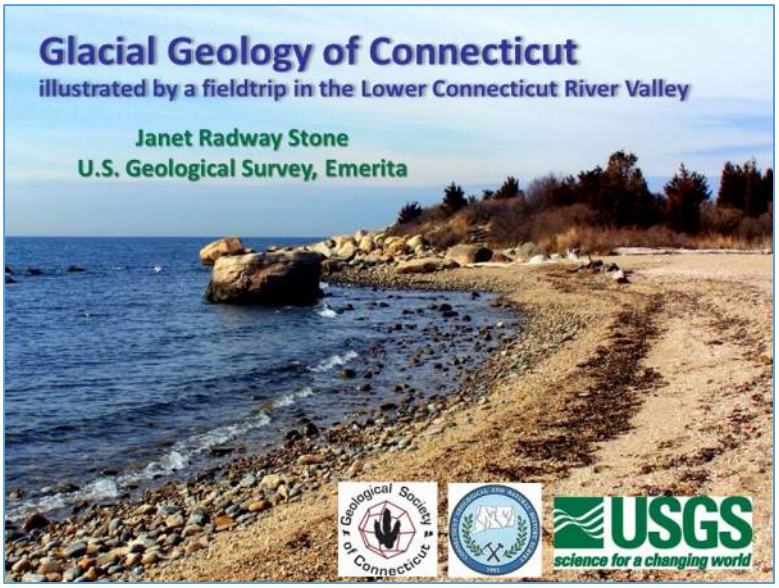
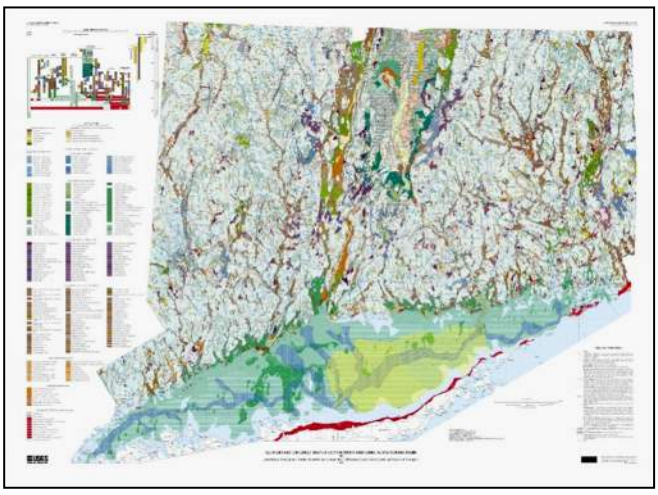
Course Description and itinerary for Glacial Geology of Connecticut illustrated by a Fieldtrip in the lower Connecticut River valley (May or June 2024)

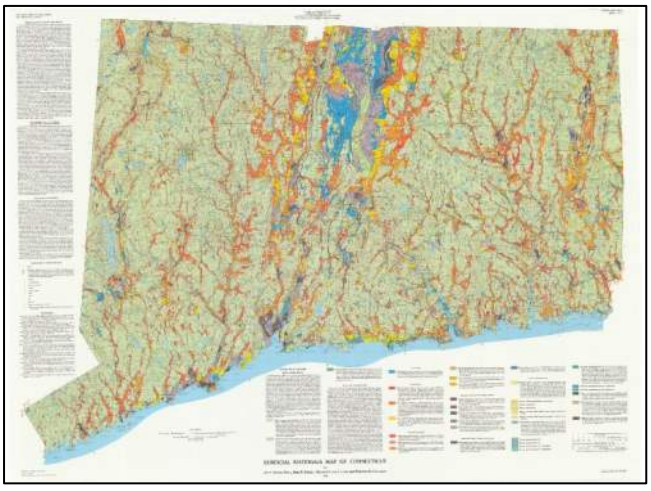
7:30 AM **Assembly at DEEP Marine Headquarters, Old Lyme CT**

8:00-9:00 **Introduction to Connecticut Quaternary Geology in an oral slide presentation including previews of features to be seen on the fieldtrip**—the presentation will demonstrate some of the important geologic deposits and features formed in Connecticut during the Quaternary timeframe which includes the Pleistocene (glacial) and Holocene (postglacial) Epochs. The Quaternary has been the time of development of many details of the landscape and of all the surficial (unconsolidated) deposits. These materials are of pervasive importance to the present occupants of the land. Three main types of surficial deposits are present in Connecticut: 1) *glacial ice-laid deposits* were laid down beneath ice as continental ice sheets advanced across Connecticut at least twice in the Middle and Late Pleistocene; 2) *glacial meltwater sediments* were deposited in glacial lakes and streams as the last ice sheet retreated northward across Connecticut; and 3) *postglacial deposits* which were formed by various processes after the recession of the last ice sheet.



Glacial and postglacial deposits and features across Connecticut have been mapped and are illustrated on two State geologic maps. The Quaternary Geologic map of Connecticut and Long Island Sound Basin (Stone and others, 2005) illustrates the geologic history and the distribution of depositional environments during the emplacement of glacial and postglacial surficial deposits, and the landforms resulting from those events. A companion map, the Surficial Materials Map of Connecticut (Stone and others, 1992) emphasizes the surface and subsurface texture (grain-size distribution) of these materials. The features portrayed on the two maps are very closely related: each contributes to the interpretations of the other.



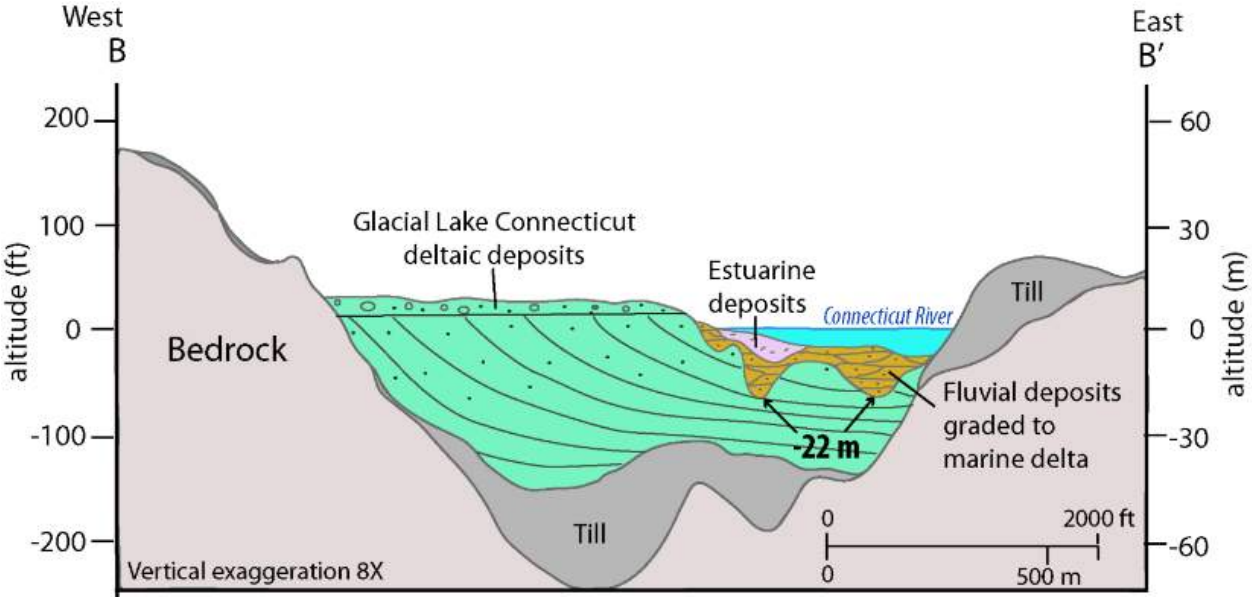


On the fieldtrip we will examine glacial deposits and landforms and their internal structure in the southeast Connecticut towns of Old Lyme, Lyme, East Haddam, East Hampton, and Portland.

FIELDTRIP

9:15 Exit DEEP Marine Headquarters and walk a short distance to Stop 1.

9:15-9:40 Stop 1. Dock area at CT DEEP Marine HQ. Looking north from this vantage point we have an excellent view of the Baldwin Bridge (I-95), which crosses the Connecticut River at its narrowest point in the lower estuary region. We are on the east side of the River underlain here by till and bedrock. Cross-section B-B' (see below) was constructed using bridge-boring data for the new span that was built in 1989-90, excavations on both sides of the river during construction, other well data, and seismic-reflection profiles.



We can also view a glaciodeltaic terrace surface (see base of houses in photo below) on the west side of the River built into glacial Lake Connecticut formerly occupying Long Island Sound. The delta plain surface here is at 7 m altitude (that is **7 m above river level** which is sea level) and a topset-foreset contact at about 6 m was observed in a former excavation a little north of here.

Following discussion illustrated by posters, we will Board the bus.

9:40-10:00 Twelve-mile route to Stop 2—Glacial geologic features will be pointed out and discussed by leaders along the way:

- Note rock outcrops on south end of hill as we leave the parking lot—steeply dipping, northeast trending strike ridges of Potter Hill gneiss in the western limb of the Lyme Dome (Walsh, 2003). As we turn north onto Rt. 156, note to the left that the north side of this hill has no bedrock outcrops and is made up of thick till deposits.
- Bouldery fields on thick glacial till at Tiffany Farms along Rt. 156
- Glacial meltwater deposits in the Eightmile R. valley farther along Rt. 156
- Ice-dammed pond deposits along Brush Hill Road and Rt. 148—stage 1 of Glacial Lake Hadlyme deposits

10:00-12:45 Stop 2. Hadlyme village/Gillette Castle area.

2a. **Chester-Hadlyme Ferry Landing (30 min)**.
We will discuss the geometry of the CT River valley and the 50-m depth to the bedrock surface at a deep corehole site located at the base of the vertical bedrock face exposed here. The borehole penetrated 50 m of glacial sediment before hitting the bedrock surface; it encountered the terrane-bounding Honey Hill Fault at -221 m and penetrated 153 m deeper into underlying rock of the Avalonian Terrane.

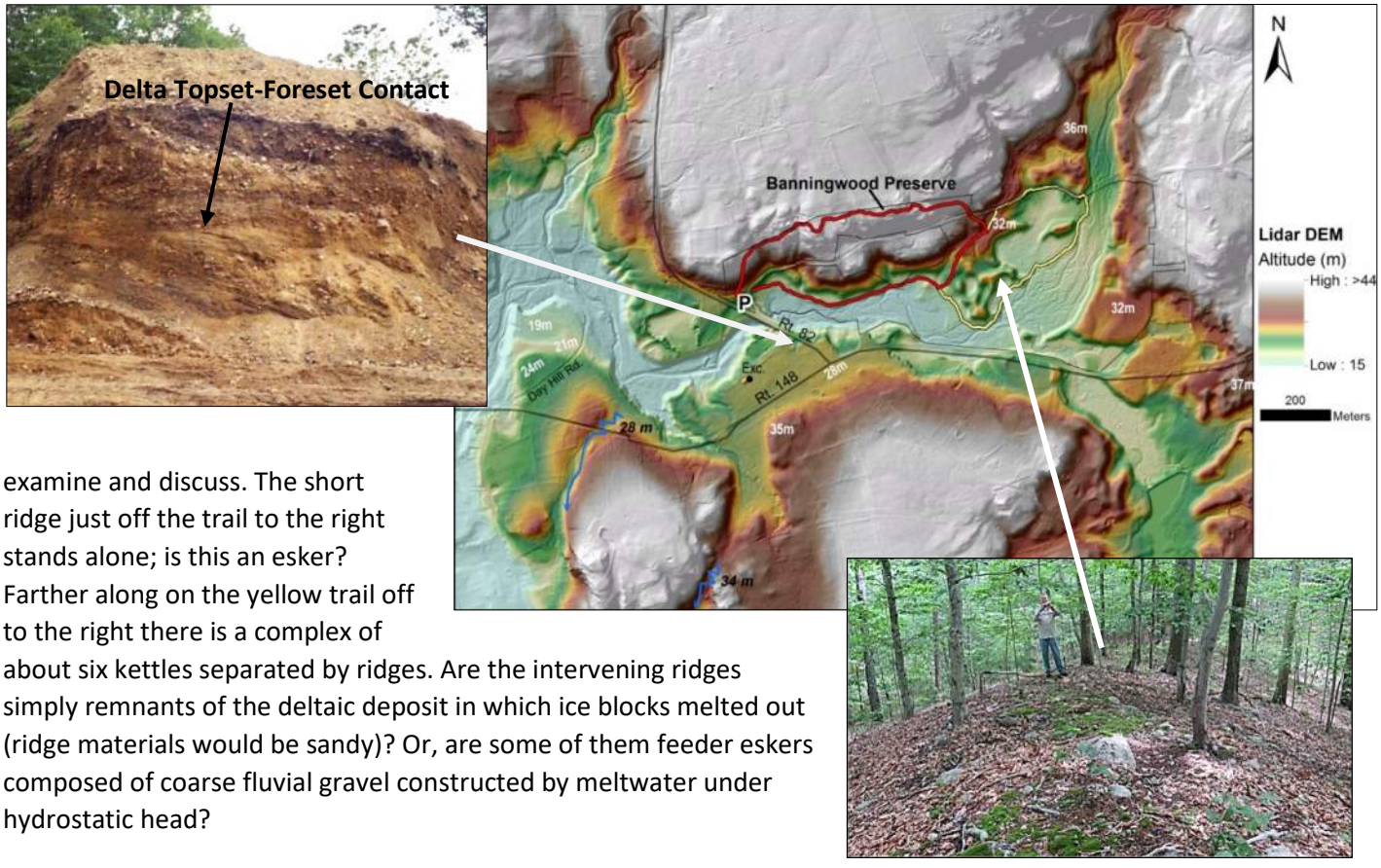
Across the River from here, the glaciodeltaic terrace deposits are exposed just north of the Ferry Landing where the delta surface (beneath the house in photo below) lies at **20 m above River level.**

2b. **Glacial Lake Hadlyme Spillway and deltaic surface (30 min).**

Inland from the River in Hadlyme village, higher level, glacial lake deposits were built into a series of small, ice-dammed ponds (Glacial Lake Hadlyme, Stone and Lewis, 2015). We begin on a deltaic surface which is underlain by gravelly topset beds overlying sandy forest beds as seen in a former house foundation excavation (see photo **a** below). We will then hike a short distance to examine the spillway for stage 2 of that lake that is cut across a till and bedrock surface (see photo **b** below).

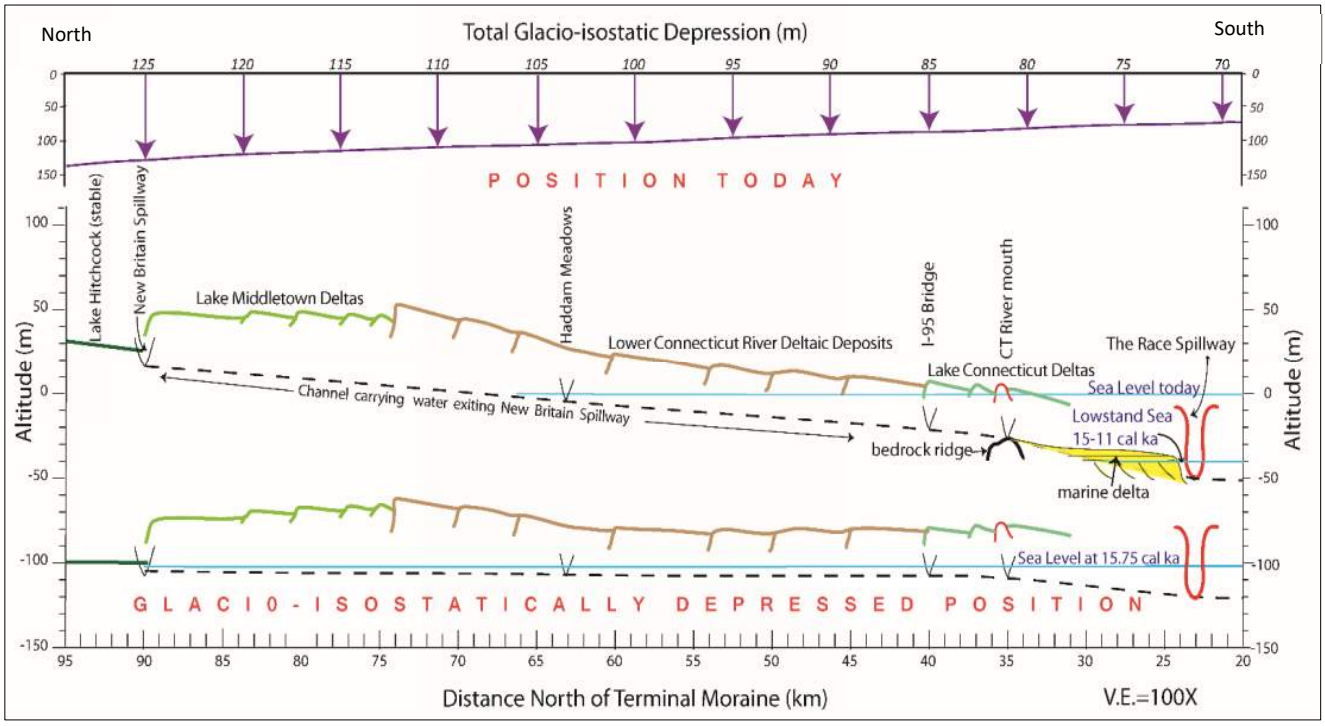
2c. **Banninningwood Preserve (Lyme Land Trust) east side of Rt. 82 in Hadlyme village (60 min)**.

A trail leads past bedrock outcrops in the hanging wall of the Honey Hill thrust fault which is the Avalonian Terrane boundary, to an area where glacial sands and gravels form a highly collapsed deltaic surface, part of the ice-marginal head of deltaic deposits built into Glacial Lake Hadlyme. After descending to the junction with the yellow trail, we will walk across the surface of glacial Lake Hadlyme stage 3 deltaic deposits, and then head east on the yellow trail. The trail encircles a well-preserved complex of kettles, which we will leave the trail to examine and discuss. The short ridge just off the trail to the right stands alone; is this an esker? Farther along on the yellow trail off to the right there is a complex of about six kettles separated by ridges. Are the intervening ridges simply remnants of the deltaic deposit in which ice blocks melted out (ridge materials would be sandy)? Or, are some of them feeder eskers composed of coarse fluvial gravel constructed by meltwater under hydrostatic head?



2d. **Gillette Castle State Park. Lunch Stop and View of River Valley (45 min).**

This 122-acre park has picnic and restroom facilities, trails and scenic views. Views from the Castle are enhanced by its riverside location high on the southernmost of the "seven sister" hills that line the northeast side of the Connecticut River. We will have lunch here while we discuss the altitudes of the glaciodeltaic terraces in the lower Connecticut River Valley (see profiles in diagram below), including the 20-m level of the Fort Hill terrace across the River in Chester (seen here).

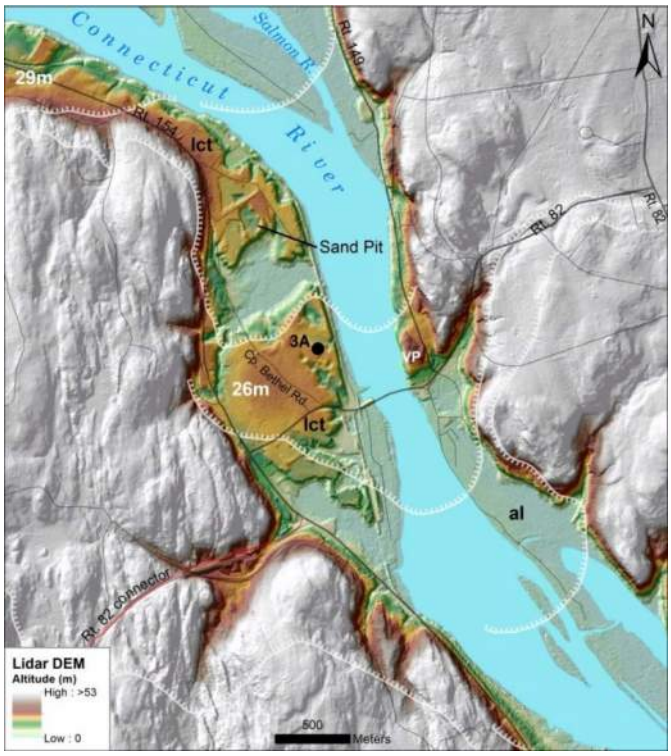


Profiles showing positions of delta deposits and other features in the lower Connecticut River valley and Long Island Sound. Dashed lines are positions of channel pathway for water spilling from glacial Lake Hitchcock at the stable level. Upper profile shows position of features today; lower profile shows glacio-isostatically depressed positions.

12:45-1:00 **Five-mile route to Stop 3**. Leaders will point out glacial features to be seen along the way.

1:00-1:30 Stop 3. View across River in East Haddam village of Camp Bethel glaciodeltaic terrace.

Camp Bethel is located on an ice-marginal deltaic morphosequence in the glaciodeltaic terrace; surface altitude here is about 26 m. Visiting Camp Bethel one can see several nice examples of 10-15-m deep kettles that mark the delta surface (see lidar image below). The ice-margin position (ticked white line on lidar image) from which this deltaic morphosequence was built lies only about 250 m north of here, and these kettles mark the melting of detached blocks of glacial ice associated with that position. We continue eastward to the eroded edge of the deposit where we can see across the River. The deltaic terrace originally extended across the entire valley and was incised by the Connecticut River in early postglacial time as glacial lakes drained to the south. The very sharp scarp that marks the eastern edge of this deposit is indicative of the erosional (incised) nature of this edge; in contrast, note the gentler slope (ice-contact) on the northern edge of the deposit. Although there are currently no exposures in this deltaic morphosequence, a former excavation (labeled sand pit on lidar image) in the next delta to the north revealed deltaic bedding and a topset-foreset contact at approximately 25 m in altitude.

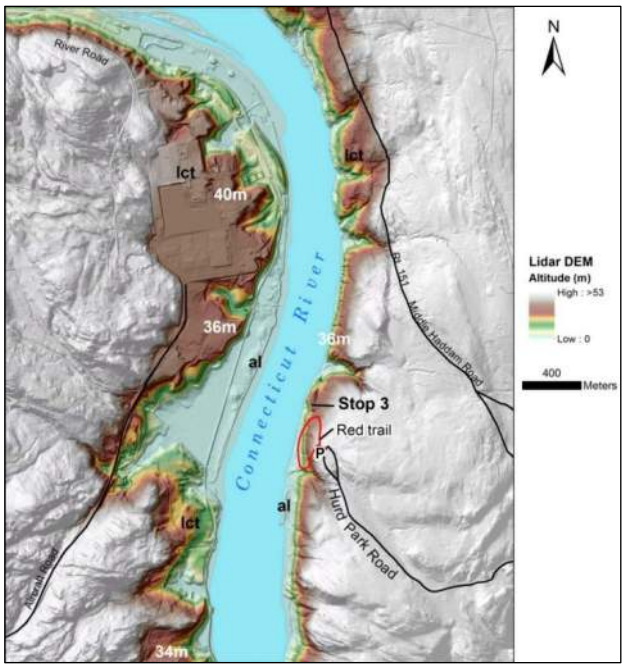


1:30-1:50 Ten-mile route to Stop 4. Leaders will point out glacial features along the route.

- Excellent views of postglacial freshwater tidal marshes along the Connecticut River and the mouth of Salmon River as we head north on Rt. 149 in East Haddam.
- Ice-dammed pond deposits in the Moodus River valley at Johnsonville.
- Cave Hill on north (right) side of Rt. 151, source of the historically mysterious “Moodus Noises”, now known to be periodically occurring small earthquakes.
- Meltwater deposits in the Salmon River valley.
- Well-developed bedrock strike ridges of the steeply dipping Collins Hill formation.

1:50-2:30 Stop 4. Hurd State Park glaciodeltaic terrace (36 m) along the Connecticut River.

A short hike from the parking area on the red trail to a green trail to reach a narrow terrace surface at 36 m altitude underlain by pebbly sand and gravel that can be seen in tree throws and an old borrow pit just off the



trail. This terrace is a narrow remnant of deltaic deposits that remain on the east side of the River. Through the trees we can view the much wider extent of the terrace on the west side of the River. The narrow terrace is not readily apparent on the 1;24,000-scale topographic map and was not mapped on the Quaternary map (Stone and others, 2005). It shows up nicely on the high-resolution LIDAR images now available for Connecticut.

2:30-2:45 Five-mile route to Stop 5. Leaders will point out glacial features along the route.

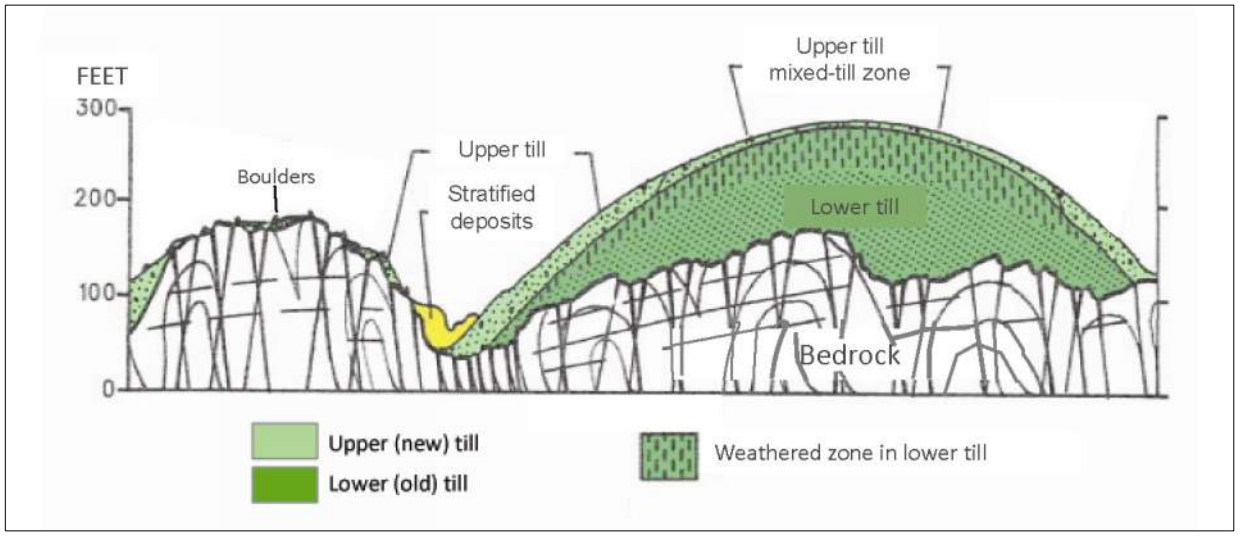
- At Middle Haddam village descend till/bedrock surface and drive over glaciodeltaic deposits on River (left) side of Rt. 151 at 43 m in altitude.
- After turning west on Rt. 66 at Cobalt, we pass entrance to St. Clement's Castle on left which sits on another glaciodeltaic terrace surface at 46 m altitude.

2:45-3:30 Stop 5. Exposures in the Connecticut River glaciodeltaic deposit along Rt. 66 in Portland.

At the Srb excavation (a) on north side of the road, we have excellent exposure of horizontally bedded topset gravels and sand near the ice-marginal head of a deltaic morphosequence. Deep kettles and a well-preserved esker stand nearby. The fluvial gravel beds shallowly overlie crystalline bedrock on the east side of the excavation and just a short distance to the west, the bedrock surface drops to well below sea level beneath the adjacent 35-m deep kettle hole. On the south side of Rt. 66, pink, sandy deltaic forest beds can be seen in a separate excavation (b) next to the Morin Diesel Company. We will also discuss the altitude of the deltaic terrace surface which has risen to 46-m here, 32 km farther north up the Connecticut River from where we began the fieldtrip at Stop 1.

3:30-3:45 **Five-mile route to Stop 6**

3:45-4:15 **Stop 6. Baker Hill drumlin in East Hampton.** Baker Hill sits high in the landscape with a summit altitude of 669 ft and atop NNE trending strike ridges of Brimfield Schist (fig. 22). Till in the drumlin is about 90 ft thick as indicated by the highest surrounding bedrock surface altitude at 580 ft. A former shallow exposure at 540 ft in the lower northwest side of Baker Hill revealed the presence of the lower (old) till in this drumlin. A new (2023) apartment complex has been constructed on the east side of the drumlin and in the process an excellent exposure of glacial till was revealed as seen in drone image from winter 2023 below. Hopefully some of this exposure will still be available for us to examine on the fieldtrip.



Idealized cross-section of a typical drumlin in southern New England showing the distribution of two distinct tills of different ages (modified from Melvin and others, 1992).

4:15-4:45 **Twenty seven-mile route back to DEEP Marine headquarters in Old Lyme.** Summary and closing remarks. End of Fieldtrip.