DELAWARE GEOLOGICAL SURVEY
University of Delaware, Newark
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GEOLOGIC MAP OF THE FRANKFORD AND SELBYVILLE QUADRANGLES, DELAWARE

by

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2013

Acknowledgements
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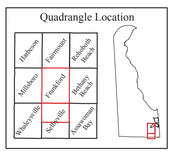
MAP CREDITS
Base Map
Delaware state plane coordinate system
Transverse mercator projection
North American Datum of 1983 (NAD83) HARN
The Delaware Department of Transportation Centerline for Delaware, 2009
The Delaware Office of State Planning Coordination Delaware Municipal Boundaries, 2009
USGS National Hydrography Dataset, 2009
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 Park Areas, 2009
Other
Cartography by Lillian T. Wang, Delaware Geological Survey
Edited by Stefanie J. Baxter, Delaware Geological Survey

Quadrangle Location



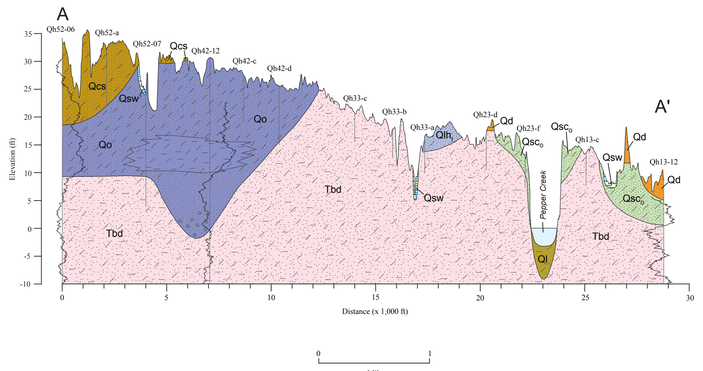
1991 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24,000

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

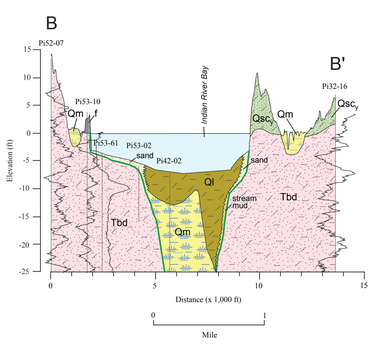
10-foot Index with a 6-foot Intermediate Contour Interval
Soundings in feet
NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

SYMBOLS *(on map)*
- Qh52-06 Well or borehole
- Qh42-c Soil auger boring
- 14b-1 Shot point
- Sandpit
- State Park and Wildlife Areas
- Municipal Boundary
- State Boundary
- Power Transmission Line
- Contact
- Extension of Omar Formation lagoon at depth



SYMBOLS *(on cross sections)*
- pebble
- clay
- gamma log
- silt
- base of Holocene
- clean sand
- fine to coarse, silty to clayey sand with scattered clay laminae
- very fine to fine moderately silty sand
- clayey silt to silty clay

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.



EXPLANATION

FILL
Man-made and natural materials (sand, gravel) placed in stream valleys or marshes to bring the topography above grade, usually in road beds, dams, or construction near a shoreline. Fill deposits include sediment dredged from the marshes and offshore in Indian River Bay and placed on the uplands.

MODIFIED LAND
Areas of land where the surficial deposits have been modified due to human activity to the point that surficial deposits can no longer be reliably determined. The unit is shown in areas large enough to be identified at the map scale but does not include local disturbances on the scale of an individual housing lot or shallow disturbances such as large parking lots or retail areas. An example of modified land is a golf course where numerous ponds and embankments have been constructed.

SHORELINE DEPOSITS
White to light-gray, well-sorted, very coarse to fine sand with scattered pebbles. Along the southern shoreline of Indian River Bay, these deposits are thin, ephemeral sand bodies less than 3 ft thick. Holocene.

LAGOON DEPOSITS *Indian River and Indian River Bay*
Medium-gray to dark-gray clayey silt that grades westward to clayey silt with fine to coarse sand and organic laminae. Sedimentary structures are rare, consisting of relict burrows or thin laminae of marsh grass, sand, or organic fragments (twigs and leaves). Shells and shell fragments are rare to common. Lagoon deposits grade laterally into marsh deposits. They are up to 60 ft thick (Banaszak, 2011) near the center of Indian River Bay and thin to less than 5 ft thick to the west (Chrzastowski, 1986). Holocene.

SWAMP DEPOSITS
Gray to brown, silty and clayey gravelly sand overlain by organic-rich fine to coarse sand. Swamp deposits are found in the upper reaches of the modern stream valleys and are also associated with the modern Cypress Swamp. In the stream valleys, deposits 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 stream valleys, deposits (up to 15 ft thick) are capped by several feet of organic silt. Swamp deposits associated with Cypress Swamp consist of a pale-yellow, fine to coarse sand containing laminae of light-brown to brown, organic-rich silt and fine to very fine sand with abundant plant fragments. The deposit is overlain in places by an organic muck consisting primarily of silt-size organic fragments with varying amounts of silt to very fine sand. Holocene.

MARSH DEPOSITS
Light-gray to brown, organic-rich, clayey silt. Peat beds consisting of finely comminuted organic fragments (primarily marsh grass) are common near the base of the unit and scattered throughout. Marsh deposits are generally less than 10 ft thick. Holocene.

CAROLINA BAY DEPOSITS
Well-sorted, medium to fine sand in raised rims (dunes) with silty sand in the interior of the circular features. These deposits are found in the northwestern portion of the Frankford Quadrangle and the northwestern portion of the Selbyville Quadrangle. A few of the features, such as Jay Patch, have either seasonal or year-round standing water where the water table is high, and commonly contain swamp deposits. The deposits are less than 5 ft thick in their interiors and up to 10 ft thick where the sand rims are best developed. The features are likely related to cold-climate processes during the Pleistocene (Ramsey, 1997). Latest Pleistocene to Holocene.

CYPRESS SWAMP FORMATION
Dark grayish-brown, organic-rich, very fine, silty sand to sandy silt with organic silt and peat beds overlain by a pale-yellow, fine to very fine, clean to slightly silty sand with scattered light-gray silt and grayish-brown organic silt laminae. The basal organic sand ranges from 5 to 15 ft thick, with scattered 1- to 5-ft thick beds of peat (with plant fragments) to organic silt. In places, the lower sand overlies a 1- to 3-ft thick bed of light-gray to grayish brown sand that ranges from very fine slightly silty sand to clean, coarse sand with granules and pebbles. The fine to very fine, clean sand that overlies the unit is 5 to 10 ft thick. It the map area, the Cypress Swamp Formation is up to 30 ft thick. Radiocarbon dates indicate two periods of deposition of the organic-rich sands, one from 42,000 to 33,000 yrs B.P. and another, the main phase of deposition, from 25,000 to 17,000 yrs B.P. Deposition of the upper sands continued until about 10,500 yrs B.P. The lower sands and organic silts are interpreted to have been deposited in swamps and widespread sphagnum bogs at the end of the last interglacial in cool to cold climatic conditions. The upper sands are interpreted to be the result of cold, dry conditions in which large sand dunes migrated over the area. Organic deposits in the sands were the result of small, ephemeral bogs between the dunes. Late Pleistocene to early Holocene.

DUNE DEPOSITS
White to pale-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. Dune deposits, which are up to 9 ft thick, 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 that have well-developed and deep (>3 ft) soil profiles may be older than latest Pleistocene and are middle to late Pleistocene in age. Middle Pleistocene to Holocene.

SCOTTS CORNERS FORMATION (YOUNGER)
Pale-yellow to light-gray gravelly sand grading up to fine sand. Commonly capped by 1 to 3 ft of very fine, sandy, clayey silt. Scattered beds of 1 to 3 ft of gray silty clay with organic-rich laminae are also common. The deposits are found beneath low terrace flats less than 10 ft in elevation along the margins of Indian River Bay and are up to 10 ft thick. They are considered to be lagoon-margin deposits; the result of a sea-level highstand along the margins of an ancestral Indian River Bay at approximately 80,000 yrs B.P. (Ramsey, 2010a). Late Pleistocene.

SINEPUXENT FORMATION
Gray, laminated, silty, very fine to fine, micaceous sand to sandy silt. The base of the unit is typically a 3- to 5-ft thick zone of bluish-gray to dark-gray clayey silt to silty clay that is interbedded with and grades upward into sandy silt. In places, the silty clay and the lower portion of the sandy silt are interbedded with a fine to medium sand. East of the map area, in the vicinity of Bethany Beach, the lower sand contains abundant *Mulinia* shells (Ramsey and Tomlinson, 2012). The upper portion of the Sinepuxent Formation, especially near its contact with the Ironshire Formation, consists of 2 to 10 ft of clean, fine to medium sand with some coarse sand to pebbles. In the map area, total thickness of the unit ranges from less than 5 ft at its western margin to over 20 ft thick in the southeastern most corner of the Selbyville Quadrangle. The Sinepuxent Formation is interpreted to have been deposited in a lagoonal environment during the late Pleistocene (approximately 80,000 yrs B.P.) (Ramsey, 2010a). The coarser sediments near the land surface are nearshore deposits emplaced after the lagoon was filled and when the Atlantic Ocean shoreline was west of its present position (Ramsey, 2010a). Late Pleistocene.

SCOTTS CORNERS FORMATION (OLDER)
White to pale-yellow, well-sorted, coarse to fine sand with scattered thin clay laminae and rare beds of gray silty clay. Beds of pebbly, coarse to granule sand are common at the base of the unit. These deposits, which are up to 10 ft thick, are found beneath terrace flats between 10 and 20 ft in elevation along the margins of Indian River Bay and its tributaries (cross section A-A'). They are primarily tidal-stream and tidal-flat deposits related to a sea-level highstand at approximately 120,000 yrs B.P. (Ramsey, 2010a). Late Pleistocene.

IRONSHIRE FORMATION
Pale-yellow to light-gray, fine to very coarse sand. Granules to pebbles are a common constituent of the unit, especially near its base. Thin, light-gray, silty clay beds occur but are not present at all localities. It is up to 23 ft thick. It is distinguished from the adjacent Sinepuxent and upper Cypress Swamp and Omar Formations by the cleaner and coarser textures of the sands. Where the sands are finer, the Ironshire Formation may not be easily differentiated from the sandy, upper part of the adjacent Omar Formation. In this area, the contact between the Ironshire and Omar Formations is drawn at the toe of a topographic break at approximately 18 ft in elevation. The Ironshire Formation is interpreted to be a shoreline and nearshore deposit related to sea-level highstand at approximately 120,000 yrs B.P. (Ramsey, 2010a). Late Pleistocene.

LYNCH HEIGHTS FORMATION
Loose, clean to slightly silty, white to pale-yellow, well-sorted, fine to coarse sand with scattered very coarse sand to pebble laminae. These deposits are found in the west and in the northwest corner of the Frankford Quadrangle. The sediments are considered to have been deposited along the margins of a tidal stream during a sea-level highstand around 320,000 yrs B.P. (Ramsey, 2010a; Ramsey and Tomlinson, 2011). Middle Pleistocene.

Where shown with pattern in the western half of the Frankford Quadrangle (Qlh_L), the Lynch Heights Formation consists of a thin (<5 ft thick) layer of heterogeneous sediments 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 interpreted to be the result of local reworking of the underlying Beaverdam Formation sediments in shallow nearshore tidal environments. The Lynch Heights Formation is differentiated from the Beaverdam by the lack of the characteristic white silt matrix. A layer of coarse sand to gravel is commonly 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 during a sea-level highstand around 400,000 yrs B.P. and possibly reworked during the subsequent highstand around 320,000 yrs B.P. (Ramsey, 2010a). Middle Pleistocene.

OMAR FORMATION
Light-gray to gray, silty clay to silty, very fine sand with scattered shell beds and a coarse basal sand. The Omar Formation consists of up to 5 ft of light to dark-gray, basal, pebbly, coarse to very coarse sand that grades upward into 1 to 3 ft of gray to very dark-gray, fine to coarse silty sand with scattered laminae to thin beds of peat composed of sand to gravel-size plant fragments. The sands are overlain by 3 to 5 ft of very dark-gray to black organic-rich, sandy silt to silty clay. In the areas where the Omar is thickest, 10 to 40 ft of greenish-gray, compact, silty clay to clayey silt is common above the organic-rich zone. The clayey silt grades upward into a gray to light greenish-gray, silty clay to silty fine sand with scattered laminae to thin beds of *Crassostrea* (oyster) shell. In places, there is a 2- to 10-ft thick bed of medium to coarse, relatively clean sand separating the compact clayey silt from the overlying shelly, silty clay. The fine-grained deposits are overlain by gray to pale-yellow, fine to very fine, clean to slightly silty sand with rare silt laminae. The overall thickness of the Omar Formation in the map area ranges from 2 ft thick along the surficial contact with the Beaverdam Formation to greater than 85 ft thick northeast of Selbyville. The Omar Formation fills an east-west oriented paleovalley and is composed of swamp, marsh, and lagoonal sediments deposited during a sea-level highstand at approximately 400,000 yrs B.P. and possibly reworked during the subsequent highstand around 320,000 yrs B.P. (Ramsey, 2010a). Middle Pleistocene.

BEAVERDAM FORMATION
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 (Tbd_U in Figure 1). Laminae and beds of very coarse sand with pebbles to gravel are common (Tbd_U in Figure 1). Laminae and beds of bluish-gray to light-gray silty clay are also common. 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 silt matrix that gives samples a milky appearance when wet. This white silt matrix is the most distinguishing characteristic of the unit and readily differentiates the Beaverdam Formation from the adjacent cleaner sands of the Scotts Corners and Lynch Heights Formations and the upper sands of the Cypress Swamp, Ironshire, and Omar Formations, where present. The Beaverdam Formation is interpreted to be a Late Pliocene fluvial to estuarine deposit and ranges from 50 to 100 ft thick in the map area (Ramsey, 2010a, b). Late Pliocene.

Discussion

The geological history of the surficial units of the Frankford and Delaware portion of the Selbyville Quadrangles was the result of deposition of the Beaverdam Formation during the late Pliocene and its subsequent modification by erosion and deposition related to sea-level fluctuations during the Pleistocene. The geology at the land surface was then further modified by periglacial activity that produced dune deposits in the map area. Surficial geologic mapping was conducted using field maps at a scale of 1:12,000 with 2 foot contours. Stratigraphic boundaries drawn at topographic breaks reflect detailed mapping using contours not shown on this map.

The Beaverdam Formation is exposed in the north-central and central portion of the Frankford Quadrangle and on the eastern margin of Selbyville Quadrangle and underlies all the younger deposits in the map area. The Beaverdam Formation consists of stacked, 1- to 5-feet 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). Rare burrows have been observed in the Beaverdam Formation elsewhere in Delaware that indicate 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. 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 found in the northwestern portion of the Frankford Quadrangle. It is a composite unit consisting of deposits from two sea-level highstands occurring 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. In the majority of the map area, the Lynch Heights Formation (Qlh_L) is a thin unit (<5 feet thick) consisting of fine to medium sand that coarsens to a coarse sand. In places, a pebbly sand to 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 highstands. On the eastern boundary in the northern portion of the Frankford Quadrangle, fluvial deposits flank the modern drainage and are related to the initial stages of drainage formation during the middle Pleistocene (Ramsey and Tomlinson, 2012). Lynch Heights Formation (Qlh) sediments closest to the modern drainage are thicker deposits (6 to >11 feet) of clean, loose, well-sorted sand with few to abundant heavy minerals. Away from the drainage, these deposits become less well-sorted and siltier.

The Omar Formation is exposed at the surface in an east-west band running across the center of the map area. Throughout the majority of the Selbyville Quadrangle and in the southern portion of the Frankford Quadrangle, the Omar Formation is found in the subsurface where it extends as an east-west oriented paleovalley carved into the Beaverdam Formation (cross section A-A'). In the western portion of the map area it underlies the Cypress Swamp Formation; to the east it underlies most of the Ironshire Formation (Owens and Denny, 1979; Ramsey, 2010a). The thalweg of the paleovalley (cross section A-A') lies just north of the boundary between the Frankford and Selbyville Quadrangles. The Omar Formation is also found in the northeastern corner of the Selbyville Quadrangle where the modern drainage has incised into the overlying Ironshire Formation and as a small topographic high in the southeastern portion of the Selbyville Quadrangle. The topographic high is interpreted to be an erosional remnant likely formed as the Ironshire Formation was being deposited. The Omar Formation is a composite unit consisting of deposits related to one or possibly two sea-level highstands (Ramsey, 2010a). It is composed of a lower brown to gray, organic-rich, sandy clay overlain by a compact, greenish-gray clayey silt to silty clay. Overlying the silty clay is a bed of fine to coarse sand, which is then overlain by a greenish-gray clayey silt to silty clay that commonly contains shell beds dominated by *Crassostrea virginica* (oyster). These beds grade upward into greenish-gray to yellowish-brown very fine sand. Amino-acid racemination of shells from the Dirickson Creek ditch just east of the map area indicates that the deposits fall in aminozone IIc with an approximate age of 320,000 yrs B.P., suggesting that deposition of the Omar Formation was contemporaneous with a depositional phase of the Lynch Heights Formation (Ramsey and Tomlinson, 2012; Ramsey, 2010a; Groot et al., 1990). The Omar Formation ranges from 2 feet thick along the margins of the paleovalley to greater than 85 feet thick northwest of Selbyville. The Omar Formation is differentiated from the Lynch Heights in that it is composed of relatively clean, fine sand overlying estuarine mud, while the Lynch Heights Formation is poorly sorted sand with pebbles.

Following deposition of the Lynch Heights and Omar Formations, the Indian River drainage developed in its current location. Subsequent erosion carved into these deposits, and inset terraces of stream, nearshore, and beach deposits were formed in the late Pleistocene (120,000 yrs B.P. and 80,000 yrs B.P.; Ramsey, 2010a) during sea-level highstands. These deposits make up the Scotts Corners Formation mapped along the north and south shores of Indian River Bay. Two phases of deposition and erosion (120,000 yrs B.P. (older) and 80,000 yrs B.P. (younger)) are represented in the Scotts Corners Formation. The units are very similar lithologically and are therefore mapped based on their geomorphology (land surface elevations).

The Ironshire Formation consists of fine to very coarse sand that is commonly interlaminated or interbedded with coarse to very coarse gravelly sand. The unit is found in a northeast-southwest band along the eastern boundary of the map area. The Ironshire Formation lies to the west of a topographic break at elevations of less than 8 feet where it is bounded on the east by Sinepuxent and Beaverdam Formations. It is bounded on the west by the surface of the Omar and Cypress Swamp Formations at elevations between 12 and 18 feet. Where the Ironshire unconformably overlies the Beaverdam Formation in the southeastern portion of the Selbyville Quadrangle, it is usually less than 10 feet and commonly less than 5 feet thick. The sands of the Ironshire Formation are readily distinguishable from those of the Beaverdam Formation in that they are better sorted and lack the characteristic white silt matrix of the Beaverdam. Where the Ironshire Formation overlies the Omar to the west, it is up to 20 feet thick. The sediments of the Ironshire Formation are coarsest at the eastern bounding scarp (gravelly sand) and fine westward to a fine to medium sand. Where the Ironshire Formation overlies the Omar Formation and the sands of the Ironshire are fine to very fine, they are difficult to distinguish from the sands of the uppermost Omar Formation. A granule lamina is commonly found at the contact between the two units but is not present everywhere. The sands of the Ironshire Formation also tend to have little to no silt whereas the upper Omar Formation sands are slightly to moderately silty. The Ironshire Formation in the map area is interpreted to be a coastline and nearshore deposit where the shoreline was eroding a headland of the Beaverdam Formation, which provided the source of the coarse sediments. No fossils have been found in the Ironshire Formation in Delaware. Based on its stratigraphic and geomorphic position, it is considered to be about 120,000 yrs B.P. in age; therefore, it was deposited contemporaneous with the older Scotts Corners Formation (Ramsey, 2010a).

The Sinepuxent Formation is over 20 feet thick in the map area. It consists of a lower, silty clay to clayey silt that grades upward into a micaceous, very fine sandy silt to silty sand. The upper few feet of the Sinepuxent consist of a fine to medium sand that grades to a gravelly sand to the west toward the bounding scarp with the Ironshire Formation. The micaceous sediments of the Sinepuxent Formation distinguish it from all other units in the map area (Ramsey and Tomlinson, 2012). The source of the mica is unknown. Other than the sporadic presence of *Mulinia* (clam) found near the base of the Sinepuxent Formation east of the map area, the unit is lacking shells or other fossils. However, the sediments are highly bioturbated, which is indicative of an active subbottom biota during deposition. The sediments of the Sinepuxent Formation are interpreted to be back-barrier, open water lagoonal deposits. The sandy upper portion of the Sinepuxent Formation represents the transgression of the coastal barrier across the map area. Where the shoreline of the Ironshire Formation was reoccupied, coarser sediments from the Ironshire Formation were reworked into the Sinepuxent Formation. Amino acid racemization data from *Mulinia* shells from the Sinepuxent Formation in the vicinity of Bethany Beach place the unit in aminozone IIa (Ramsey, 2010a) which is late Pleistocene in age, most likely OIS 5a (~80,000 yrs B.P.) (Ramsey, 2010a; Wehmiller et al., 2004). This time of deposition makes the Sinepuxent Formation age-equivalent to the younger Scotts Corners Formation.

The Cypress Swamp Formation (Andres and Howard, 2000) consists of a lower, very fine silty sand to sandy silt with beds of organic silt and peat overlain by a clean to slightly silty fine to very fine sand with scattered clayey silt and organic silt laminae. The unit is thickest (up to 30 feet) on the western boundary of the map area and thins to the north and east, where it is commonly 10 to 15 feet in thickness. Radiocarbon dates from the organic beds indicate that the lower sandy silt was deposited between 42,000 and 10,500 yrs B.P. with the majority of the dates ranging from 25,000 to 17,000 yrs B.P. The Cypress Swamp Formation unconformably overlies the Omar Formation. Limited pollen data from the organic beds indicate that the Cypress Swamp Formation was deposited in a cool to cold climate in a landscape with few trees (Andres and Howard, 2000). Elevation of the base of the Cypress Swamp Formation and woody organic sediment at the bottom indicate that deposition began in swamps in a stream valley during the last interglacial (MIS 3). After a hiatus in deposition during the transition between the interglacial and the last glacial period, deposition of the lower organic silts resumed in sphagnum bogs which filled the stream valley with sediment. Once the stream valley was filled, sand dunes migrated across the area depositing the upper portion of the Cypress Swamp Formation. Organic laminae in the upper sandy portion were deposited in ephemeral bogs between the dunes.

Dune deposits are medium to fine, well-sorted sands found scattered throughout the map area. The dunes have a pronounced surficial expression as linear features that rise above the surrounding landscape. The majority of these features in the map area are found in the central portion of the Frankford Quadrangle. Some of these dunes are probably latest Pleistocene to early Holocene in age (Andres and Howard, 2000), but some could possibly be as old as late Pleistocene. Dune features are also associated with the rims of Carolina Bays. A few large examples of these features are found in the northwestern portion of the Selbyville Quadrangle. Both the dunes and the Carolina Bays are cold-climate related features located where winds move over 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.

Cross section B-B' illustrates the distribution of Holocene sediments that overlie the Beaverdam Formation in Indian River Bay. Data for this interpretation are from seismic reflection data and structure contours presented by Banaszak (2011). Lithostratigraphic interpretations were made by Chrzastowski (1986) from vibracores and were updated with newer borehole data from DGS files by the authors. Recent seismic data collected as part of a University of Delaware study on submarine groundwater discharge indicate that the paleovalley is narrower than previously thought (Chrzastowski, 1986). On the broad, shallower area of the bay bottom, less than three feet of Holocene sediment overlies the much older Beaverdam Formation. At the deepest part of the paleovalley in the cross section, Holocene deposits are approximately 60 feet thick (Banaszak, 2011). These Holocene deposits, along with the terraces comprised of the Scotts Corners Formation on both the north and south sides of the modern lagoon, indicate that the incision of the Indian River paleovalley predates the deposition of the older Scotts Corners Formation (120,000 yrs B.P.). The valley has been flooded at least twice (older and younger Scotts Corners Formation) during late Pleistocene sea-level highstands and was incised during the intervening sea-level lowstands. During the last sea-level lowstand, the valley was again deeply incised (~60 feet at the cross section) (Banaszak, 2011) and is presently being filled with marsh and lagoonal sediment.

Seismic data (Figure 1) correlate well with geophysical and lithologic logs and the current understanding of the depositional architectures of the Holocene-age bay bottom deposits overlying the Beaverdam Formation. The Holocene section is a very thin (<3 ft) veneer of silty sands that is poorly resolved by the seismic data (light yellow overprint). Figure 1 shows the only portion of the seismic dataset that images the Holocene sediments over the Beaverdam Formation. The surface of the Beaverdam, interpreted as a weathering horizon, is represented by strong reflection events nearly coincident with the reflection marking the modern bay bottom. A relatively continuous strong reflection event within the Beaverdam Formation separates the uppermost beds (Tbd_U) composed of heterogeneous silty to clayey, fine to coarse sands deposited in tidal flats and channels from underlying beds (Tbd_L) of coarse sand and gravel deposited in tidal channels and deltas (light orange overprint).

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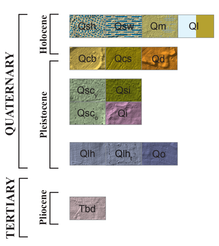

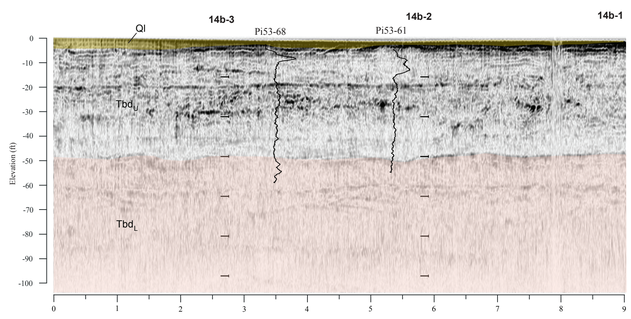

Figure 1. Seismic data from Indian River Bay. Seismic line intersects cross section B-B'. The Holocene section, Ql, (light yellow overprint) is a thin veneer of silty sands which overlies the Beaverdam Formation. The coarser-grained lower Beaverdam (Tbd_L) is separated from the finer-grained upper Beaverdam (Tbd_U) by a stong reflection event. Bold labels are seismic shot points.