DEPARTMENT OF ENVIRONMENTAL PROTECTION
LAND USE MANAGEMENT
NEW JERSEY GEOLOGICAL SURVEY

Prepared in cooperation with the
U. S. GEOLOGICAL SURVEY
NATIONAL GEOLOGIC MAPPING PROGRAM

INTRODUCTION

The Woodmansie quadrangle is in the Pine Barrens area of the New Jersey Coastal Plain, in the southeastern part of the state. Outcropping geologic materials in the quadrangle are surficial deposits of late Miocene to Holocene age and the underlying Cohansey Formation, a marginal marine deposit of middle Miocene age. The surficial deposits are river, wetland, hillslope, and windblown sediments. The Cohansey Formation was deposited in coastal settings about 12 to 11 million years ago (Ma), when sea level was more than 200 feet higher than at present in this area. As sea level lowered after 11 Ma, rivers flowing on the emerging Coastal Plain deposited the Beacon Hill Gravel, forming a broad regional river plain. With continued lowering of sea level, this river system incised and shifted to the west, as recorded by the extent, elevation, and paleoflow direction of the Bridgeton and Pensauken Formations, which are regional fluvial deposits that are younger and lower than the Beacon Hill and that form plains south and west of the quadrangle (Owens and Minard, 1979; Stanford, 2003). Local streams then began to erode into the Beacon Hill plain. Throughout the latest Miocene, Pliocene, and Pleistocene epochs (about 8 Ma to 20,000 years ago), stream and hillslope sediments were deposited in several stages as valleys were progressively deepened by stream incision, and widened by seepage erosion, in step with lowering sea level. The age of the deposits and episodes of valley erosion are shown on the correlation chart. Lithologic logs for six test borings drilled for this study (numbers 32-29284, 32-29542, and 32-29551 through 29554) are provided in table 1.

The cross sections show materials to a depth of 250-300 feet, which includes the base of the Cohansey Formation and the uppermost part of the Kirkwood Formation. Four test holes in the quadrangle (wells 32-43, 32-435, 32-31, and 32-21805) penetrated below the Kirkwood, to total depths of 1519, 595, 873, and 1779 feet, respectively. Lithologic and geophysical logs of these wells (except 32-21805) are provided in Johnson (1961), Kasabach and Scudder (1961), and Zapecza (1989), and formations below the Kirkwood are shown on sections and described in Owens and others (1998). They are not shown or discussed on this map.

DESCRIPTION OF MAP UNITS

ARTIFICIAL FILL—Sand, pebble gravel, minor clay and peat; gray, brown, very pale brown, white. In places includes minor amounts of man-made materials such as concrete, asphalt, brick, cinders, and glass. Unstratified to poorly stratified. As much as 15 feet thick. In road and railroad embankments, dams, dikes around cranberry bogs, and piles of waste material from clay pits.

Qals WETLAND AND ALLUVIAL DEPOSITS—Fine-to-medium sand and pebble gravel, minor coarse sand; light gray, yellowish-brown, brown, dark brown; overlain by brown to black peat and gyttja. Peat is as much as 8 feet thick. Sand and gravel consist chiefly of quartz and are generally less than 3 feet thick. Sand and gravel are stream-channel deposits; peat and gyttja form from the vertical accumulation and decomposition of plant debris in swamps and marshes. In wetlands and flood plains on modern valley bottoms.

Qal DRY-VALLEY ALLUVIUM—Fine-to-medium sand and pebble gravel, minor coarse sand; very pale brown, white, brown, dark brown, light gray. As much as 5 feet thick. Sand and gravel consist of quartz. In dry valley bottoms forming headwater reaches of streams. These valleys lack channels or other signs of surface-water flow. They may have formed under cold-climate conditions when permafrost impeded infiltration, increasing surface runoff. The deposits are therefore largely relict.

Qe EOLIAN DEPOSITS—Fine-to-medium quartz sand; very pale brown, white. As much as 20 feet thick. Form dunefields and dune ridges where sand of the Cohansey Formation or upper terrace deposits was exposed to wind erosion. In the Shoal Branch valley, eolian deposits lie southeast of blow-out basins and broad valley-bottom flats, indicating that they were laid down by winds blowing from the northwest.

Qtl LOWER TERRACE DEPOSITS—Fine-to-medium sand, pebble gravel, minor coarse sand; light gray, brown, dark brown. As much as 10 feet thick. Sand and gravel consist of quartz. Form terraces in valley bottoms with surfaces 2 to 5 feet above modern wetlands. Include both stratified stream-channel deposits and unstratified pebble concentrates formed by seepage erosion of older surficial deposits. Sand includes gyttja in places, and peat less than 2 feet thick overlies the sand and gravel in places. The gyttja and peat are younger than the sand and gravel and accumulated because of poor drainage. Gravel is more abundant in lower terrace deposits than in upper terrace deposits.

Qtu UPPER TERRACE DEPOSITS—Fine-to-medium sand, pebble gravel, minor coarse sand; very pale brown, brownish-yellow, yellow. As much as 15 feet thick, generally less than 6 feet thick. Sand and gravel consist of quartz. Form terraces and pediments with surfaces 5 to 15 feet above modern wetlands. Include stratified stream-channel deposits and poorly stratified to unstratified deposits laid down by groundwater seepage on pediments.

TQg UPLAND GRAVEL, LOWER PHASE—Fine-to-medium sand, slightly clayey in places, and pebble gravel; minor coarse sand; yellow, very pale brown, reddish-yellow. Sand and gravel consist of quartz and a trace (<1 percent) of white weathered chert in the coarse-sand-to-fine-pebble-gravel fraction. Clay-size material is chiefly from weathering of chert. As much as 10 feet thick, generally less than 5 feet thick. Occurs as erosional remnants on lower interfluves and hilltops, and as more extensive deposits in headwater valleys, between 100 and 160 feet in elevation. Includes stratified stream-channel deposits, poorly stratified deposits laid down by groundwater seepage on pediments, and pebble concentrates formed by winnowing of sand from older surficial deposits by groundwater sapping or surface runoff.

Tg UPLAND GRAVEL, HIGH PHASE—Fine-to-medium sand, some coarse sand, clayey in places, and pebble gravel; yellow, brownish-yellow, reddish-yellow, very pale brown. Sand and gravel consist of quartz, with as much as 5 percent white weathered chert, and traces of weathered feldspar, in the coarse-sand-to-fine-pebble-gravel fraction. Clay-size material is from weathering of chert and feldspar. As much as 20 feet thick, generally less than 10 feet thick. Occurs as erosional remnants on interfluves and hilltops, and as more extensive deposits on uplands adjacent to the Beacon Hill Gravel, between 150 and 180 feet in elevation. Includes stratified stream-channel deposits (fig. 1) and poorly stratified to unstratified pebble concentrates formed by washing of sand and clay from the Beacon Hill Gravel by groundwater sapping or surface runoff.

Tbh BEACON HILL GRAVEL—Medium-to-very-coarse sand, some fine-to-medium sand, clayey to very clayey in places, pebble gravel; reddish-yellow, yellow, brownish-yellow, red, very pale brown. Clay is from weathering of chert and feldspar. Sand and gravel consist of quartz with as much as 15 percent brown and dark gray chert; gravel includes rare red and gray sandstone and siltstone, and rare white granite and gneiss; sand includes traces of weathered feldspar. Rarely, chert pebbles may contain fossil molds of brachiopods, pelecypods, and corals of Paleozoic age. Most chert is weathered to white and yellow clay-size material. As much as 30 feet thick. Generally unstratified, or poorly stratified, owing to weathering, cryoturbation, and bioturbation. In places, tabular, planar cross-bedding is preserved (fig. 2). Occurs on erosional remnants on highest hills and plateau areas, above 165-180 feet in elevation. The Beacon Hill Gravel is a regional river-plain deposit that was laid down on the emerging Coastal Plain as sea level declined after deposition of the Cohansey Formation. Paleoflow directions, slope of the restored river plain, and gravel provenance, indicate that the Beacon Hill was laid down by rivers flowing southward from the Valley and Ridge province in northwestern New Jersey and southern New York (Owens and Minard, 1979; Stanford, 2003).

COHANSEY FORMATION—Fine-to-medium quartz sand, with some strata of medium-to-very-coarse sand, very fine sand, and interbedded clay and sand, deposited in estuarine, bay, beach, and inner shelf settings. The Cohansey is divided here into two map units: a sand facies and a clay-sand facies, based on test drilling, gamma-ray well logs, and surface mapping using 5-foot hand-auger holes, exposures, and excavations. Total thickness of the formation in the Woodmansie quadrangle is as much as 300 feet.

The Cohansey has been interpreted as either 1) a deltaic deposit with inner-shelf sand at the base, passing upward into interbedded delta-front sand and clay, in turn overlain by fluvial sand and gravel and alluvial clay (Markewicz, 1969; Rhodehamel, 1973; Newell and others, 2000), or 2) two or three stacked sequences composed of beach and shoreface sand overlain by tidal-flat sand and clay (Carter, 1972, 1978). Newell and others (2000) mapped inner-shelf and overlying delta-front facies in the Woodmansie quadrangle, implying a single rise of sea level. Carter (1972) indicates two or three stacked transgressive sequences in the map area, implying several rises and falls of sea level. Pollen and dinoflagellates recovered from peat beds in the Cohansey at Legler, about 16 miles northeast of Woodmansie, are indicative of a coastal swamp or tidal marsh (Rachele, 1976). The Legler pollen, and pollen recovered from a corehole near Mays Landing, New Jersey, indicate a middle Miocene age for the Cohansey (Greller and Rachele, 1983; Owens and others, 1988).

In the Woodmansie quadrangle, clayey strata in the Cohansey consist of thin clay beds or laminas generally less than 6 inches thick interbedded with sand. Most clays are oxidized and multicolored but brown organic clay and peat was observed in spoil piles at the former clay pits east of Woodmansie, and was penetrated in boring 32-29553 at a depth of 83-90 feet and in boring 32-29552 at 95-96 feet (table 1). Clayey strata are generally less than 15 feet thick, and some are continuous for as much as 2 or 3 miles downdip and 7 or 8 miles along strike. The laminated bedding and thin but areally extensive geometry indicate bay or estuarine intertidal settings. Clays of alluvial origin are generally deposited in abandoned channels and overbank areas of flood plains, producing deposits that are thicker and more areally restricted than those observed here. Clayey strata occur throughout the entire thickness of the Cohansey in the Woodmansie quadrangle, and there is no upsection transition to coarser fluvial sediments. The contact of the Cohansey and the Beacon Hill Gravel is not exposed but clayey strata in the Cohansey directly underlie the Beacon Hill on the upland east of Woodmansie. Thus, the stratigraphic transition from intertidal deposition in the Cohansey to fluvial deposition in the Beacon Hill is abrupt and possibly unconformable. These observations favor the stacked beach-tidal flat model of Carter (1972) for the Cohansey in the Woodmansie quadrangle, and imply that the Cohansey was deposited during several rises and falls of sea level.

Tchs Sand Facies—Fine-to-medium sand, some medium-to-coarse sand, minor very fine sand, minor very coarse sand to very fine pebbles, trace fine-to-medium pebbles; very pale brown, brownish-yellow, white, reddish-yellow, rarely reddish-brown. Well-stratified to unstratified; stratification ranges from thin, planar, subhorizontal beds to trough and planar cross-bedding (fig. 3). Sand consists of quartz; coarse-to-very coarse sand may include as much as 5 percent weathered chert and a trace of weathered feldspar. Coarse-to-very coarse sands commonly are slightly clayey; the clay occurs as grain coatings or as interstitial infill. This clay-sized material is from weathering of chert and feldspar rather than from primary deposition. In a few places, typically above clayey strata, sand may be hardened or cemented by iron oxide, forming reddish-brown hard sands or ironstone masses. Locally, sand facies includes isolated lenses of interbedded clay and sand like those within the clay-sand facies described below. Where penetrated by hand-auger holes, these occurrences are indicated by notation "Tchc" on the map. The sand facies is as much as 100 feet thick.

Tchc Clay-Sand Facies—Clay interbedded with clayey fine sand, very-fine-to-fine sand, fine-to-medium sand, less commonly with medium-to-coarse sand. Clay beds are commonly 0.5 to 3 inches thick, rarely as much as 2 feet thick; sand beds are commonly 1 to 6 inches thick (fig. 4). Clays are white, yellow, very pale brown, reddish-yellow, light gray; sands are yellow, brownish-yellow, very pale brown, reddish-yellow. Rarely, clays are brown to dark brown and contain organic matter. As much as 20 feet thick.

Tkw KIRKWOOD FORMATION—Fine sand, fine-to-medium sand, sandy clay, and clay; gray, dark gray, brown. Sand consists of quartz and some mica. Contains mollusk shells in places. In subsurface only, penetrated by wells 32-31, 32-435, 32-21805, 32-16264, and 32-43. Approximately 130-150 feet thick in map area. Kirkwood sediments in the Woodmansie quadrangle are in the "lower Kirkwood sequence" of Sugarman and others (1993) and in the lower and Shiloh Marl members of Owens and others (1998). These members are of early Miocene age, based on strontium stable-isotope ratios and diatoms (Sugarman and others, 1993).

MAP SYMBOLS

Contact of surficial deposits—Solid where well-defined by landforms as visible on 1:12,000 stereo airphotos, long-dashed where approximately located, short-dashed where gradational or featheredged, dotted where formerly present but removed by excavation.

Contact of Cohansey facies—Approximately located. Dotted where concealed by surficial deposits.

4 Material penetrated by hand-auger hole, or observed in exposure or excavation—Number indicates thickness of surficial material, in feet, where penetrated. Symbols within surficial deposits without a thickness value indicate that surficial material is more than 5 feet thick.

Tchc Isolated occurrence of Cohansey Formation, clay-sand facies—Within areas mapped as Cohansey Formation, sand facies.

figure 2 Photograph location

(Tchc) Concealed Cohansey Formation clay-sand facies—Covered by surficial deposits.

32-11881 30 Tchs 32 Tchc 232 Tchs Well or test boring showing formations penetrated—Location accurate to within 200 feet. Identifiers of the form 32-xxxx are N. J. Department of Environmental Protection well-permit numbers. Identifiers of the form 5-xxx are U. S. Geological Survey Ground-Water Site Inventory identification numbers. "G" following identification indicates gamma-ray log available, "E" indicates electric log available. Borings 32-29284, 32-29542, and 32-29551 through 29554 were drilled for this study. Lithologic logs for these wells are provided in table 1. Gamma-ray log for well 32-27994 near Woodmansie is provided by Walker and others (2008). Number followed by map-unit symbol is depth, in feet below land surface, of base of unit. Final number is total depth of well rather than base of unit. Unit symbol "Tch" indicates that sand facies and clay-sand facies cannot be identified separately from the well log. Owing to the discontinuous geometry of the clay-sand facies, and to variability in the detail and accuracy of drillers' logs, units shown for some wells may not match the map and sections. Surficial deposits generally cannot be identified from lithologic or geophysical logs. Where not identified, surficial deposits, if present, are included in the uppermost Cohansey facies.

32-13413 10 Tchs 21 Tchc 27 Tchs Well or test boring showing formations penetrated—Location accurate to within 500 feet. Identifiers and symbols as above.

Geophysical log—On sections. Gamma-ray log is shown by red line, radiation intensity increasing to right. Electric log is shown by paired blue lines, with spontaneous potential shown on left-hand curve (voltage increasing to right) and resistance shown on right-hand curve (resistance increasing to right)

Paleocurrent direction—Arrow indicates direction of streamflow, as inferred from dip of planar, tabular cross-beds observed at point marked by x.

Head of seepage valley—Line at top of scarp, ticks on slope. Marks head of small valleys and hillslope embayments formed by seepage erosion. No seepage occurs today in these valleys, so the landforms are relict. The valleys formed during times when the water table was higher than at present, perhaps during periods of permafrost in the middle to late Pleistocene.

Active seepage scarp—Line at foot of scarp, at position of groundwater emergence. Water drains downslope from this position.

Inactive seepage scarp—Line at foot of scarp. No seepage occurs today along these scarps.

Dune ridge—Line along crest.

Shallow topographic basin—Line at rim, pattern in basin. Smaller basins may have formed from melting of permafrost. Larger basins commonly are bordered by eolian deposits and may have formed from wind erosion.

Excavation perimeter—Line encloses excavated area. Topography within these areas may differ from that on the base map. Dotted contacts within perimeter show inferred extent of materials at the time of topographic survey (1947). In places, these materials have been entirely removed by excavation.

Sand pit—Active in 2008.

Sand or clay pit—Inactive in 2008. Clay pits indicated by "c".

Iron-cemented sand—Extensive iron cementation or hardening in Cohansey Formation, sand facies.

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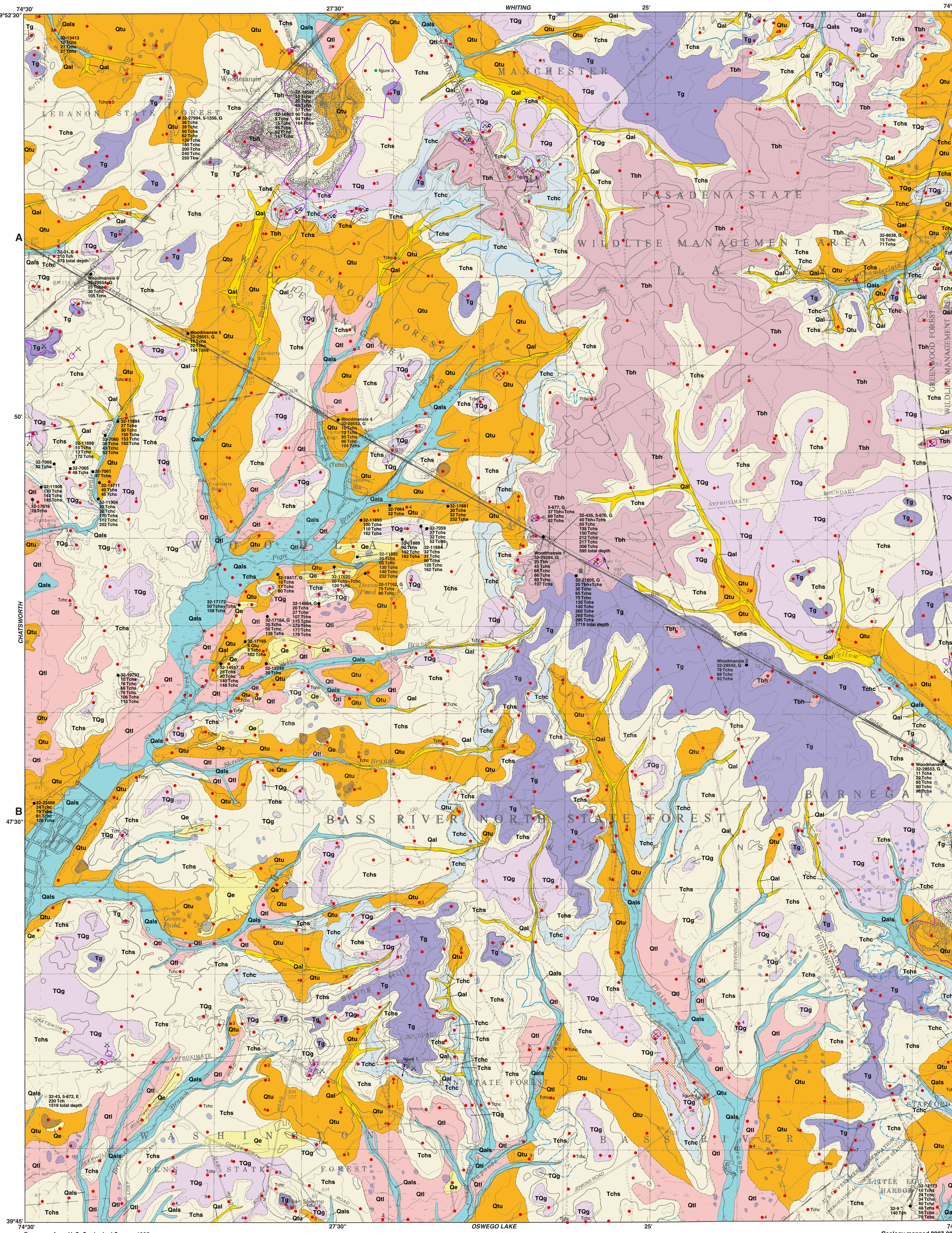
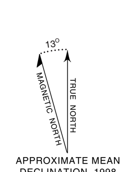
Table 1.—Lithologic logs of test borings.

N. J. permit number and identifier	depth (feet below land surface)	description (map unit assignment in parentheses)
32-29284 Woodmansie 1	0-20	yellow, brownish-yellow, very pale brown medium sand, minor fine and coarse sand, a few horizons with fine-to-medium quartz pebbles, some white weathered chert (Tbh)
	20-45	yellow to very pale brown medium sand, minor fine and coarse sand, a couple of thin beds (0.5 inch) of white clay at 20 feet (Tchs)
	45-68	thinly bedded (0.25-0.5 inch) light gray to white clay and yellow to brownish-yellow fine-to-medium sand (Tchc)
	68-107	yellow, brownish-yellow, very pale brown fine-to-medium sand, minor coarse sand, trace very coarse sand, gamma log shows clay from 86-89 but this interval was not sampled (Tchs)
32-29553 Woodmansie 2	0-28	very pale brown fine-to-medium sand (Tchs) with thin beds of white clay from 11 to 22 (Tchc)
	28-83	very pale brown to brownish-yellow medium-to-coarse sand, some very coarse sand and very fine pebbles (Tchs)
	83-90	yellowish-brown, yellow, reddish-yellow medium-to-coarse sand, some very coarse sand and trace very fine pebbles, iron cementation from 83-84, with laminas to thin beds of dark gray, grayish-brown, and black, clay and very fine sand (Tchc)
	90-96	gray to dark gray fine-to-medium sand with trace clay as interstitial material (Tchs)
32-29542 Woodmansie 3	0-25	brownish-yellow to reddish-yellow medium-to-coarse sand with some very coarse sand and fine pebbles, trace weathered chert (Tbh)
	25-55	brownish-yellow to yellow medium sand, some coarse sand, little very coarse sand and fine pebbles (Tchs)
	55-70	yellow to very pale brown medium sand, little coarse sand, trace very coarse sand (Tchs)
	70-78	very pale brown fine-to-medium sand (Tchs)
	78-88	pink, white, light gray clay (Tchc)
	88-93	very pale brown fine-to-medium sand (Tchs)
32-29552 Woodmansie 4	0-10	very pale brown fine-to-medium sand, trace very fine pebbles (Tchs)
	10-12	white clay (Tchc)
	12-69	light gray to very pale brown fine-to-medium sand (Tchs)
	69-104	yellow to brownish-yellow medium sand, some coarse sand (Tchs); a bed of very dark grayish-brown to black very fine sandy clay to clayey very fine sand with some organic fibers at 95-96 (Tchc)
32-29551 Woodmansie 5	0-17	very pale brown to brownish-yellow fine sand (Tchs)
	17-22	yellow to brownish-yellow fine-to-medium sand with some thin laminas (0.1-0.25 inch) of white to light gray clay (Tchc)
	22-104	yellow to brownish-yellow medium-to-coarse sand, some fine sand and very coarse sand (Tchs)
32-29554 Woodmansie 6	0-25	very pale brown to white fine sand (Tchs)
	25-30	very pale brown, to brownish-yellow fine-to-medium sand, trace coarse sand, trace very fine pebbles, and laminas (0.1-0.5 inch) of white clay (Tchc)
	30-75	very pale brown, brownish-yellow fine-to-medium sand, some very coarse sand, trace fine pebbles (Tchs)
	75-105	very pale brown, brownish-yellow medium-to-coarse sand, some very coarse sand (Tchs)



Base map from U. S. Geological Survey, 1995
Corner ticks are on North American Datum of 1983

Geology mapped 2007-2008
Drilling by G. Steidl and J. Curran
GIS coverages by M. Girard
Cartography by S. Stanford
Reviewed by J. M. Wilson and J. V. Browning



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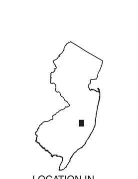
1 KILOMETER
CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



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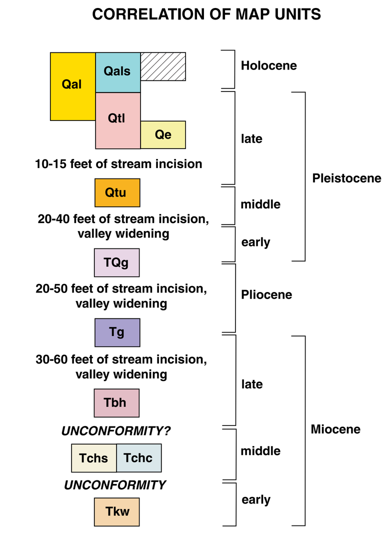
CORRELATION OF MAP UNITS



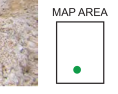



Figure 1.--Tabular, planar cross-bedding in Upland Gravel, High Phase exposed on Spring Hill upland. Location of photo shown on map and inset.

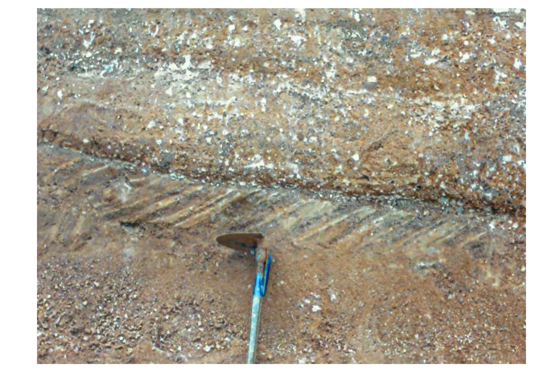
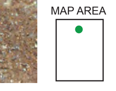



Figure 2.--Tabular, planar cross-bedding in Beacon Hill Gravel, exposed in former clay pit on upland east of Woodmansie. Weathered chert-pebble gravel overlies the cross-bedded sand. Location of photo shown on map and inset.

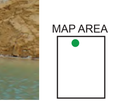



Figure 3.--Thin, horizontal bedding to low-angle cross-bedding in Cohansey Formation, sand facies, exposed in large sand pit east of Woodmansie. Bedding is deformed or destroyed by cryoturbation in upper 5-10 feet. Height of exposure approximately 30 feet. Location of photo shown on map and inset.

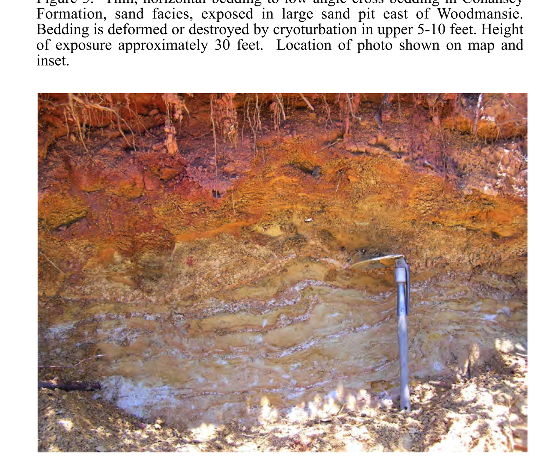
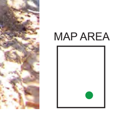



Figure 4.--Laminated to thinly bedded clay and sand of Cohansey Formation, clay-sand facies. Clay beds are white to light brown and are 0.25-0.5 inch thick, sand beds are yellow to reddish-yellow and are 1-6 inches thick. Red to orange iron-cemented sand overlies the sand-clay facies. Bedding is deformed by cryoturbation. In roadcut on Jenkins Road west of Plains Branch. Location of photo shown on map and inset.

GEOLOGY OF THE WOODMANSIE QUADRANGLE BURLINGTON AND OCEAN COUNTIES NEW JERSEY

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2010