Identification_Information:
  Native_Data_Set_Environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 2; ESRI ArcCatalog 9.2.4.1420
  Description:
    Abstract:
      The vector data set contains the rock unit polygons for the surficial geology for DGS Geologic Map No. 10. The original Geologic Map Description of the published map follows:

      This map is of the crystalline bedrock units in the Piedmont of Delaware and adjacent Pennsylvania. The southern boundary of the mapped area is the updip limit of the Potomac Formation (Woodruff and Thompson, 1972, 1975). Soil, regolith, and surficial deposits of Quaternary age are not shown. This map is available in both analog and digital formats from the Delaware Geological Survey (DGS) website; data on individual rock types can be found in the DGS Data Repository on the DGS web site. The map incorporates much of the previous work done in the Piedmont (Bascom et al., 1909; Bascom and Miller, 1920; Bascom and Stose, 1932; Ward, 1959; Woodruff and Thompson, 1972, 1975; Higgins et al. 1973; Crawford and Crawford, 1980; Crawford and Mark, 1982; Wagner and Srogi, 1987; Srogi, 1988; Alcock, 1994; Woodruff and Plank, 1995; and Plank and Schenck, 1997). The map includes the adjacent Pennsylvania Piedmont to show the entire extent of the Mill Creek Nappe and the Arden Pluton. We were aided in mapping the geology around the Landenberg and Avondale anticlines by J. E. Alcock (personal communication, 2000). The amphibolites in Pennsylvania are as mapped in the Pennsylvania Geologic Atlas (Berg and Dodge, 1981). We have attempted to show the larger amphibolite bodies within the Wissahickon Formation in Delaware. Schenck (1997) gives a detailed history of previous geologic work in the Piedmont of Delaware and adjacent Maryland and Pennsylvania. Our model for the geologic history of the Delaware Piedmont is one of eastward dipping subduction and closure of a forearc basin bringing magmatic arc crust over forearc basin sediments, nearshore deposits, and continental crust during the Taconic orogeny. The metaigneous, metavolcanic, and igneous rocks of the Wilmington Complex represent the magmatic arc, the metasedimentary rocks of the Wissahickon Formation represent forearc sediments, and the rocks of the Glenarm Group and Baltimore Gneiss represent Paleozoic nearshore deposits and continental crust of Grenville-age, respectively. Although penetrative deformation and upper amphibolite to granulite facies metamorphism have obscured most igneous fabrics and contact relationships in the Wilmington Complex, we consider the Brandywine Blue Gneiss, Barley Mill Gneiss, Montchanin Metagabbro, Mill Creek Metagabbro, and Christianstead Gneiss as metamorphosed plutonic rocks, and the Rockford Park Gneiss, Faulkland Gneiss, and Windy Hills Gneiss as metamorphosed volcanic and volcaniclastic rocks. U-Pb ages of igneous crystallization of zircon for these 8 units within the Wilmington Complex range between 488 and 470 Ma. (John N. Aleinikoff, U. S. Geological Survey, personal communication, 2000). The Arden composite pluton, Bringhurst Gabbro, and Iron Hill Gabbro are probably younger than the other units in the Wilmington Complex because igneous fabrics are preserved, and U-Pb dates on the igneous zircons in the Arden composite pluton are reported to be 4226.5 Ma. (Bosbyshell et al., 1998) and 4344 Ma (John N. Aleinikoff, U. S. Geological Survey, personal communication, 2000). Trace elements in the mafic rocks of the Arden composite pluton indicate the mafic rocks are similar to E-MORBS or back arc basin basalts

(Plank et al., in press), thus they probably intruded during a late-stage rifting event within the arc. The metasedimentary rocks and amphibolites of the Wissahickon Formation were deposited in a forearc basin. Geochemistry of the amphibolites indicates they were derived from a variety of magma sources (R. C. Smith and J. H. Barnes,1994; Pennsylvania Geological Survey, unpublished reports). One type of amphibolite is enriched in Fe and Ti and has trace element compositions similar to intraplate basalts suggesting the magma formed seamounts within the forearc basin. Another type of amphibolite has trace element compositions similar to MORBs and E-MORBs. This magma either erupted during rifting within the forearc basin or was preserved in the basin as a remnant of oceanic crust. Metamorphism in the Delaware and adjacent southeas

tern Pennsylvania Piedmont varies from amphibolite to granulite grade. The highest grade of metamorphism is recorded in the Brandywine Blue Gneiss and the Rockford Park Gneiss in Delaware with the intensity of metamorphism decreasing from there in all directions (Wycoff, 1952; Crawford and Mark, 1982; Wagner and Srogi, 1987; Alcock, 1989; Plank, 1989; Schenck and Plank, 1995; Alcock and Wagner, 1995; Bosbyshell et al., 1999). The decrease has also been noted within the Brandywine Blue Gneiss and the Rockford Park Gneiss where granulite gneiss in the city of Wilmington and east of Concord Pike changes to amphibolite grade gneiss to the north in Pennsylvania (Ward, 1959). The interfingering of Wissahickon metasediments with Wilmington Complex volcanic and volcaniclastic rocks plus the identification of a small dike of Rockford Park Gneiss that intrudes the Wissahickon Formation in Glens Mills, Pennsylvania (Bosbyshell et al., 1999), suggests that the Wissahickon Formation and Wilmington Complex came into contact early in history of the arc. Isotopic evidence based on metamorphic zircons in the Brandywine Blue Gneiss constrains the high grade metamorphism to 441 Ma. (Grauert and Wagner, 1975; Wagner and Srogi, 1987) and 4326 Ma (John N. Aleinikoff, U. S. Geological Survey, personal communication, 2000). The metamorphic ages are similar to the igneous ages of the younger plutons that intruded during the rifting event at about 422 Ma and 432 Ma and indicate that the granulite metamorphism was associated with high heat flow developed during arc rifting. Previous studies have modeled the thrust emplacement of the Wissahickon Formation and the folding and thrusting of the Mill Creek Nappe as events that occurred during northwest directed Taconic compression. These events probably represent a continuum beginning with the deformation of the Baltimore Gneiss, the Glenarm units, and the Wissahickon Formation. As subduction closed the forearc basin between the magmatic arc and ancient continent, Wissahickon sediments were thrust over developing nappes in the Baltimore Gneiss and its Glenarm cover. Folding continued, and this initial thrust contact was also folded. In a final compressional event, a thrust developed that cut the first thrust and brought the Baltimore Gneiss and Glenarm Group over Wissahickon to the northwest (Alcock, 1989, 1991, and 1994; Woodruff and Plank, 1995; Plank and Schenck, 1997).

Purpose: The update of earlier work and mapping of new units is important not only to geologists, but also to hydrologists who wish to understand the distribution of water resources, to engineers who need bedrock information during construction of roads and buildings, to government officials and agencies who are planning for residential and commercial growth, and to citizens who are curious about the bedrock

under their homes. Each rock unit on our new map is described in this report, and although the information is detailed and technical, we have attempted to make it broad enough to provide information at all levels of interest. Formal names are assigned to all rock units according to the guidelines of the 1983 North American Stratigraphic Code (NACSN, 1983) herein referenced as the 1983 Code. With the exception of the Baltimore Gneiss and the Setters Formation, the new units occur within the redefined Wilmington Complex and are classified as lithodemes. Lithodemic stratigraphy allows us to map individual rock units within the Wilmington Complex without a complete understanding of the complex relationships that exist between them. The study area is located within the Appalachian Piedmont province and includes the Piedmont of Delaware and adjacent Pennsylvania. The Delaware Piedmont covers roughly 82 square miles and consists of highly deformed metasedimentary, metaigneous, and igneous rock units, many of which were involved in an early Paleozoic collision between a magmatic arc and a continental margin (Thompson, 1979; Crawford and Crawford, 1980; Thompson, 1981; Plank and Schenck, 1997). Wilmington and its suburbs are undergoing intensive development, and outcrops are sparse, commonly limited to stream valleys, old quarries, and construction sites. Much of our work was focused on visiting both old and temporary exposures, describing the rocks, and documenting the information. We have gathered structural and lithologic data on more than 900 rock exposures.

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    Citation_Information:
      Originator: Delaware Geological Survey, University of Delaware
      Publication_Date: 2000
      Title: Digital Geology Layer for DGS Geologic Map No. 10
(Crystalline Bedrock Units in the Piedmont of Delaware and adjacent
Pennsylvania)
      Geospatial_Data_Presentation_Form: vector digital data
      Publication_Information:
        Publisher: Delaware Geological Survey, University of Delaware
        Publication_Place: Newark, Delaware
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    Time_Period_Information:
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Access_Constraints: None- Please give proper credit to the Delaware Geological Survey. Please reference as follows: Schenck, W. S., Plank, M. O., and Srogi, L., 2000, Bedrock Geologic Map of the Piedmont of Delaware and Adjacent Pennsylvania: Delaware Geological Survey Geologic Map Series No. 10.
Use_Constraints: The Delaware Geological Survey (DGS) is constantly gathering data from multiple sources, interpreting the data, and reflecting its interpretations on maps. DGS's interpretations of multiple data sources are reflected in this map available for download. Reasonable efforts have been made by DGS to verify that this digital shapefile accurately interprets the source data used in its preparation; however, this map may contain omissions and errors in scale, resolution, rectification, positional accuracy, development methodology, interpretations of source data, and other circumstances. This map is also date specific and as additional data becomes available and as verification of source data continues, this map may be reinterpreted and updated by DGS without notification. The DGS maintains a digital geologic polygon layer on which these changes may be reflected. Please check the metadata for these layers to verify any updates. This map was prepared for a scale of 1:36,000 and should not be used at larger scales for denotation of rock unit boundaries. Geologic symbology is not included in the digital polygon files and it is suggested that those who wish to portray the geology in a GIS environment also download the associated geologic symbology files and the PDF image of this map so that they can accurately reflect the correct geology of this area. These data are avarilable through the Delaware Geologic Information Resource (DGIR) on the DGS web site. Nothing contained herein shall be deemed an expressed or implied waiver of the sovereign immunity of the State of Delaware or its duly authorized representatives, agents, or employees.
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Contact_Person: Digital Data Coordinator
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State_or_Province: Delaware
Postal_Code: 19716-7501
Country: USA
Address: Delaware Geological Survey, University of Delaware
Address: 257 Academy Street
Contact_Voice_Telephone: 302-831-2833
Contact_Position: Digital Data Coordinator
Contact_Facsimile_Telephone: 302-831-3579
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for Delaware geologic units. Geologic Unit Names are documented in DGS
Stratigraphic web page.
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and mircofossil content, and radiogenic analyses.
Data_Quality_Information:
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Vertical_Positional_Accuracy:
Quantitative_Vertical_Positional_Accuracy_Assessment:
Vertical_Positional_Accuracy_Value: 2.5 feet and 5 feet
Vertical_Positional_Accuracy_Explanation: The accuracy of the topographic base map (contour layer) is plus or minus one half the contour interval. The contour interval of the maps used in this construction was 5 feet in the Delaware Coastal Plain area and 10 feet in the Delaware Piedmont area which gives a plus or minus 5 foot and 10 foot vertical accuracy, respectively, according to National Map Accuracy Standards.
Horizontal_Positional_Accuracy:
Quantitative_Horizontal_Positional_Accuracy_Assessment:
Horizontal_Positional_Accuracy_Value: 40 feet
Horizontal_Positional_Accuracy_Explanation: These geologic polygons were mapped onto 1:24,000 scale topographic maps. The accuracy of those maps is plus or minus 40 feet according to National Map Accuracy Standards.