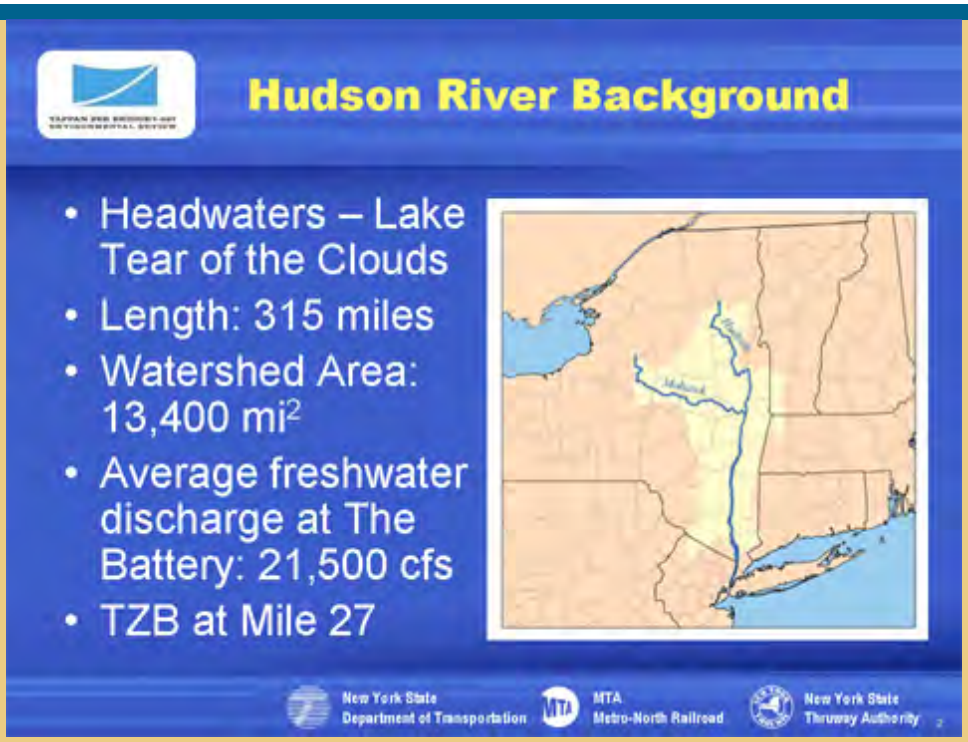
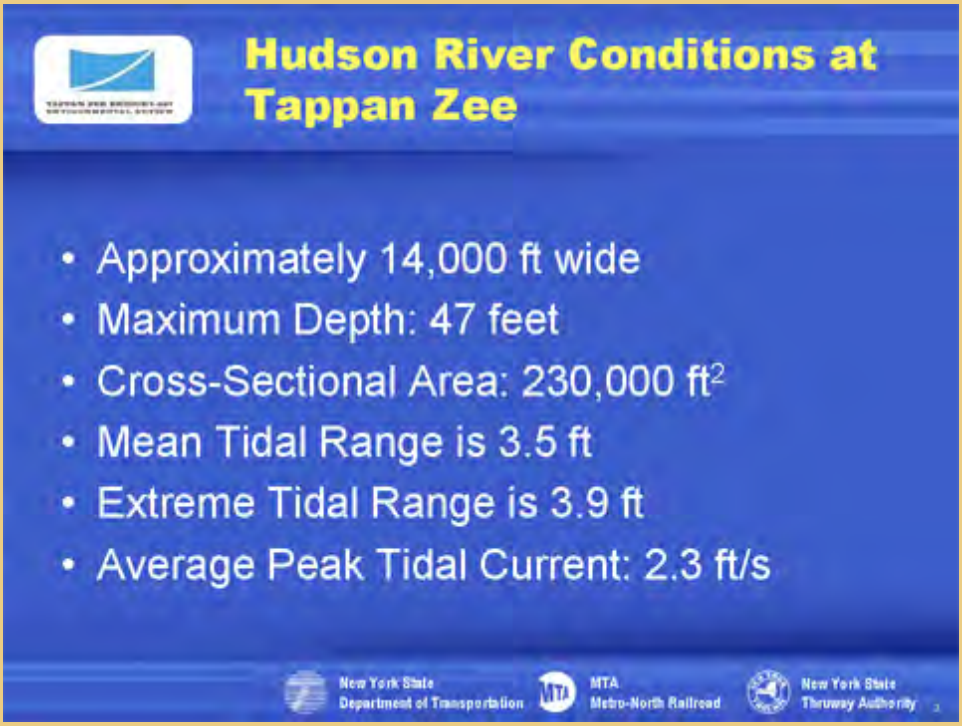
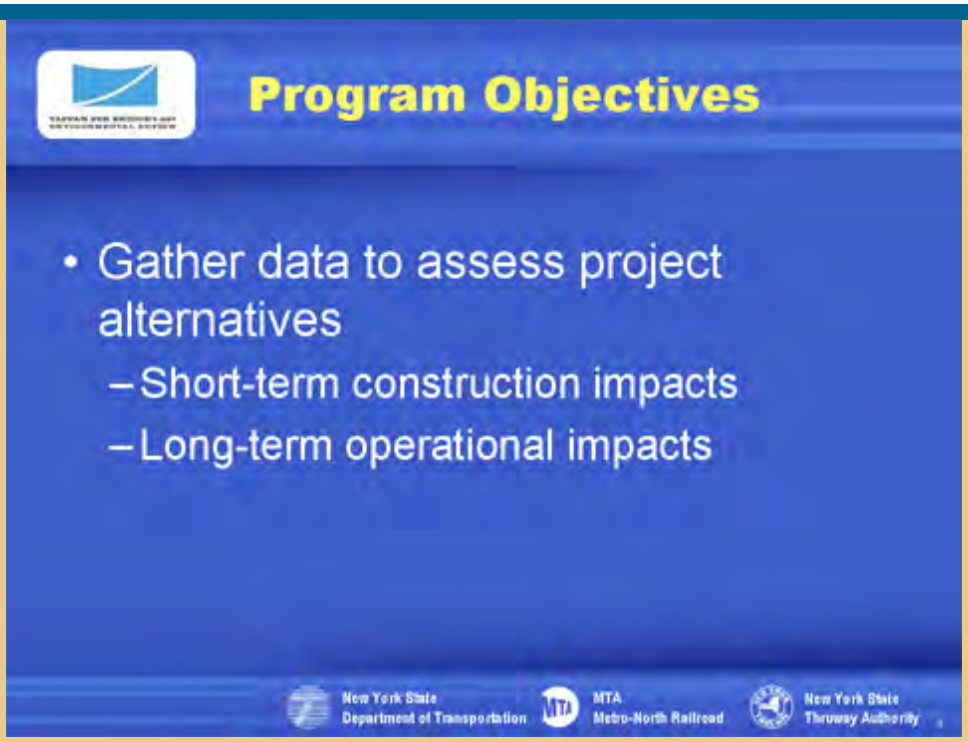


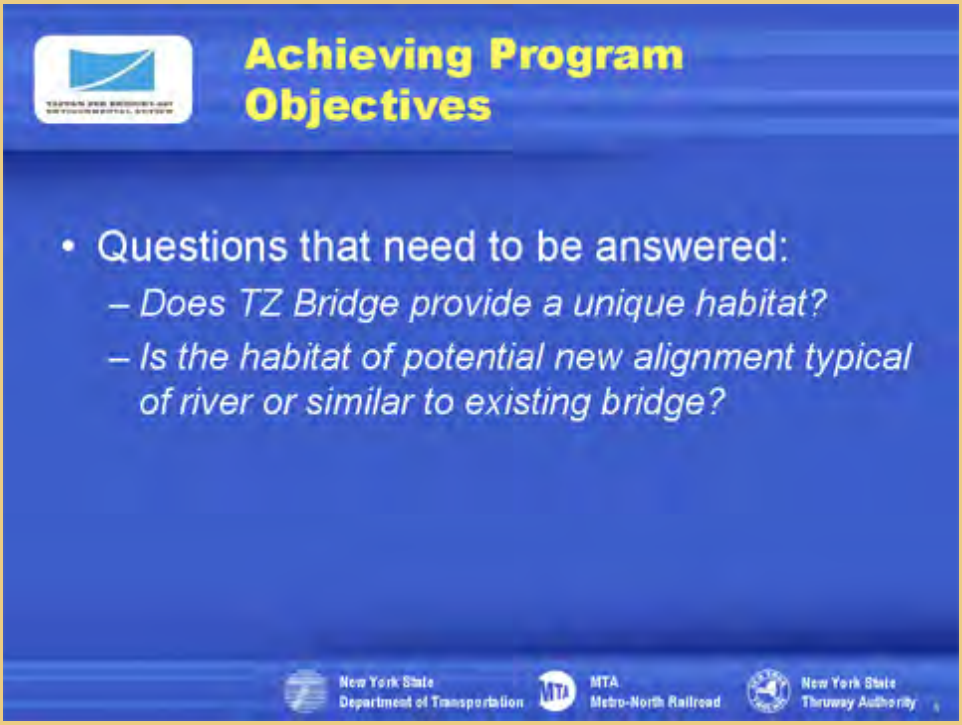
The Hudson River is 315 miles long, with a watershed area of 13,400 miles squared and average discharge flow at The Battery of 21,500 cfs.
The illustration shows the geographic extent of the Hudson River drainage basin. Below the dam at Troy, the Hudson River is technically an estuary since it is tidal up to that area. However, under typical river conditions salt water does not intrude much farther north than Bear Mountain.



Statistics for the Hudson River at the Tappan Zee Bridge, including depth, width, cross sectional area, and tidal range.

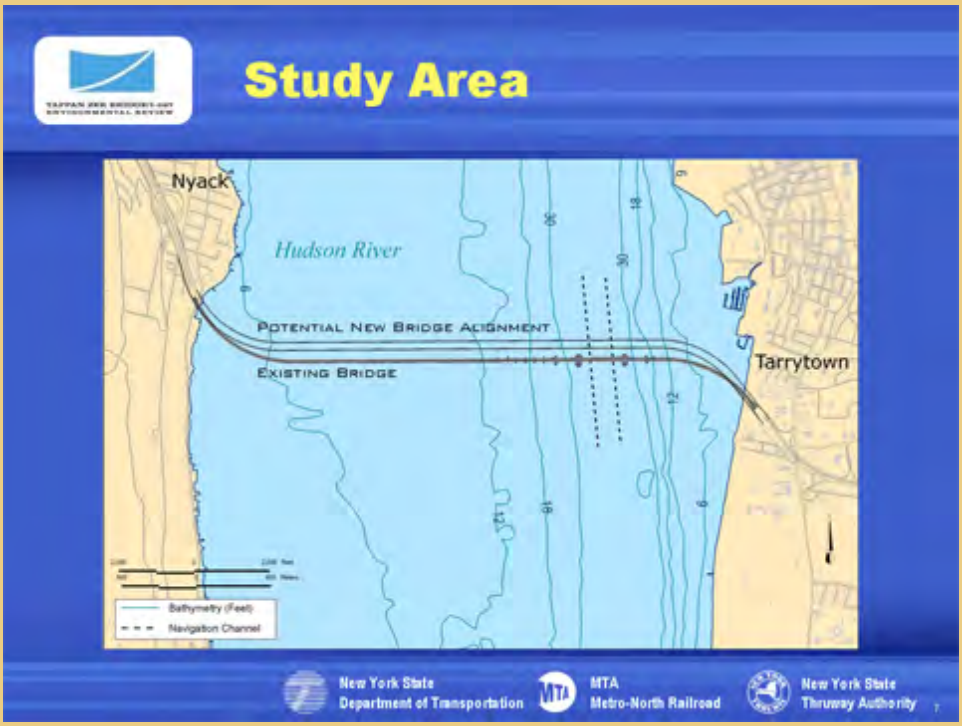


The Hudson River program is part of the overall environmental effort being undertaken for the study. One of the objectives of the program is to assess the impact of potential construction; another is to assess long-term operation implications.

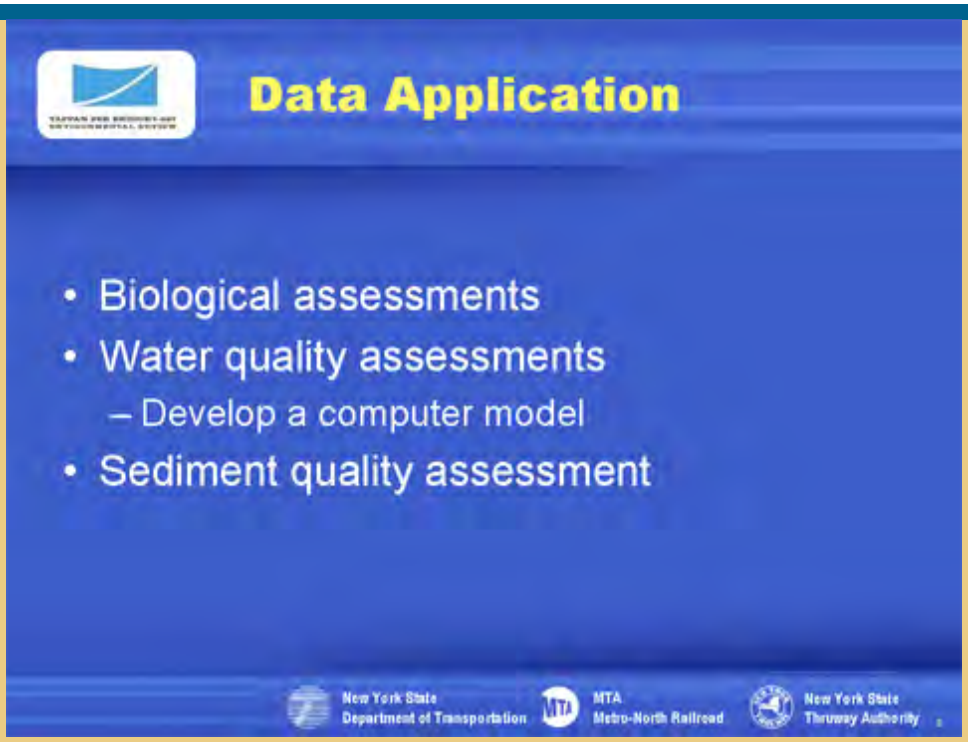


The Hudson River program is expected to address whether the existing bridge provides a unique habitat for aquatic species and if the habitat along potential new bridge alignments is typical of river conditions or comparable to that in the existing bridge vicinity.

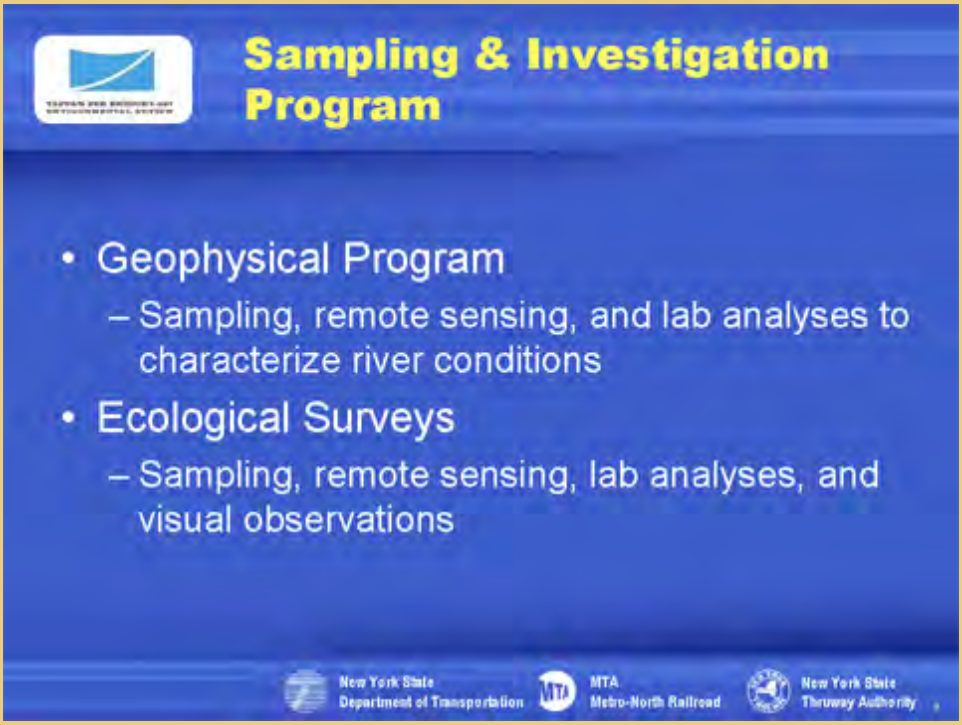
To address these questions, data-gathering efforts are concentrated near the existing bridge and along the potential alignments of new bridges. Data is also collected near the river shorelines and at several reference locations.



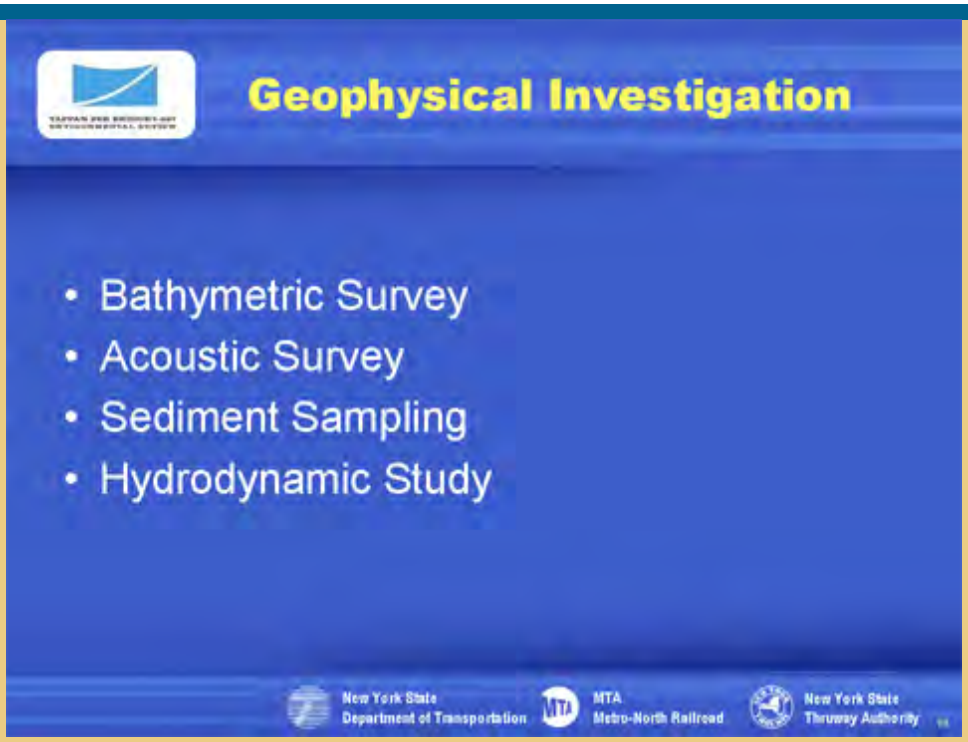
The existing bridge alignment and a potential alignment of a new bridge.



Data is acquired to conduct biological assessments, address water quality impacts, and develop an understanding of sediment conditions near the bridge.

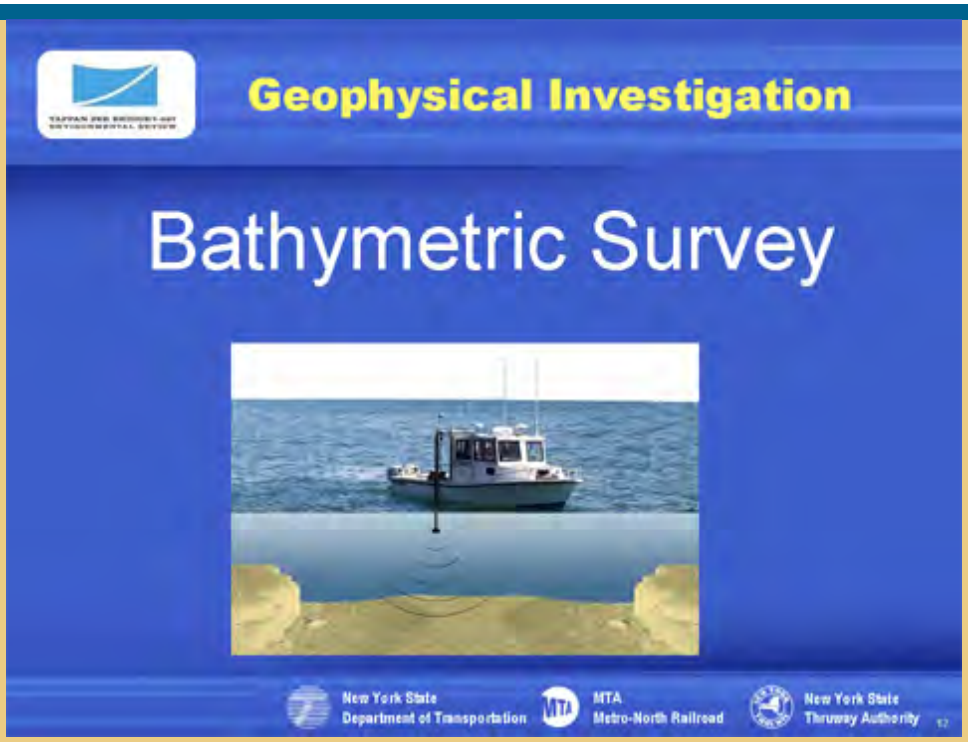


The sampling program was divided into two principal sections: geophysical/ hydrodynamic, and ecological.

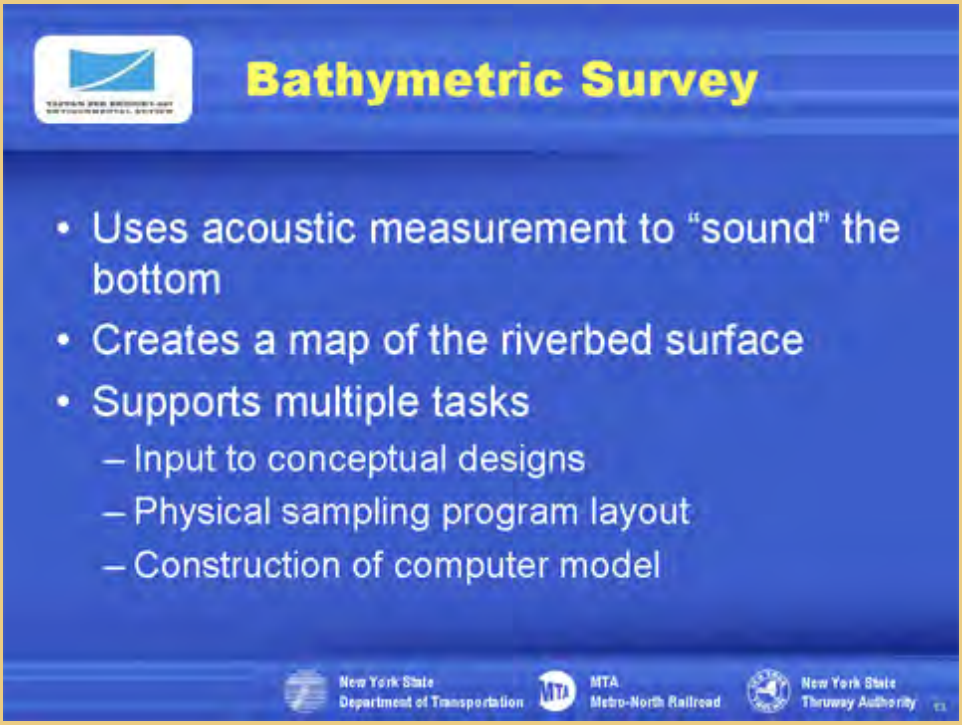


This presentation focuses on the geophysical and hydrodynamic aspects of the Hudson River program and looks at bathymetric surveys, acoustic surveys, sediment sampling, and hydrodynamic investigations.

This cross section of the river illustrates geological conditions at the site of the Tappan Zee Bridge. The upper layer of material consists of organic soils, which are of principal interest from the perspective of assessing environmental impacts.

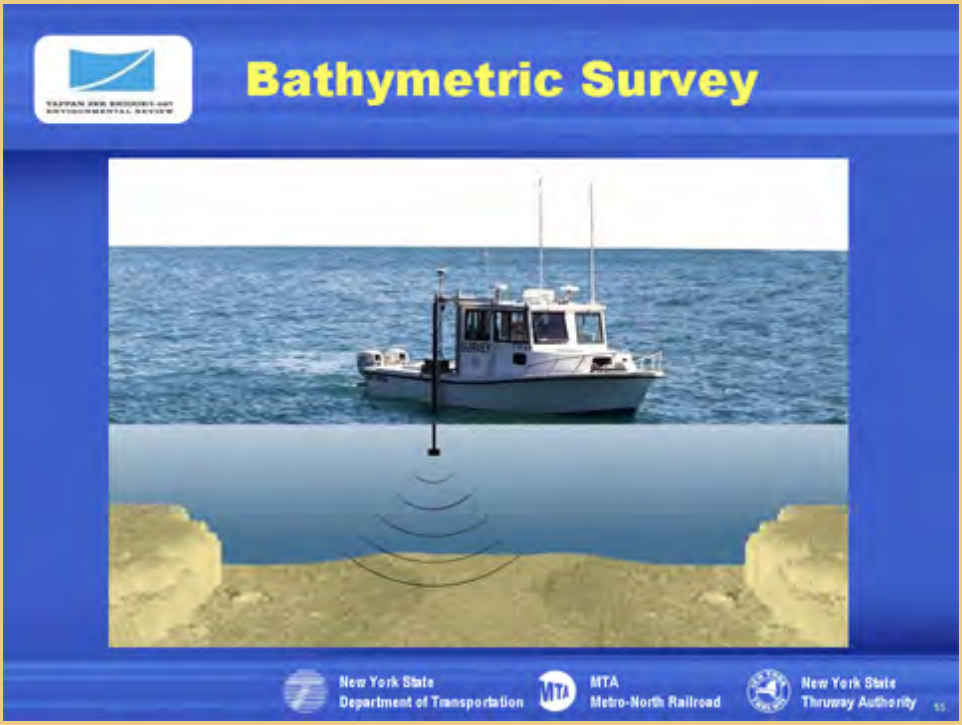


A typical vessel used to conduct a bathymetric survey. Bathymetric surveys measure the depths of a body of water.

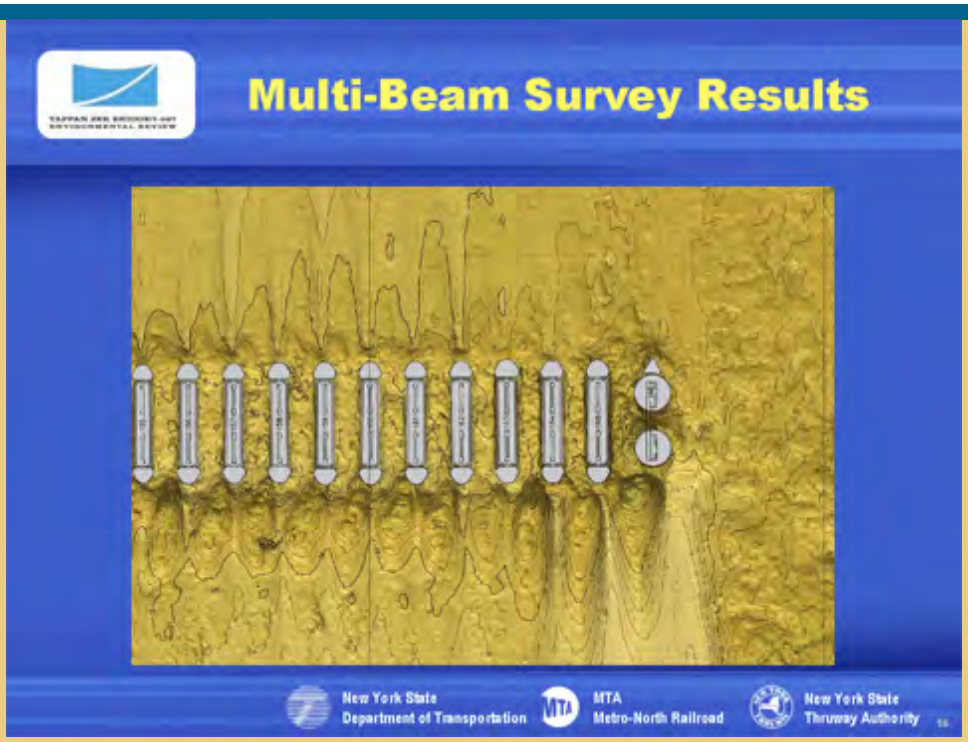


To measure the depth of the river, we used an acoustic system that "sounded" the river bottom. The result is a map of the river bottom. The bathymetric data will serve as input to bridge conceptual designs, assist with the layout of ecological and geophysical sampling programs, and will also provide input to a mathematical model being developed for the study.

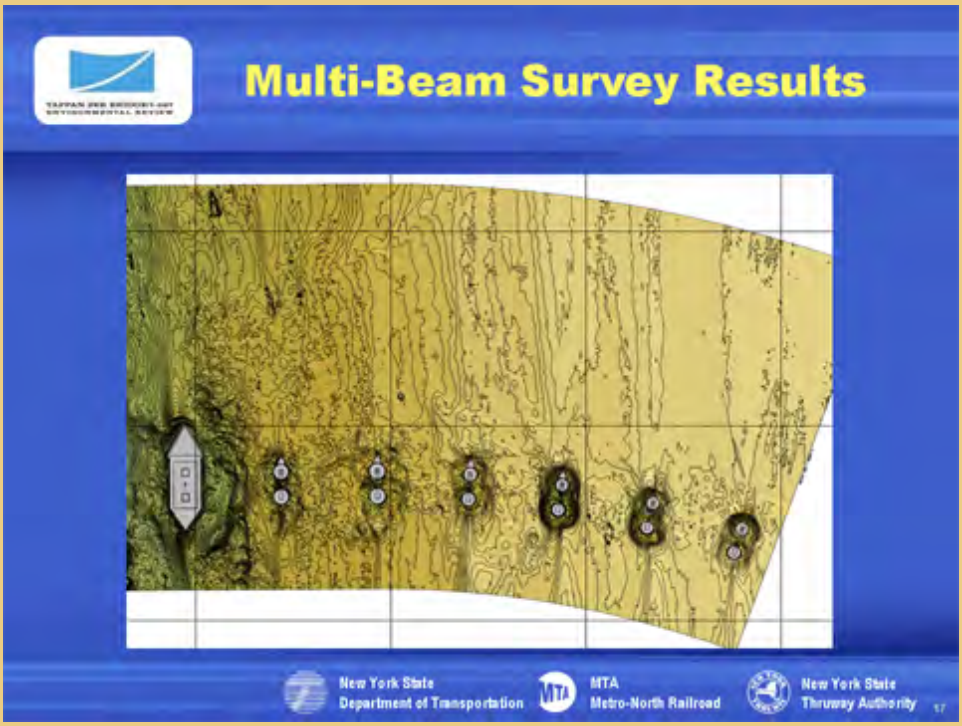
Two types of acoustic systems were used to generate bathymetric maps for the Hudson River program: a multi-beam survey, which was used to generate very detailed maps in the immediate bridge vicinity, and a single beam survey system, which generated maps in the far field.



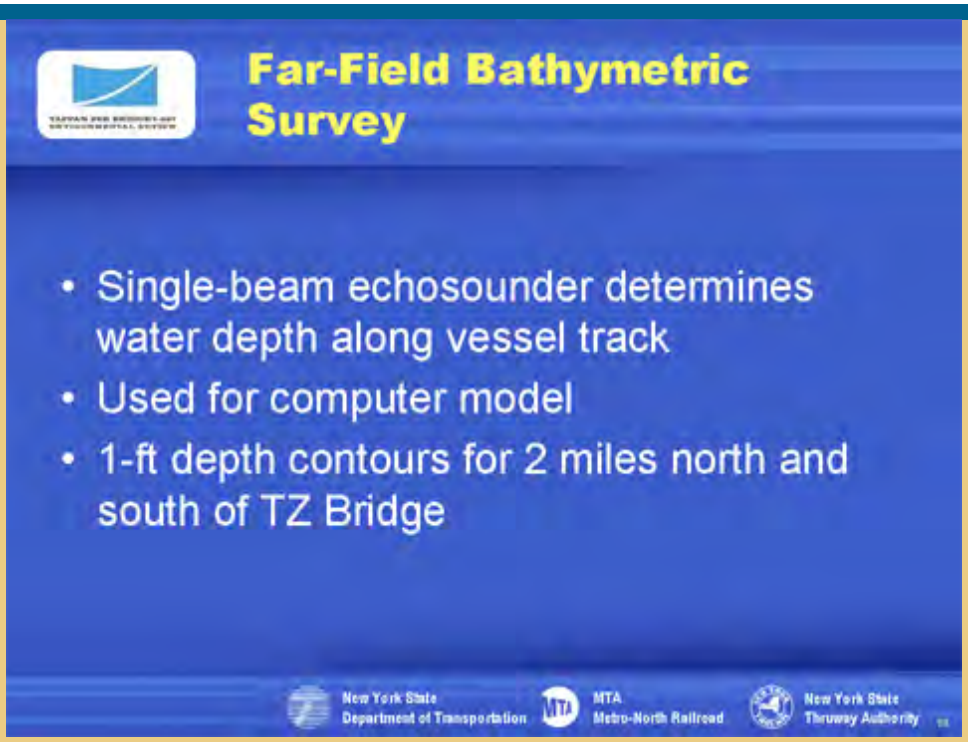
A typical survey vessel has antennae that receive GPS signals from satellites and shore-based stations. An acoustic sounder is mounted off the side of the survey vessel.



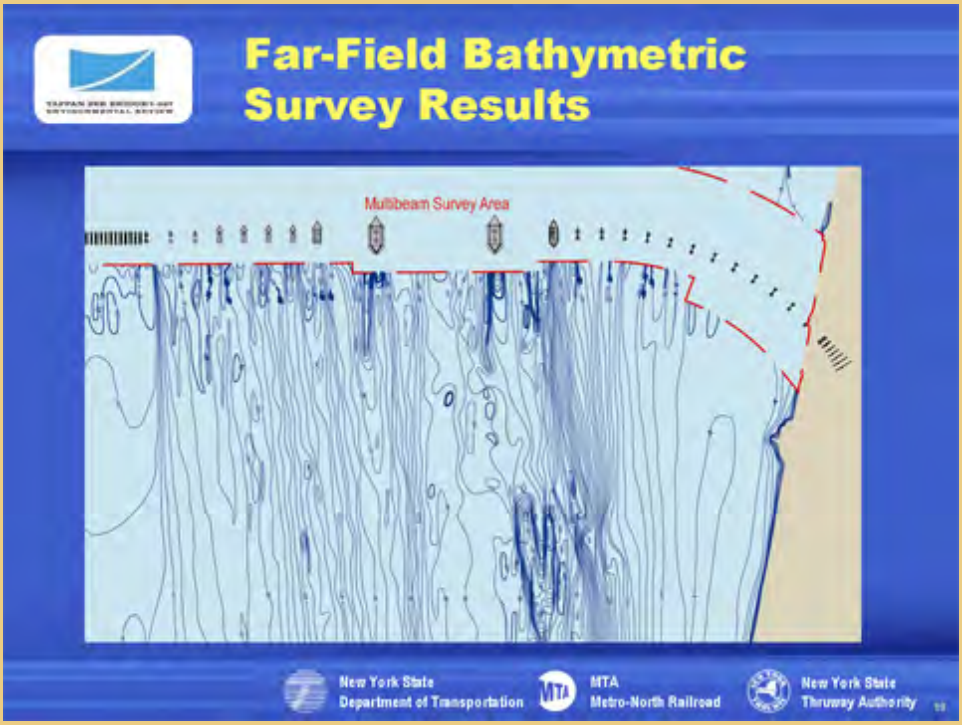
Scour maps due to river flows are clearly visible on this map, which illustrates typical results of the highly detailed multi-beam survey conducted in the immediate bridge vicinity.



Scour marks are less pronounced in this map, which also illustrates results of a multi-beam acoustic survey.

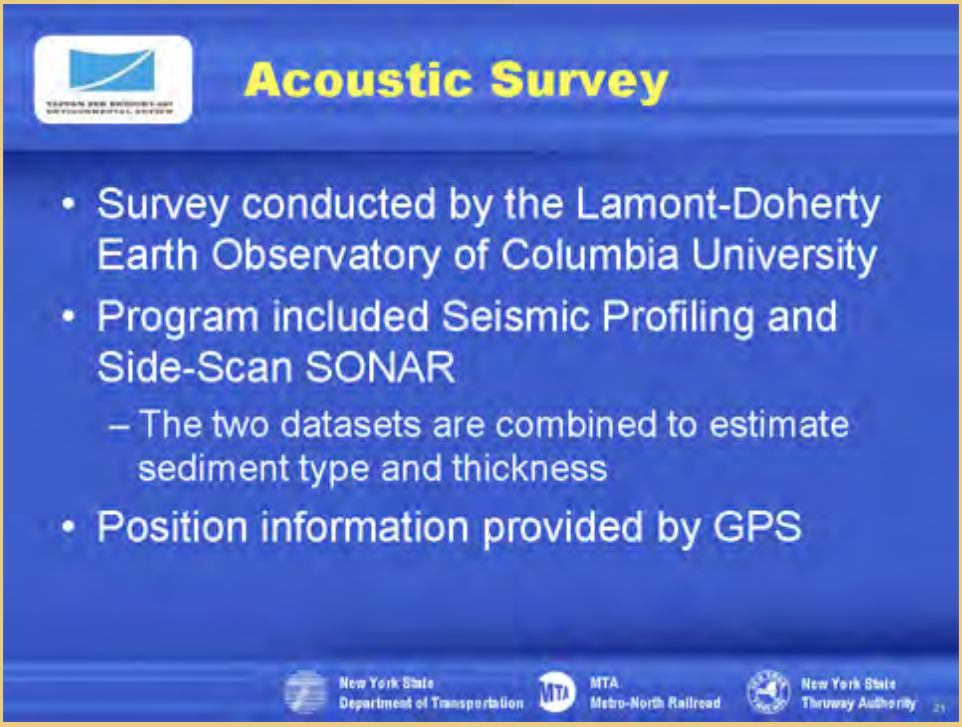


Far-field bathymetric surveys mapped the depths of the Hudson River from two miles above to two miles below the Tappan Zee Bridge.

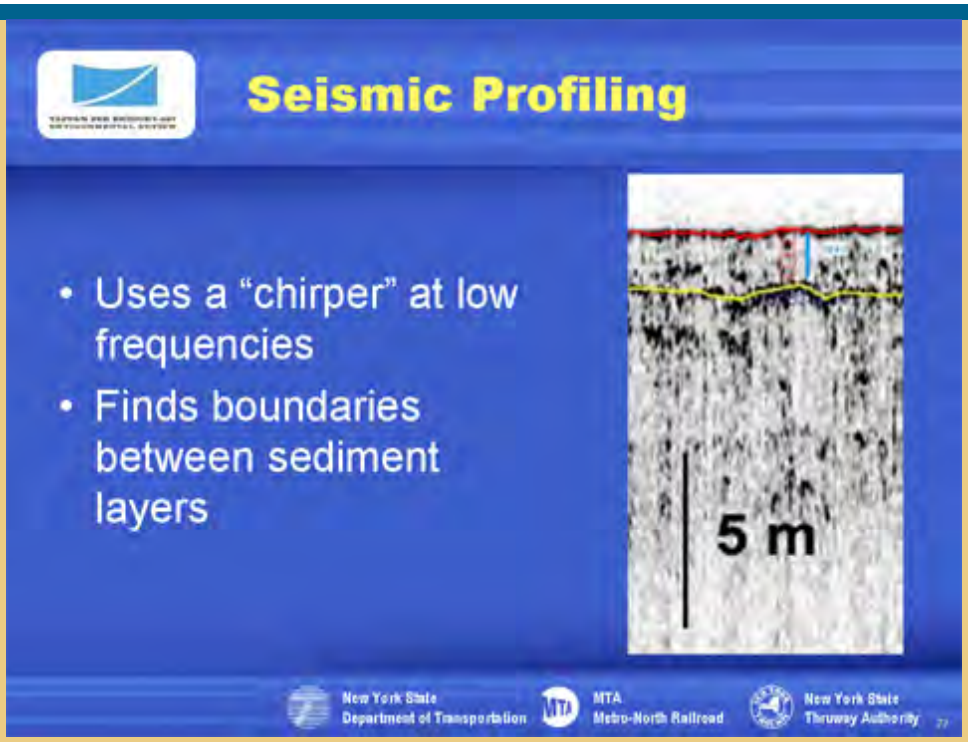


This typical far field, single beam bathymetric map is clearly less detailed than maps generated from the multi-beam survey system.

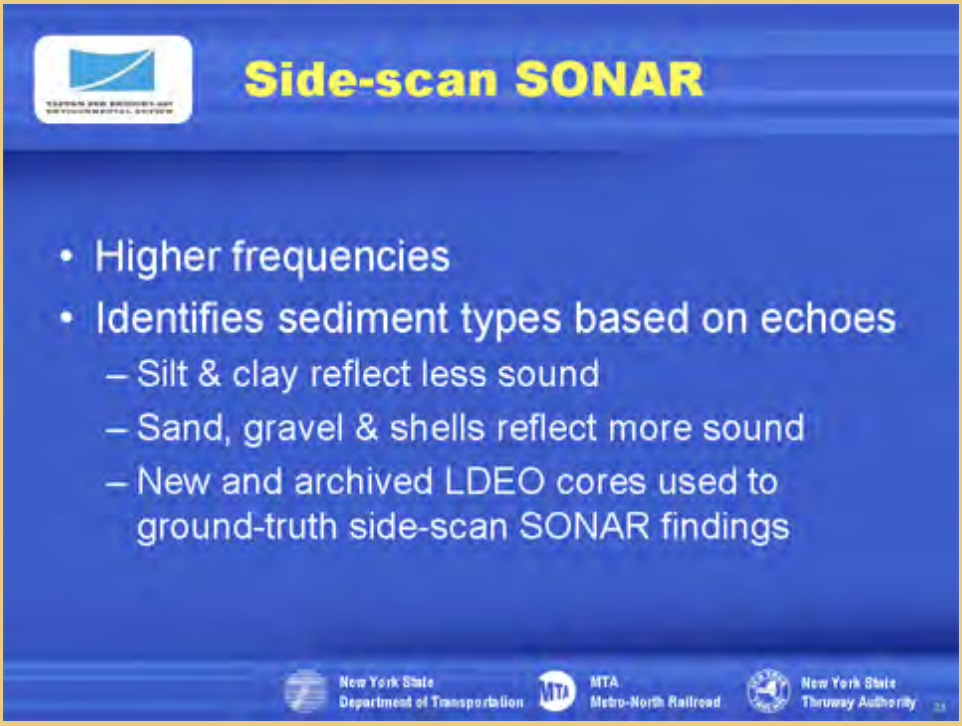
This part of the presentation focuses on the study's acoustic profiling effort.



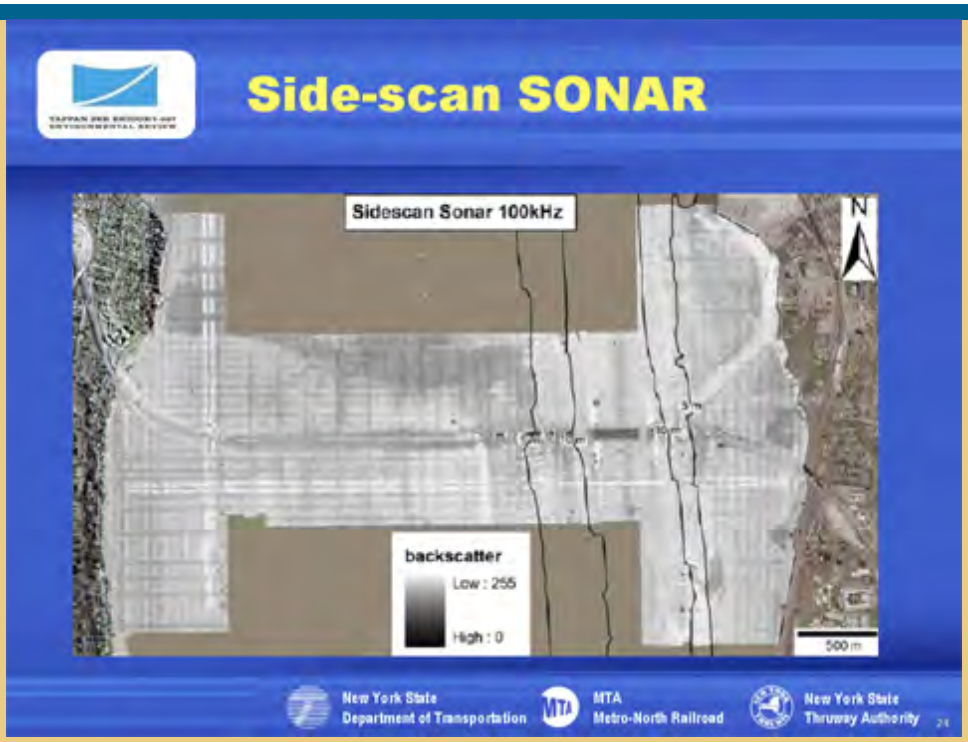
The acoustic profiling surveys were conducted by Lamont Doherty Earth Observatory to obtain an understanding of sediment depositional history in the vicinity of the Tappan Zee Bridge.
There are two parts to the LDEO effort: sub-bottom or seismic profiling and side scan sonar surficial profiling.
Sediment contamination is expected to be closely correlated with industrial-era deposition.



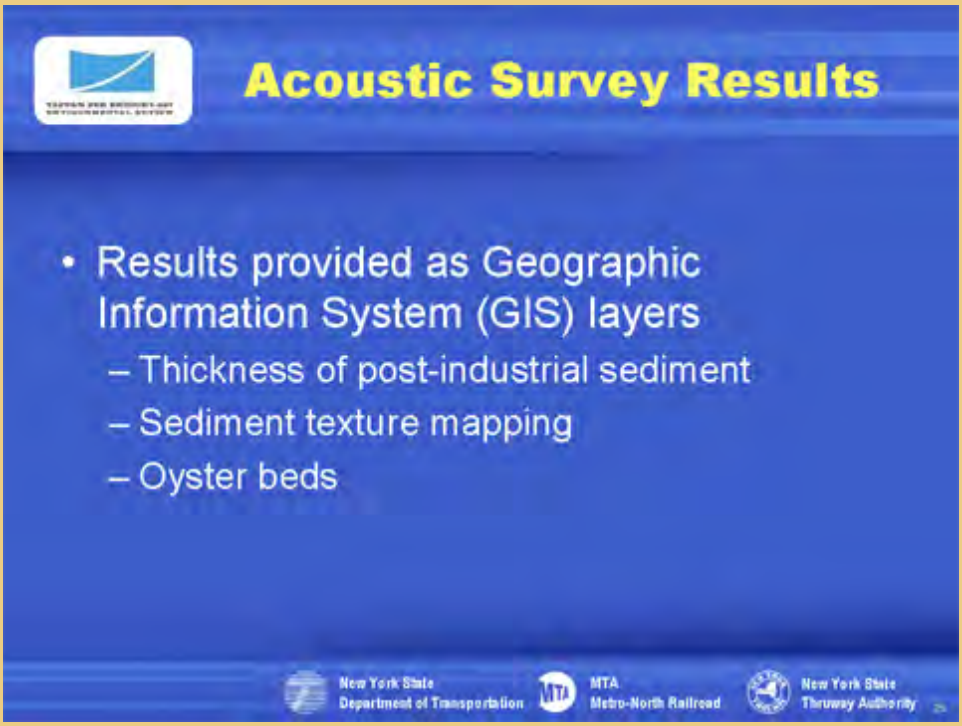
This illustration of the output of a typical sub-bottom profiling scan, and highlights the estimated boundary between recent and historic sediment deposits.



Side scan SONAR is used to establish surficial sediment types based on the strength of a reflected acoustic signal. Sands and gravels exhibit strong acoustic signal reflections while silts and clays do not reflect such signals well.
The side-scan and sub-bottom survey data were combined with data obtained from archived Hudson River sediment cores. Since lead is a good indicator of the depth of recent or industrial era deposits, LDEO scanned the sediment cores with an X-ray fluorescent detector to determine their lead (Pb) profile.



This side scan SONAR map of the vicinity of the Tappan Zee Bridge shows areas of high reflectivity (areas where surficial sediments are relatively coarse) and areas of low reflectivity (fine grained sediments).



Results of the side scan SONAR and sub-bottom profiling surveys were mapped to show thickness of recent or industrial era sediment deposits. The maps also showed locations of features such as historic oyster beds.