DELAWARE GEOLOGICAL SURVEY
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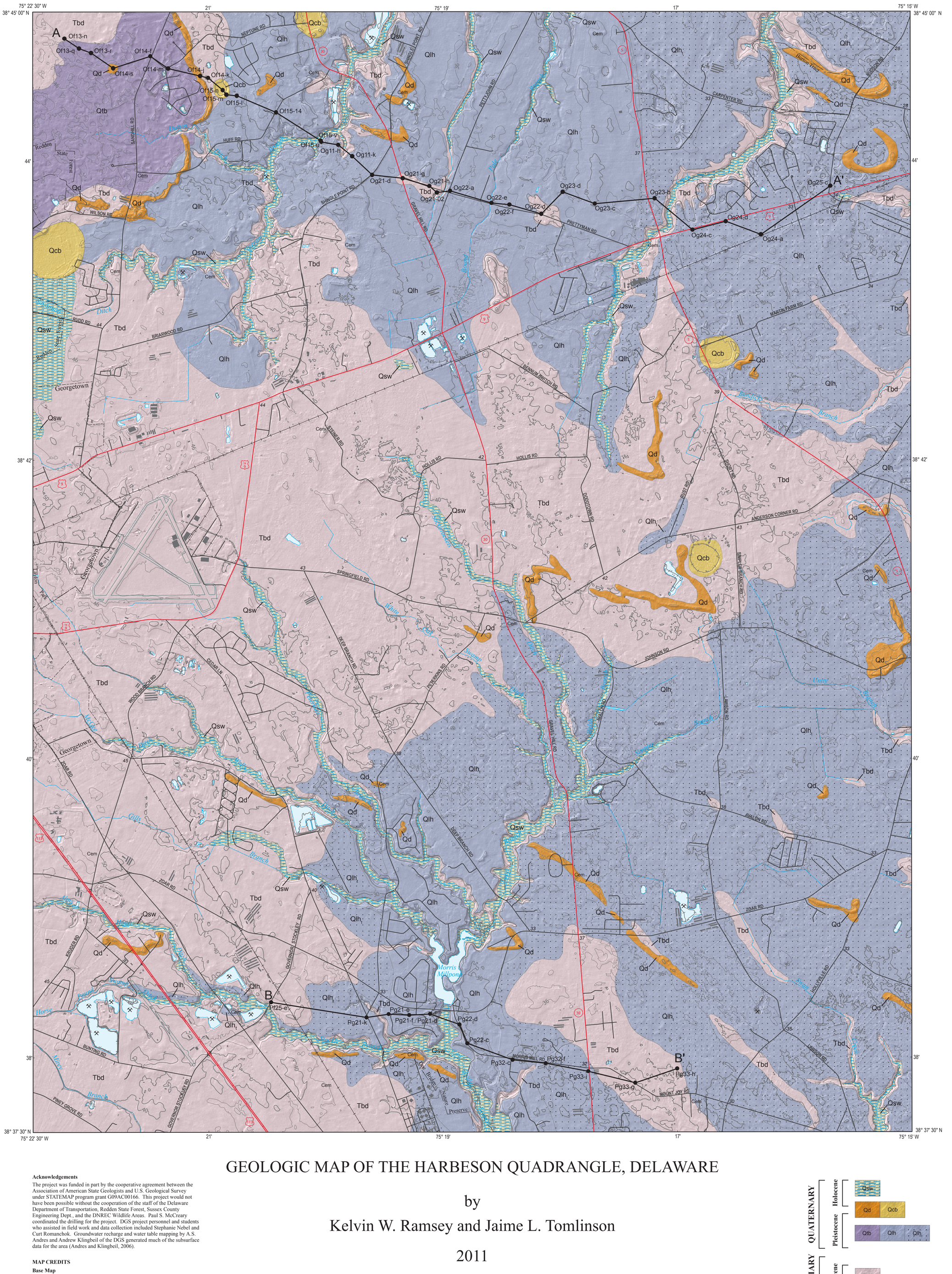
DELAWARE GEOLOGICAL SURVEY
GEOLOGIC MAP OF THE HARBESON QUADRANGLE, DELAWARE
GEOLOGIC MAP SERIES NO. 17



EXPLANATION

SWAMP DEPOSITS — Qsw

Found in the upper reaches of the modern stream valleys. Consist of 1 to 3 ft of gray to brown, silty and clayey gravelly sand at the base overlain by organic-rich, fine to coarse sand. In some of the larger valleys, the unit has several ft of organic silt at the top. Deposits are up to 15 ft thick in the larger stream valleys and less than 5 ft thick in the smaller tributaries. Holocene.

DUNE DEPOSITS — Qd

Located in raised parabolic to linear features. Consist of white to light-yellow, well-sorted, medium to fine sand. Laminae of coarse sand are common. Thin, brown soil lamellae are commonly found at depths of 1 to 3 ft within the dunes. Deposits up to 16 ft thick. The deposits are eolian features related to cold-climate processes when arboreal vegetation was scarce and winds blew sand dunes across the landscape. Some of the dunes, which have well-developed and deep (>3 ft) soil profiles, may be older than latest Pleistocene. Middle Pleistocene to Holocene.

CAROLINA BAY DEPOSITS — Qcb

Found in circular features in the northern half of the Harbeson Quadrangle. They consist of raised rims (dunes) of well-sorted, medium to fine sand with silty sand in the interior of the circular features. A few of the features contain either seasonal or year-round bodies of water where the water table is high. The deposits are less than 5 ft thick in their interiors and up to 10 ft thick where the sand rims are best developed. Features are related to cold-climate processes during the latest Pleistocene to earliest Holocene (Ramsey, 1997). Latest Pleistocene to Holocene.

TURTLE BRANCH FORMATION — Qtb

Clean, well-sorted, white to pale-yellow, fine sand grading down to interlaminated fine to coarse sand with opaque heavy mineral laminae, granules, and pebbles at its base. In the Harbeson Quadrangle, it is commonly less than 5 ft in thickness. The Turtle Branch Formation is distinguished from the adjacent Beaverdam Formation by better sorting and the absence of the white, silty matrix, which is characteristic of the Beaverdam. It is distinguished from adjacent and overlying dune deposits by having a better developed soil profile and the common presence of opaque heavy mineral laminae which are rare in the dune deposits. DEM images of the map area show distinctive circular features on the surface of the Turtle Branch Formation which are not readily apparent in the field. These features are likely related to periglacial eolian and freeze-thaw activity upon the surface of the Turtle Branch Formation. In places, the Turtle Branch Formation is completely removed in the center of these features and the underlying Beaverdam Formation is exposed; however, the entire area is mapped as Turtle Branch Formation. Determination of the presence of Beaverdam Formation at the land surface requires detailed mapping on a scale larger than that of this map. The Turtle Branch Formation is interpreted to be a fluvial to tidal and shoreline deposit, which has been greatly modified by periglacial activity in the map area. Middle Pleistocene.

LYNCH HEIGHTS FORMATION — Qlh, Qlh$_t$

Loose, fine to very fine, moderately silty, pale-yellow to yellow sand that ranges from 2 to 15 ft in thickness north of US Rt. 9 and east of Gravel Hill Road (Rt. 30). To the west of Gravel Hill Road, these sands are interbedded with a body of compact, gray to greenish-gray, clayey silt to silty clay from 2 to 15 ft thick that forms a topographic high oriented roughly north-south. On the western margin of this clay body a paleochannel with a similar orientation is filled with 5 to 15 ft of gravelly sand grading upward to fine to medium sand. Interpreted to be estuarine sands, tidal flat or estuarine muds, and tidal channel sands, respectively.

Adjacent to Deep Branch, Peterkins Branch, and Cow Bridge Branch, the Lynch Heights Formation consists of up to 20 ft of pale-yellow, clean, gravelly sand grading up to medium to coarse sand and then to fine to medium sand. The sands continue southward into the Millsboro Quadrangle. Interpreted to be fluvial deposits related to the cutting and filling of the upper reaches of the ancestral Indian River during the middle Pleistocene.

Where mapped as Qlh$_t$ in the eastern half of the Harbeson Quadrangle, the Lynch Heights Formation consists of a thin (< 5 ft thick) layer of heterogeneous deposits ranging from reddish-brown, pale-yellow, and light-gray, silty, clayey, very coarse to fine sand, to pale-yellow to light-gray, gravelly sand to sandy gravel. These deposits are considered to be the result of local reworking of the underlying Beaverdam Formation sediments. The Lynch Heights Formation is differentiated from the Beaverdam by the lack of the characteristic white silt matrix of the Beaverdam. It is also differentiated by a layer of coarse sand to gravel that is found at the base of the unit overlying the typical Beaverdam sands. The sands are interpreted to be shallow water deposits along the margins of an estuary, and later modified by eolian activity related to several periods of periglacial climate. Middle Pleistocene.

BEAVERDAM FORMATION — Tbd

Heterogeneous unit ranging from very coarse sand with pebbles to silty clay. The predominant lithologies at the land surface are white to mottled light-gray and reddish-brown, silty to clayey, fine to coarse sand. Laminae and beds of very coarse sand with pebbles to gravel are common as are laminae and beds of bluish-gray to light-gray silty clay. In a few places near the land surface, but more commonly in the subsurface, beds ranging from 2 to 20 ft thick of finely laminated, very fine sand and silty clay are present. The sands of the Beaverdam Formation have a white, silty matrix that gives samples a milky appearance when wet. This white, silty matrix is the most distinguishing characteristic of the unit and readily differentiates the Beaverdam Formation from the adjacent cleaner sands of the Lynch Heights and Turtle Branch Formations. The Beaverdam Formation is interpreted to be a late Pliocene fluvial to estuarine deposit (Groot et al., 1990; Ramsey, 2010a, b) and ranges from 50 to 100 ft thick in the map area. Late Pliocene.

Discussion

The complex geologic history of the surficial units of the Harbeson Quadrangle is one of deposition of the Beaverdam Formation and its subsequent modification by erosion and deposition related to sea-level fluctuations during the Pleistocene. The geology is further complicated by periglacial activity that produced dune deposits and Carolina Bays scattered throughout the map area.

The Beaverdam Formation consists of stacked 1- to 5-ft thick beds of very coarse sand and gravel that commonly fine upwards to fine to medium sand and rarely to very fine silty sand to silty clay. These types of deposits are typical of either fluvial or estuarine environments (Ramsey, 2010a, b). Elsewhere in Delaware, rare burrows have been observed in the Beaverdam Formation indicating at least a marginal estuarine setting (DGS unpublished data; Owens and Denny, 1979). The age of the Beaverdam Formation is uncertain due to the lack of age-definitive fossils within the unit; however, stratigraphic relationships in Delaware indicate that it is no older than late Miocene and no younger than early Pleistocene and is most likely late Pliocene (Ramsey, 2010a, b).

The Lynch Heights Formation is a composite unit consisting of deposits from two sea-level high stands approximately 400,000 yrs B.P. and 320,000 yrs B.P. (Groot et al., 1990; Ramsey, 2010a) which cannot be differentiated in this map area. The Lynch Heights Formation in the map area consists of three distinct lithofacies associations. In the eastern portion of the Harbeson Quadrangle, the Lynch Heights Formation (Qlh$_t$) is a thin unit (< 5 ft thick) consisting of fine to medium sand that coarsens to a coarse sand. In places, a pebbly sand to pebble gravel containing abundant opaque heavy minerals is found at the base of the unit overlying the Beaverdam Formation. This portion of the Lynch Heights Formation is interpreted to be a shallow water deposit consisting of sand eroded from the Beaverdam Formation as the shoreline transgressed during one or both of the sea-level high stands.

In the north-central portion of the Harbeson Quadrangle, the Lynch Heights Formation consists of paleovalley fill (cross section A-A') with tidal channel sands, tidal flat and estuarine muds, and estuarine sands. These sediments were deposited in a drainage marginal to an ancestral Delaware estuary (Ramsey, 2011).

In the south-central portion of the quadrangle, fluvial deposits flank the modern drainage (cross section B-B') and are related to the initial stages of drainage formation during the middle Pleistocene. Sediments closest to the modern drainage are thicker deposits (4 to >11 ft) of clean, loose, well-sorted sand with few to abundant heavy minerals. Away from the drainage, deposits become less well-sorted and siltier, as shown in the B-B' cross section.

Dune deposits are fine to medium, well-sorted sands that are found throughout the map area. The dunes have a pronounced surficial expression as linear and hook-shaped features that rise above the surrounding landscape. Some of these dunes are probably latest Pleistocene to early Holocene in age (Andres and Howard, 2000) but some could be contemporaneous with deposition of the Lynch Heights Formation or the late Pleistocene Scotts Corners Formation (Ramsey, 2010a). Dune features are also associated with the rims of Carolina Bays that are found in the northern part of the map area. Some of the features mapped as Carolina Bays may be parabolic dunes with blown-out low areas on the windward side. Because the features are generally circular in shape and are consistent in size with Carolina Bays mapped elsewhere (Ramsey, 2001, 2003, 2010b), they are mapped as Carolina Bays. Both the dunes and the Carolina Bays are considered to be cold-climate related features located where winds moved sand across a landscape barren of forests (Ramsey, 1997). The exact process by which the distinctive circular shape of the Carolina Bays was formed is unknown.

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_____2011, Geologic Map of the Fairmount and Rehoboth Beach Quadrangles, Delaware: Delaware Geological Survey Geologic Map Series No. 16, Scale 1:24,000.

Acknowledgements

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MAP CREDITS

Base Map

Delaware state plane coordinate system
Transverse mercator projection
North American Datum of 1983 (NAD 83) HARN
DataMIL Layers http://datamil.delaware.gov
The Delaware Department of Transportation Centerline and Railroads for Delaware, 2010
The Delaware Office of State Planning Coordination Delaware Municipal Boundaries, 2010
USGS National Hydrography Dataset, 2005
USGS Delaware LiDAR Contours, 2005
USGS Delaware Miscellaneous Features, 1993
Delaware Department of Agriculture State Forest Areas, 2009
Delaware Division of Natural Resources and Environmental Control Wildlife Areas, 2009

Other

Cartography by Lillian T. Wang, Delaware Geological Survey
Edited by Stefanie J. Baxter, Delaware Geological Survey

Colors for geologic formations on the cross sections appear lighter than shown on the map explanation and stratigraphic chart because they do not include the shading effect of the DEM used on the map.

GEOLOGIC MAP OF THE HARBESON QUADRANGLE, DELAWARE

by

Kelvin W. Ramsey and Jaime L. Tomlinson

2011

SCALE 1:24,000

QUATERNARY
Holocene: Qsw; Qd, Qcb
Pleistocene: Qtb, Qlh, Qlh$_t$
TERTIARY
Pliocene: Tbd

LITHOLOGIC SYMBOLS *(cross sections)*
pebble
silt
clean sand
fine to coarse silty to clayey sand with scattered clay laminae
very fine to fine moderately silty sand

1 0.5 0 1 2 Kilometers
1 0.5 0 1 Miles
1,000 0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000 9,000 10,000 Feet

10-foot Index with a 6-foot Intermediate Contour Interval
2-foot contour data are available for this map from the Delaware DataMIL at http://datamil.delaware.gov
NORTH AMERICAN DATUM OF 1988 (NAVD88)

Quadrangle Location
Ellendale, Milton, Lewes, Georgetown, Harbeson, Fairmount, Trap Pond, Millsboro, Frankford

SYMBOLS *(map)*
Sandpit
Og22-a Soil auger boring
Of15-14 Core/drill hole
State Forest and Wildlife Areas
Municipal Boundary
Contact

1992 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET