies, gray, brown, black or red kaolinitic and illitic clay with lenses of quartz sand. kxc- clay facies, light grey to brown clay containing variable amounts of silt with local concentrations of lignitic debris. kxs- sand facies, highly variable, interbedded sand, gravel, silt and clay with hematite or limonite cementations in places. af- artificial fill composed of homogeneous material such as rock, unconsolidated sediment and slag. Qal- interbedded gravel, sand, silt and clay confined to oxidizing conditions. Qal located at MP 6.8-6.9, 8.7-8.9, 10.5-10.6, 11.4-11.7, 11.8-11.9, 14.7-14.75, 15.1-15.2, 15.7-15.8, 15.9-16.0		
		17.6-20.4		Lower Paleozoic*	Bradshaw Layered Amphibolite (bl) with *Tertiary age deposits of Upland Gravel (ug) at higher topographies and *Alluvium (Qal) deposits present at lower topographies, near water bodies (often confined to oxidizing conditions).	bl- centimeter to meter scale interlayered amphibolite and horn blend quartz. ug- poorly sorted fine sand to boulders commonly floating in a clay-silt mix. Deposits are common on topographies of hill tops and hillsides. Qal- interbedded gravel, sand, silt and clay confined to oxidizing conditions. Qal located at MP 18.4-18.5, 19.3-19.4.	
	20.4-21.0		Franklinville Gneiss (f) with area of overlying *Alluvium (Qal) at surface water bodies.		f- uniform medium to coarse -grained biotite, quartz, gneiss. Qal- interbedded gravel, sand, silt and clay confined to oxidizing conditions. Qal located at MP 20.6-20.7	20.5-26.8	Shallow Bedrock ³ (f/bl)

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Facilities & Location	Physiographic Province Sections or Regions	Mile Post (MP)	Geologic Description			Potential Geologic Hazards	
			Age	Geologic Group	Map Unit Description	(MP)	Hazard
Mid-Atlantic Express Pipeline <i>Baltimore, MD</i> MP 0.0-22.2 <i>Harford, MD</i> MP 22.2-44.2 <i>Cecil, MD</i> MP 44.2-48.3 <i>Lancaster, PA</i> MP 48.3-56.3 <i>Chester, PA</i> MP 56.3-87.9	Piedmont Province Uplands Section Dominant topographies include broad, rounded to flat-topped hills and shallow valleys. Paleozoic to Pre-Cambrian aged bedrock, deeply folded and faulted consisting of mainly schist, gneiss, and quartzite.	21.0-26.6	Lower Paleozoic*	Section includes Bradshaw Layered Amphibolite (bl) and Baltimore gabbro (Pzb) at higher elevations with areas of overlying *Alluvium (Qal) in lower elevations at or near surface water bodies (often confined to oxidizing conditions).	bl - Bradshaw Layered Amphibolite, centimeter to meter scale interlayered amphibolite and horn blend quartz. Pzb - massive hypersthene gabbro Qal - interbedded gravel, sand, silt and clay confined to oxidizing conditions. Qal located at MP 21.3-21.4, 22.3-22.4, 23.5-23.6 Note: Baltimore Gabbro (Pzb) mapped unit in Harford County, appears equivalent to Bradshaw Layered Amphibolite in Baltimore County.	22.4	Landslide Susceptibility ⁴
		26.6-34.9	Lower Paleozoic*	Schist and boulder gneiss from the <i>Former Wissahickon Formation</i> (pCwb, pCwl) - with areas of overlying *Alluvium (Qal) at or near surface water bodies (often confined to oxidizing conditions).	pCwb - (<i>formerly Wissahickon Formation</i>) - sy - Sykesville Formation. Boulder gneiss, thick bedded, contains lenses of metamorphosed conglomerate sandstone. pCwl - (<i>formerly Wissahickon Formation</i>) - Loch Raven Schist -Schist, chiefly biotite-muscovite-plagioclase schist with garnet, staurolite and kyanite. Qal - interbedded gravel, sand, silt and clay confined to oxidizing conditons. Qal located at MP 27.9-28.0, 28.5-29.1, 29.3-30.0, 31.8-31.9, 32.7-32.8	32.2-33.0 35.4	Shallow Bedrock ³ (pCwl/Qal) Landslide Susceptibility ⁴
		34.9-46.1	Lower Paleozoic	Intrusive rocks including ultramafic (Pzum, Pzug) and gabbro from the Baltimore Complex (bg).	Pzug, Pzum - undifferentiated ultramafic rocks. Pzb - Baltimore Gabbro bg - gabbro, pyroxene crystals, generally massive with wide varieties of mafic and ultramafic rocks. Qal - interbedded gravel, sand, silt and clay confined to oxidizing conditons. Qal located at MP 35.5-35.6	34.3-35.6 36.0-43.9	Shallow Bedrock ³ (pCwb/pzug) Shallow Bedrock (pzum/pzb)
		46.1-78.9		Peters Creek Schist (xpc), Cockeysville Marble (Xc), Glennarm Wissahickon Schist and (Xgw) and Octoraro Schist (Xo) Formation, Baltimore Complex (bs) and ultramafic rocks (Xu).	Xgw - oligoclase mica schist including lenticular amphibolite bodies Xc - white to bluish gray, finely to coarsely crystalline marble Xpc - Cholorite-sericite schist containing interbedded quartzite Xo - Includes albite-chlorite schist, phyllite, some hornblend gneiss and granitized members Xu - Undifferentiated ultramafic rocks bs - serpentinite	43.9 44.4-49.2	Landslide Susceptibility
		70.4-72.1 74.2-74.3					Shallow Bedrock ³ (Xc/Xaw) Shallow Bedrock ³ (Xc/Xgw)

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Facilities & Location	Physiographic Province <i>Sections or Regions</i>	Mile Post (MP)	Geologic Description			Potential Geologic Hazards	
			Age	Geologic Group	Map Unit Description	(MP)	Hazard
Mid-Atlantic Express Pipeline <i>Chester, PA MP 56.3-87.9</i>	Piedmont Province <i>Lowlands Section</i> Dominant topography includes broad, moderately dissected karst valleys separated by broad low hills. Paleozoic to Cambrian aged bedrock, deeply folded and faulted consisting of mainly schist, gneiss, and quartzite.	78.9- 81.3	Ordovician and Cambrian	Carbonate rock from several formations Conestoga (Occ), Ledger (Cl), Kinzers (Ck), Vintage Formation (Cv), Antietam and Harpers Formations (Cah) and Chickies Formation (Cch).	Occ- Light-gray, thin-bedded, impure contorted limestone having shale partings. Cl- Light-gray, locally mottled, massive, pure, dolomite. Ck- base, dark brown shale; middle, gray and white spotted limestone; top, sandy limestone weathered to fine grained porous sandy mass. Cv- dark gray, knotty, dolomite to marble at base. Cah- includes Antietam and Harpers Formations (quartzite and schist). Cch- light gray, hard, massive quartzite and schist interbedded dark slate at top, conglomerate at base.	78.9	Inactive Fault ²
	Piedmont Province <i>Uplands Section</i> Dominant topographies include broad, rounded to flat-topped hills and shallow valleys. Paleozoic to Pre-Cambrian aged bedrock, deeply folded and faulted, consisting of mainly schist, gneiss, and quartzite.			81.3-87.6	Pre-Cambrian	Gneiss including banded mafic (gga), graphitic felsic (gg), and intermediate (ggd) units.	ggd- medium-grained light pink to greenish gray - predominantly quartz, feldspar and mica. gga- dark, fine to medium-grained banded mafic gneiss (likely includes rocks of sedimentary origin). gg- includes Pickering Gneiss and small areas of marble, quartz and feldspar; small amounts of metamorphic minerals. Cch- light gray, hard, massive quartzite and schist interbedded dark slate at top, conglomerate at base.
						82.5-83.1	Shallow Bedrock ³ (ggd)

Notes:

- *Approximate or estimated ages provided; surficial Tertiary or Quaternary deposits also exist within these sections.
- Description of potential soil liquefaction susceptibility described in the Terminal Site Specific Design Response Spectra and Assessment of Liquefaction Potential," of the Preliminary Geotechnical Report on Sparrows Point (Appendix J in Resource Report 13). For the Pipeline, if necessary, during the detailed design, engineering measures will be incorporated - for example, weighting the pipeline, increasing the flexibility or strength of the pipe, increasing pipe wall thickness, increased yield strength, modifying welding requirements, or modifying installation techniques to address potential seismic-related impacts such as faults, seismicity or soil liquefaction potential.
- Shallow bedrock areas (depths less than five feet) have the potential to require blasting during Pipeline construction. Shallow bedrock areas were identified using SSURGO soils data (Table 7.3-1) - and adjusted based on geologic reference materials and field observations (MP18.1-18.4 excluded and MP 74.4-75.5 included as potential shallow bedrock). Mapped or reported bedrock units are identified along with shallow bedrock areas (in parentheses) in Potential Geologic Hazard column. Mitigation measures for blasting activities, if necessary, in shallow bedrock areas are included in Resource Report 6 and Appendix 6A - Project Blasting Plan.
- To minimize or avoid potential impacts from landslides, subsidence (including areas of karst occurrence) or slope failure in susceptible areas construction of the Pipeline will be completed in accordance with the Environmental Construction Plan (provided as Appendix 2A to Resource Report 2), including measures to ensure appropriate grading, limit undercutting or overloading slopes, and provide for appropriate revegetation and maintenance during operation. Furthermore during detailed design, if necessary, engineering measures will be incorporated n - for example, increasing pipe wall thickness, increasing yield strength, modifying weld requirements or modifying backfill approaches.

Resource Report 6- Geological Resources
Table 6.5-1
Summary of Mineral Resources
AES Sparrows Point Project

Approximate Location (Milepost)	Description	Approximate Distance from Construction ROW (ft)	Reported Operator/Owner	Remarks / Status
MP 9.4	Possible former borrow pit	500 LT	County of Baltimore	Inactive. Possible was a former borrow pit (could not be confirmed) during the Windlass Freeway (I-695) construction in the 1970s . No current or planned mining operations.
MP 12.9	Clay Pit	600 LT	Potts and Callahan, Inc 500 W. 29th St. Baltimore, MD 21211	Active. Occasional mining only on limited schedule (estimated two days/month), in reclamation process.
MP 14.3	Sand and Gravel	1400 LT	Nottingham Properties	Inactive. Now owned and redeveloped by Nottingham Properties; reclamation complete.
MP 39.2	Apparent Former Quarry	1200 LT	Carol F. and E.L. Dinning	Inactive. Former soapstone quarry.
MP 48.9	Coarse aggregate - Serpentinite Quarry	100 RT	Red Hill, Ltd. (Formerly Pennsylvania-Maryland Materials) 114 Foxshire Drive Lancaster, PA 17901 (Leased to Haines & Kibblehouse)	Active. Construction Aggregate operation. Reclamation is ongoing. No plans for expansion at this time.
MP 48.9	Coarse aggregate - Serpentinite Quarry	100 RT	Stoltzfus, D.M., and Son, Inc	Active. Produces Construction Aggregate. Reclamation is ongoing. Permitted for expansion to the edge of the property.

Notes:

1. Mileposts shown as MP-mileposts along new Mid Atlantic Express project route
2. RT indicates right of pipeline alignment proceeding northward from MP-0.0
3. LT indicates left of pipeline alignment proceeding northward from MP-0.0.
4. Information derived from USGS topographic maps, aerial photographs, field reconnaissance and owner/operator contacts.
5. Distances from construction right-of-way (ROW) are approximated based on mapping references.