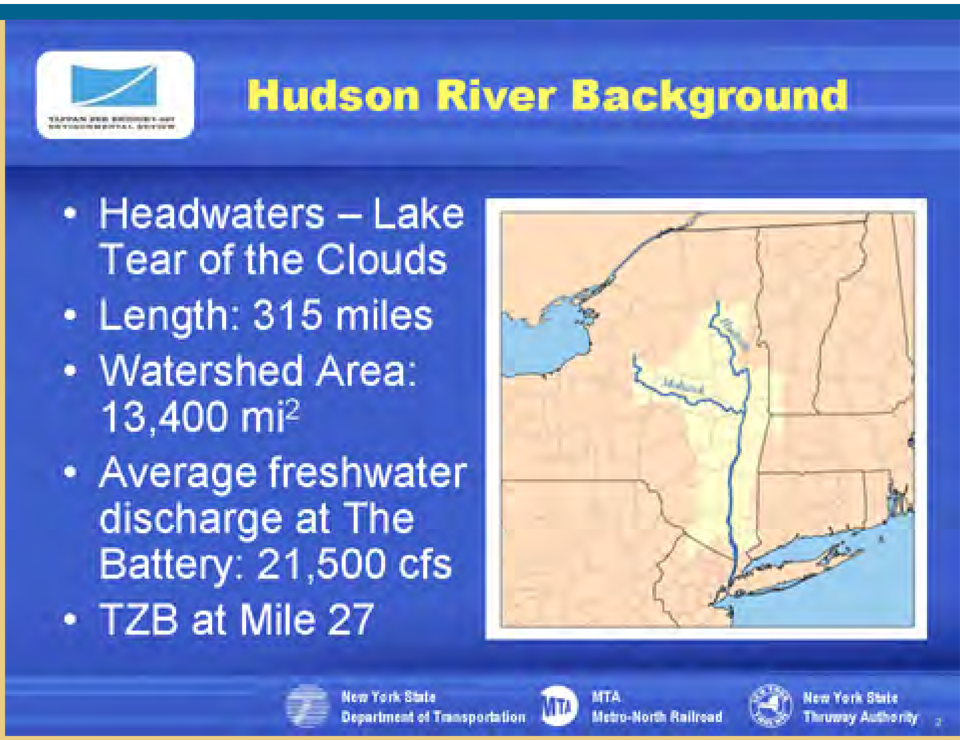
Stakeholders' Advisory Working Group Environmental Group Meeting #4, October 18, 2007

The Environmental SAWG meeting #4 was held on October 18th, 2007 at Power Authority in White Plains, NY. View minutes of the meeting here (PDF, 25 KB).

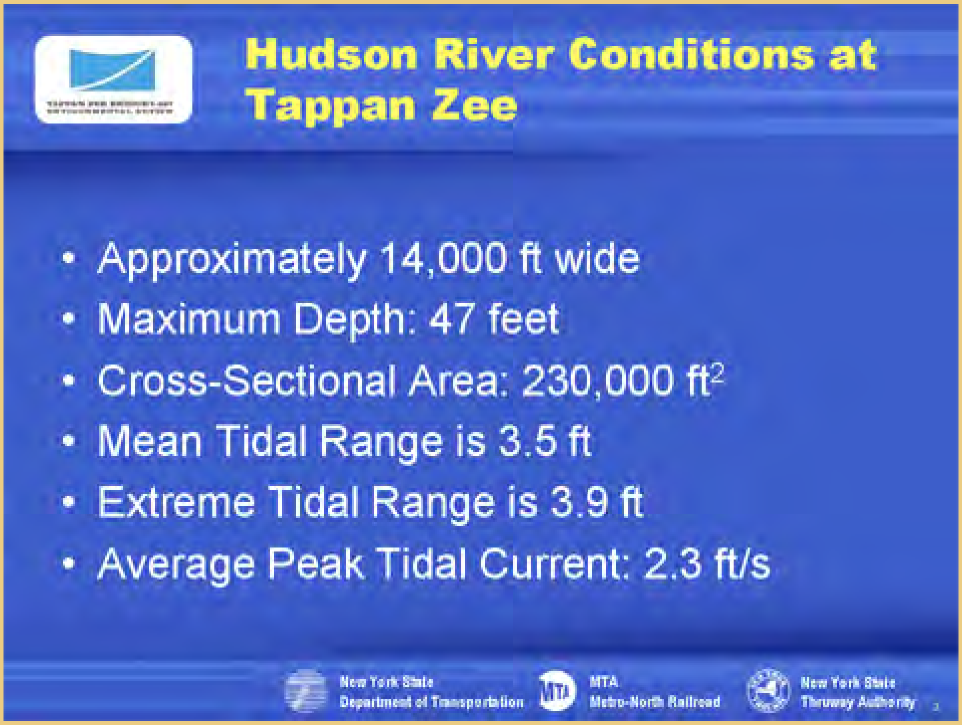
The presentation can be viewed in the following formats:

- PDF format (1.05MB)
- View the slides below with text narration

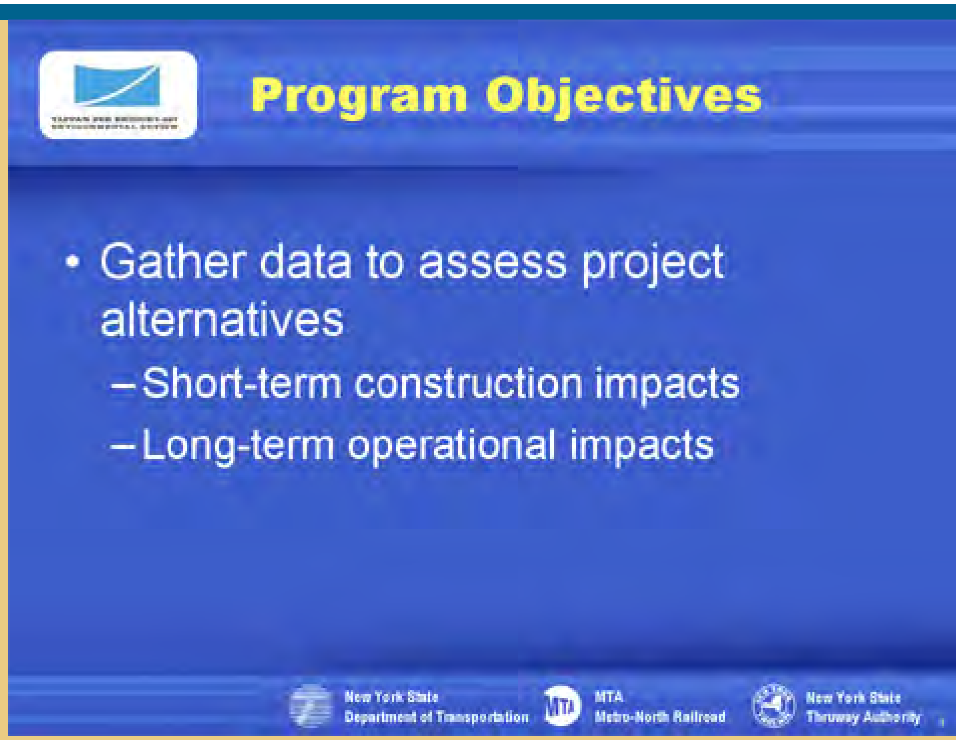
Title Slide.



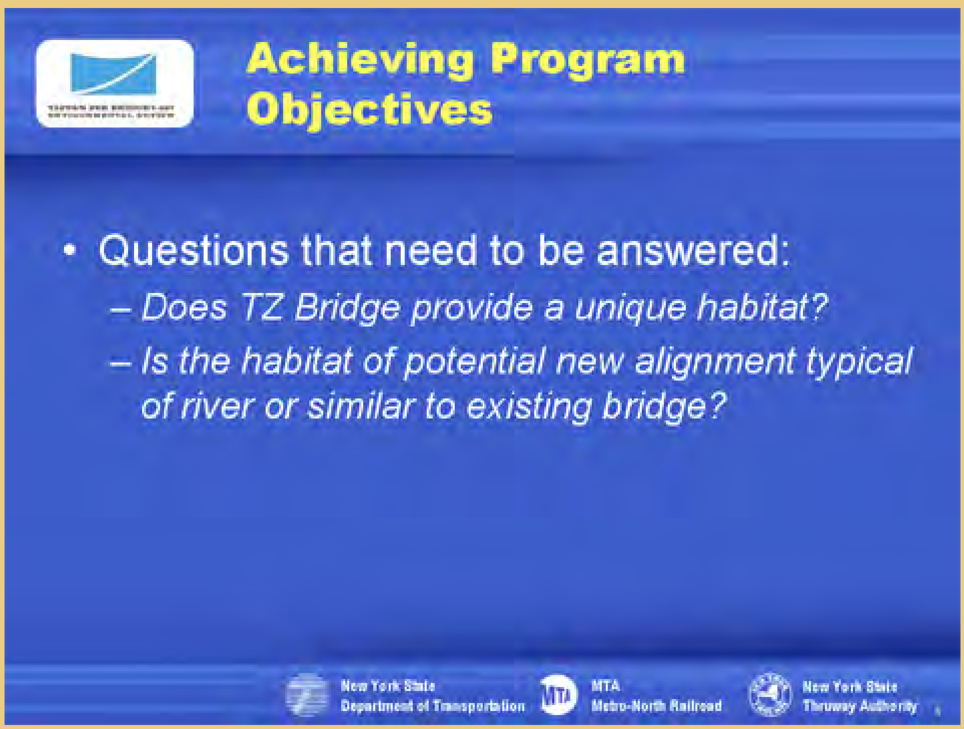
The Hudson River is 315 miles long, with a watershed area of 13,400 miles squared and average discharge flow at The Battery of 21,500 cfs.
The illustration shows the geographic extent of the Hudson River drainage basin. Below the dam at Troy, the Hudson River is technically an estuary since it is tidal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



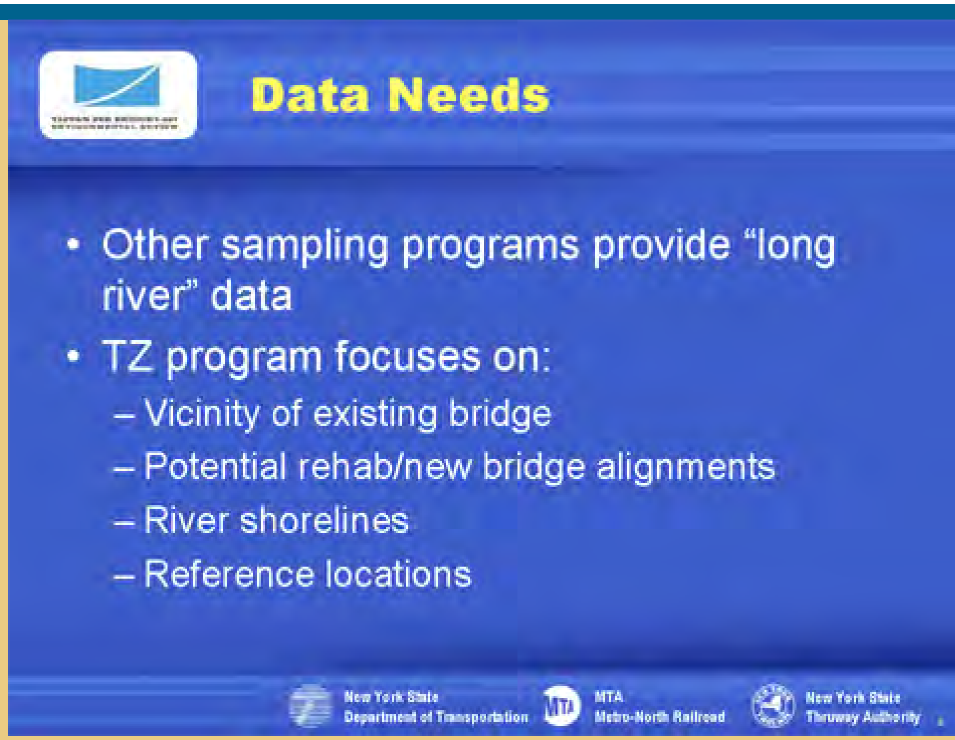
Statistics for the Hudson River at the Tappan Zee Bridge, including depth, width, cross sectional area, and tidal range.



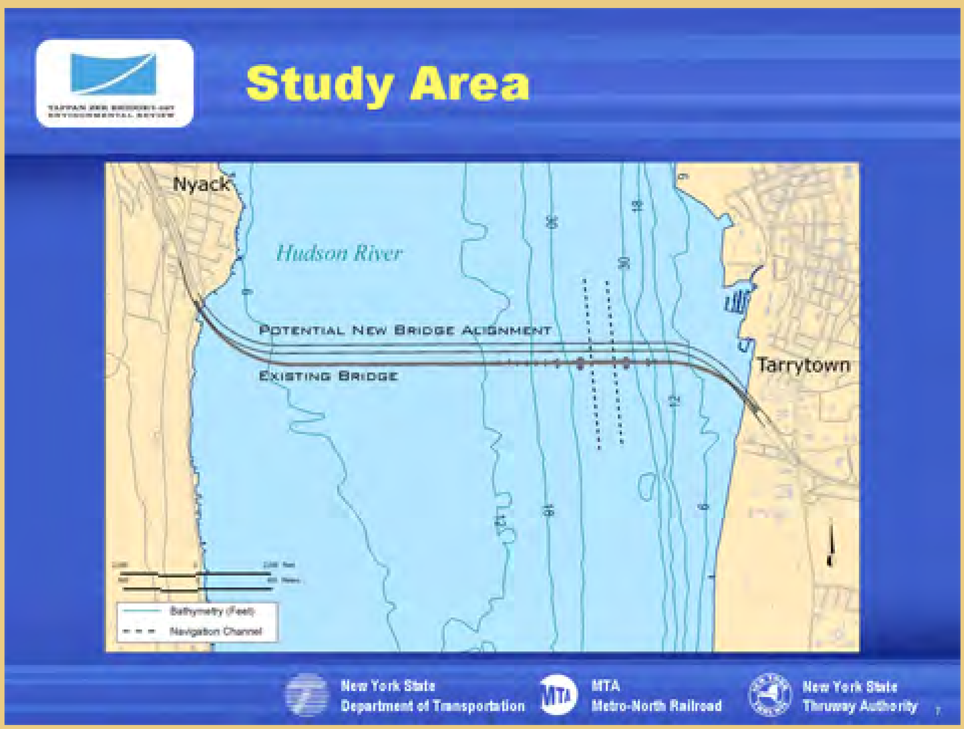
The Hudson River program is part of the overall environmental effort being undertaken for the study. One of the objectives of the program is to assess the impact of potential construction; another is to assess long-term operation implications.



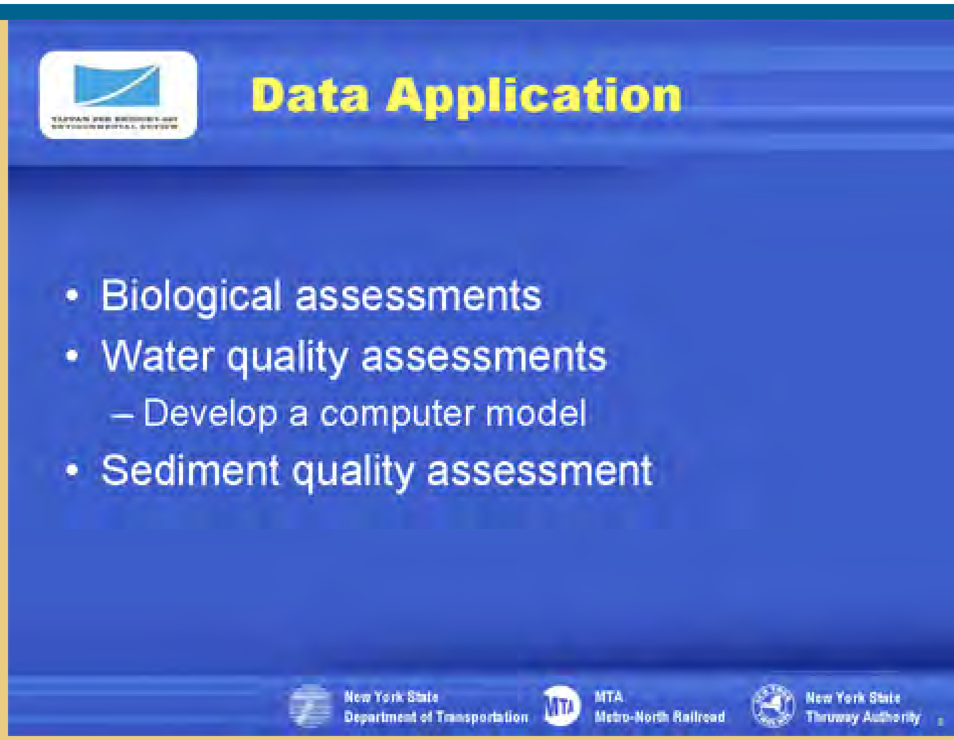
The Hudson River program is expected to address whether the existing bridge provides a unique habitat for aquatic species and if the habitat along potential new bridge alignments is typical of river conditions or comparable to that in the existing bridge vicinity.



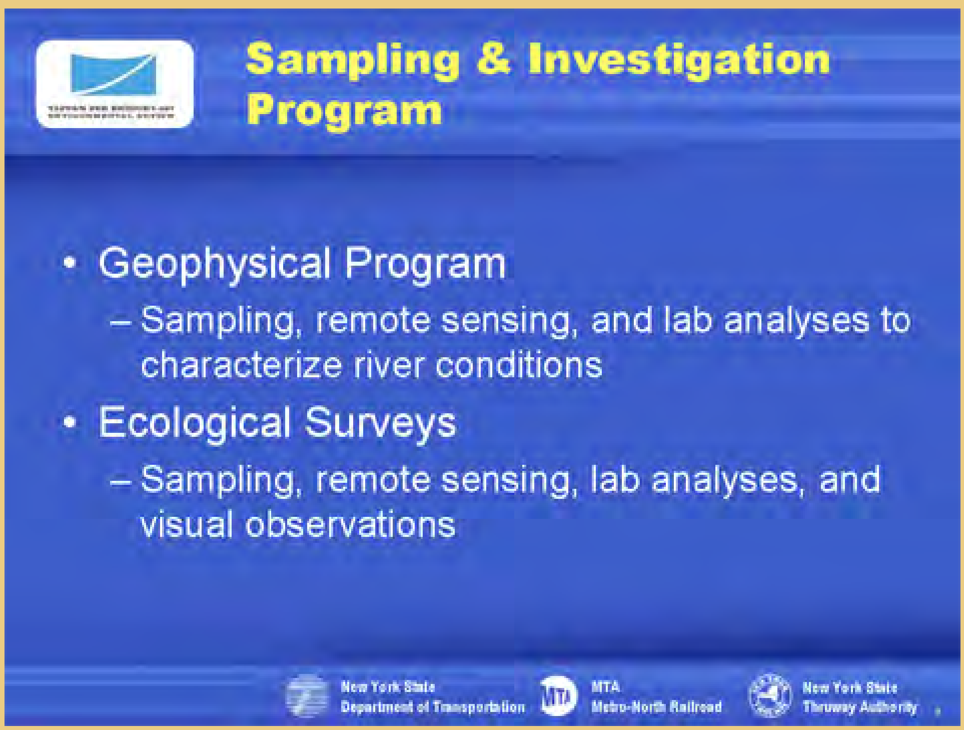
To address these questions, data-gathering efforts are concentrated near the existing bridge and along the potential alignments of new bridges. Data is also collected near the river shorelines and at several reference locations.



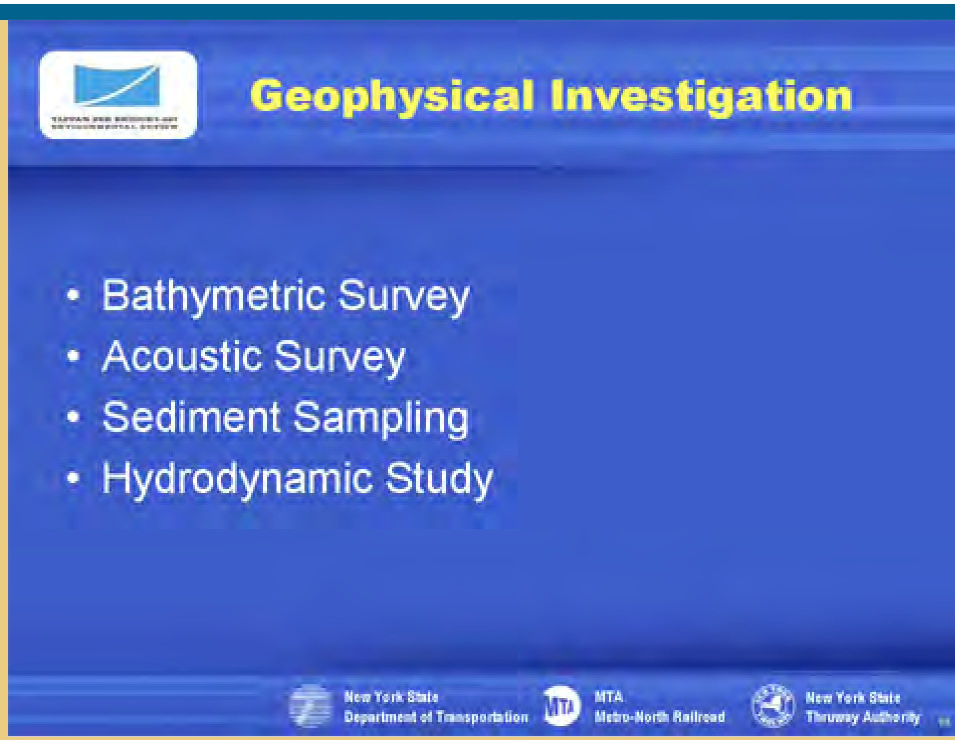
The existing bridge alignment and a potential alignment of a new bridge.



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

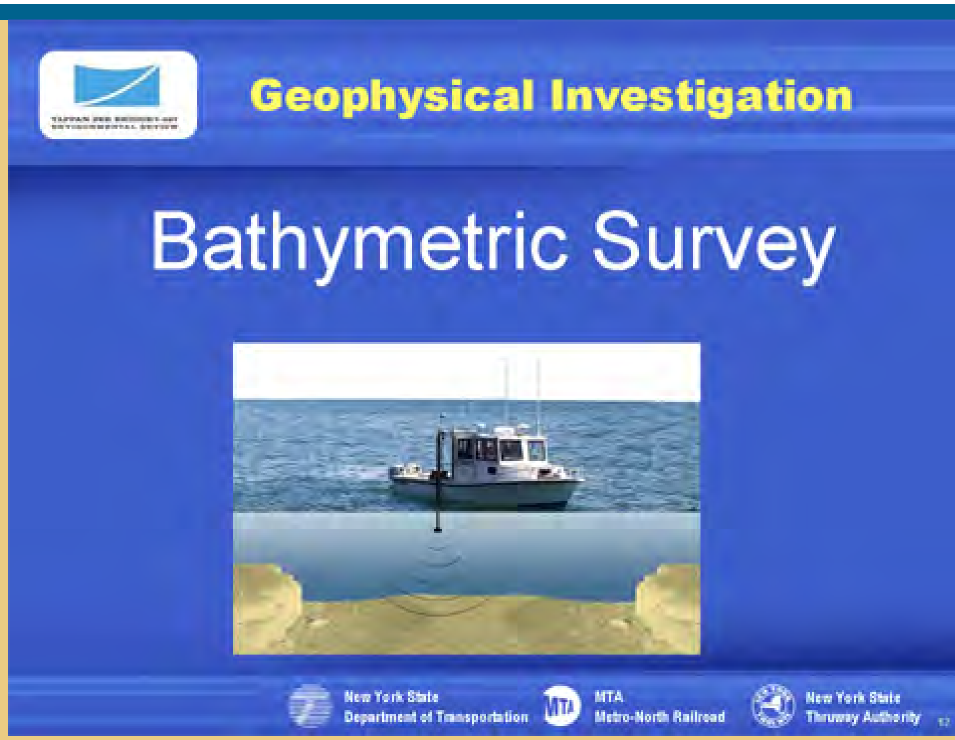


The sampling program was divided into two principal sections: geophysical/ hydrodynamic, and ecological.

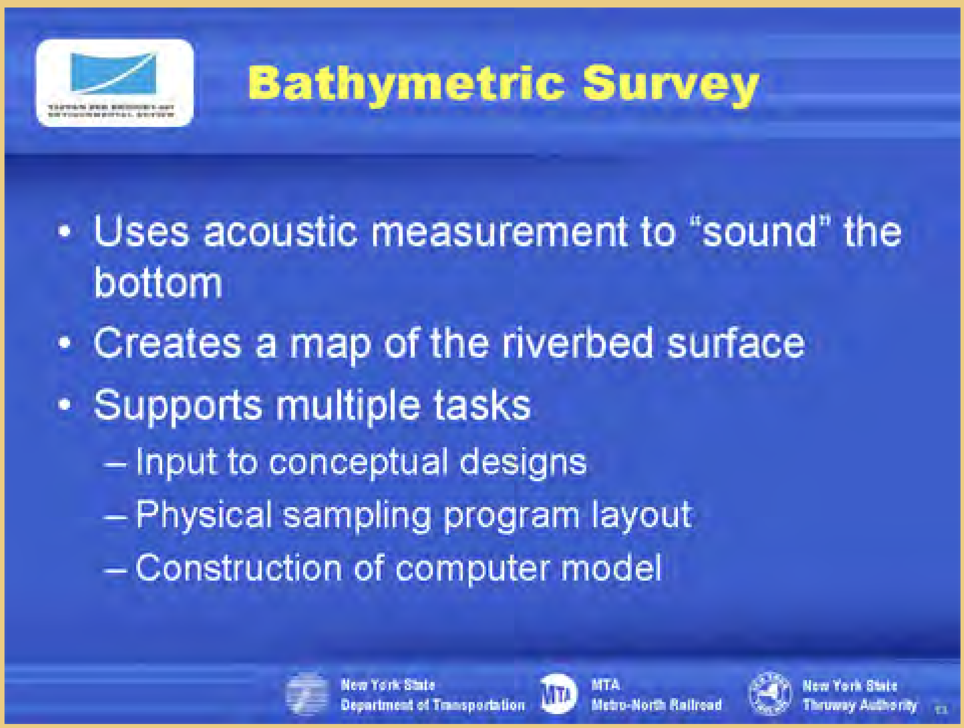


This presentation focuses on the geophysical and hydrodynamic aspects of the Hudson River program and looks at bathymetric surveys, acoustic surveys, sediment sampling, and hydrodynamic investigations.

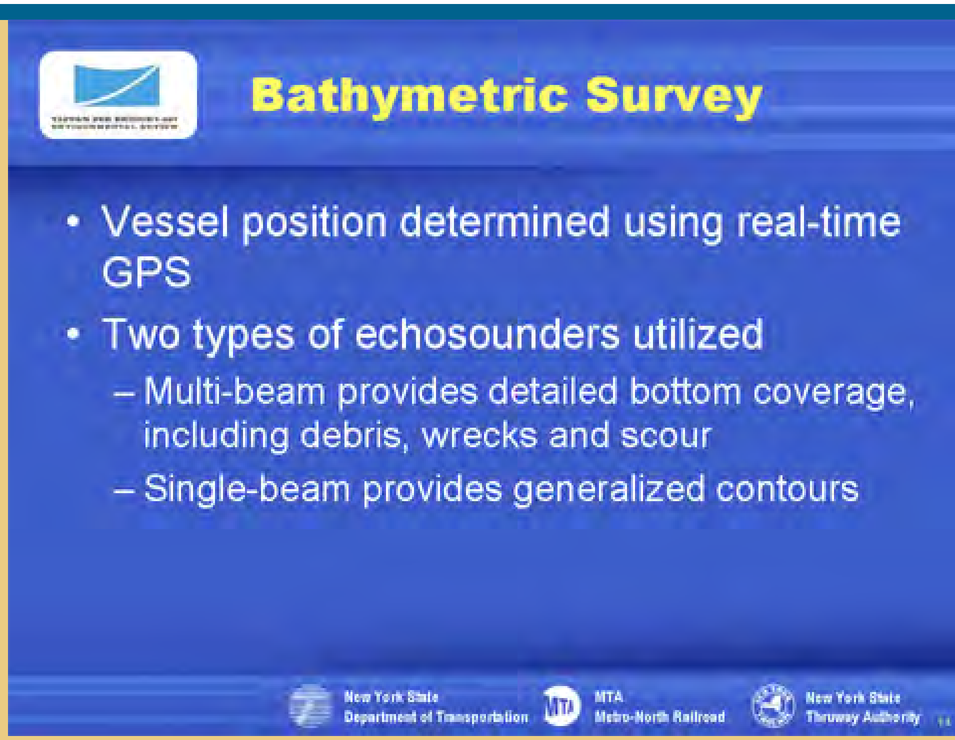
This cross section of the river illustrates geological conditions at the site of the Tappan Zee Bridge. The upper layer of material consists of organic soils, which are of principal interest from the perspective of assessing environmental impacts.



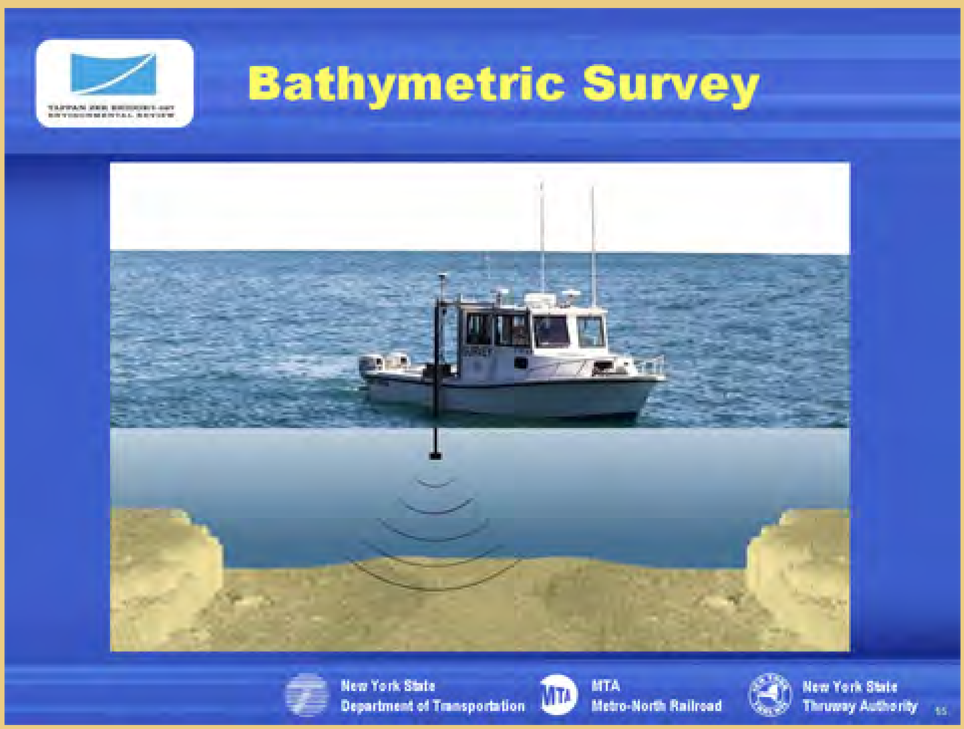
A typical vessel used to conduct a bathymetric survey. Bathymetric surveys measure the depths of a body of water.



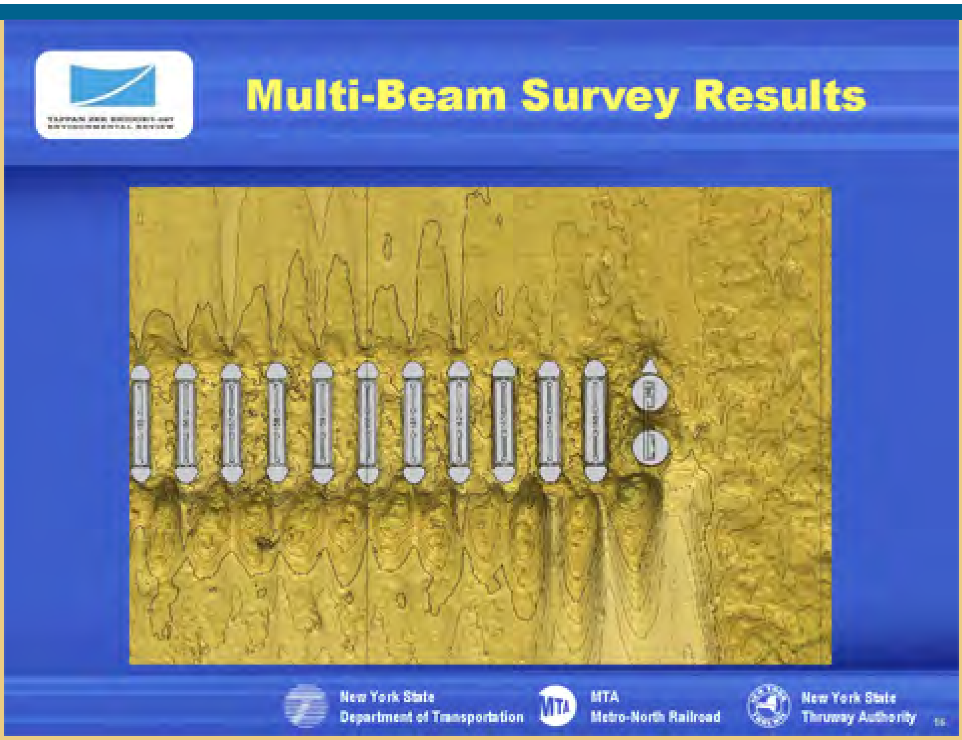
To measure the depth of the river, we used an acoustic system that "sounded" the river bottom. The result is a map of the river bottom. The bathymetric data will serve as input to bridge conceptual designs, assist with the layout of ecological and geophysical sampling programs, and will also provide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



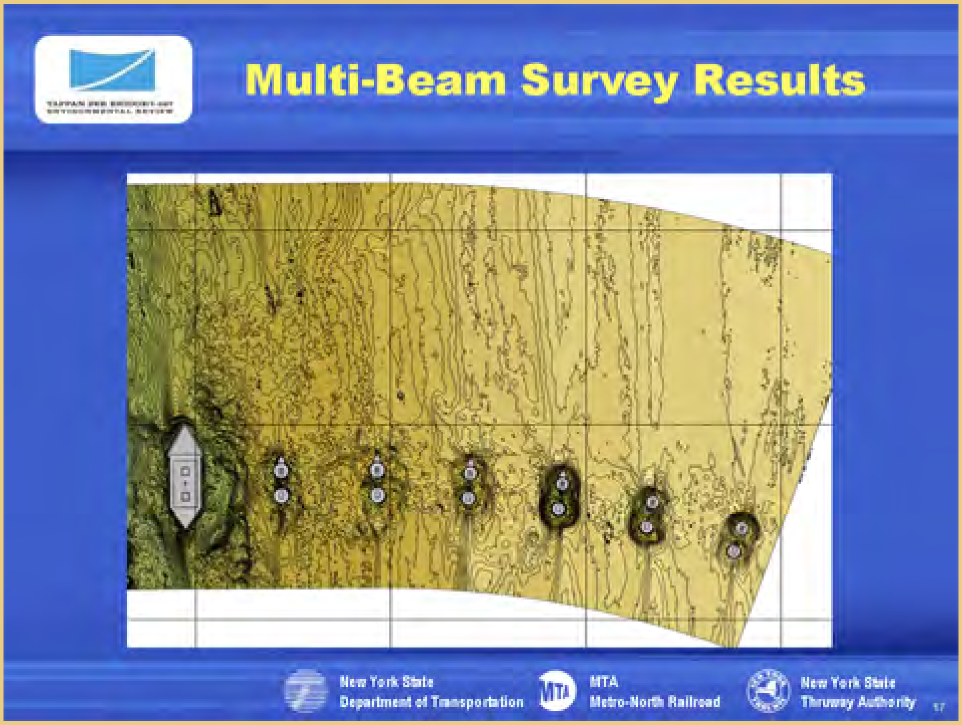
Two types of acoustic systems were used to generate bathymetric maps for the Hudson River program: a multi-beam survey, which was used to generate very detailed maps in the immediate bridge vicinity, and a single beam survey system, which generated maps in the far field.



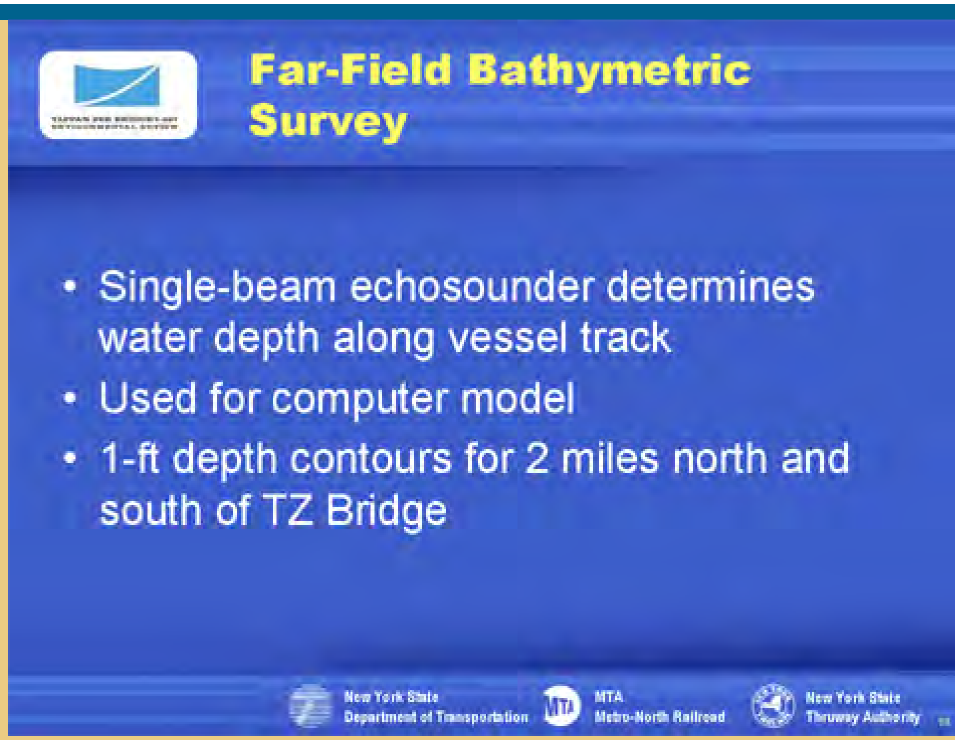
A typical survey vessel has antennae that receive GPS signals from satellites and shore-based stations. An acoustic sounder is mounted off the side of the survey vessel.



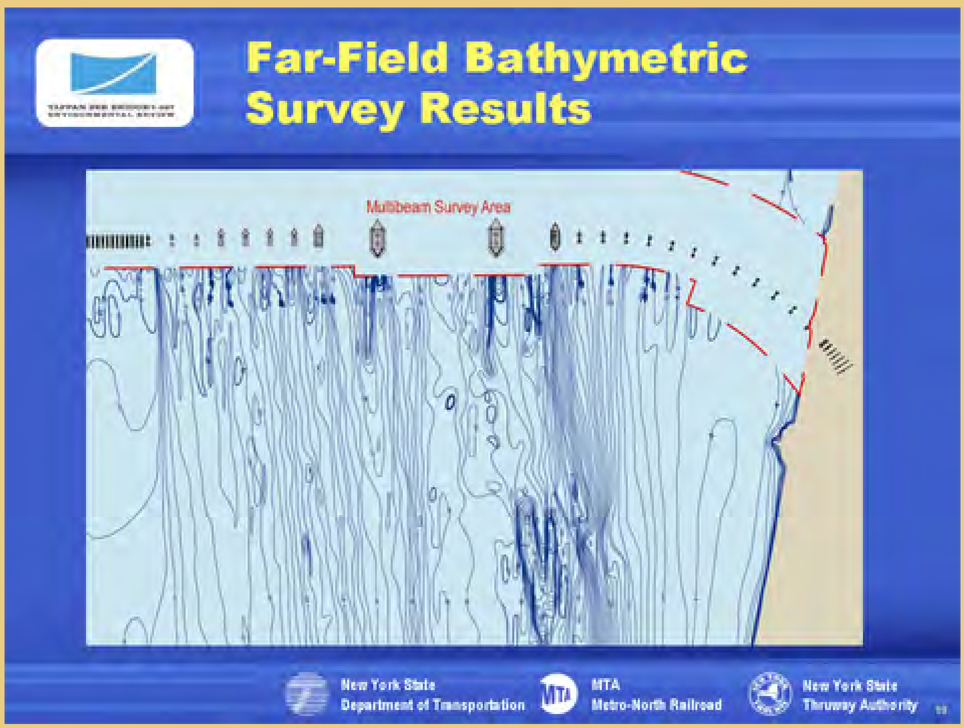
Scour maps due to river flows are clearly visible on this map, which illustrates typical results of the highly detailed multi-beam survey conducted in the immediate bridge vicinity.



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

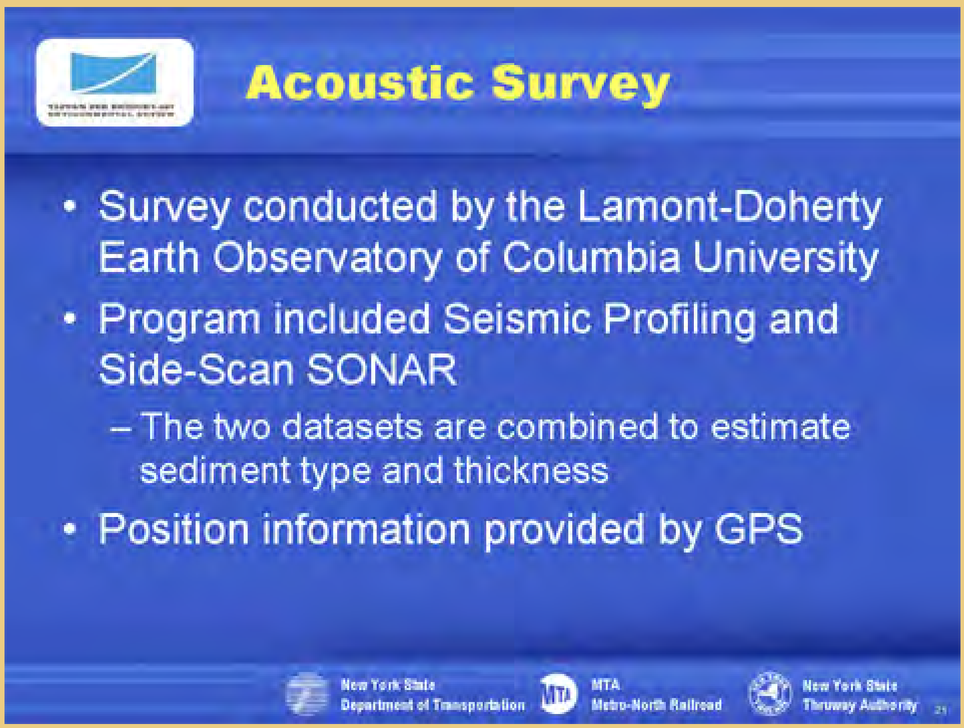


Far-field bathymetric surveys mapped the depths of the Hudson River from two miles above to two miles below the Tappan Zee Bridge.

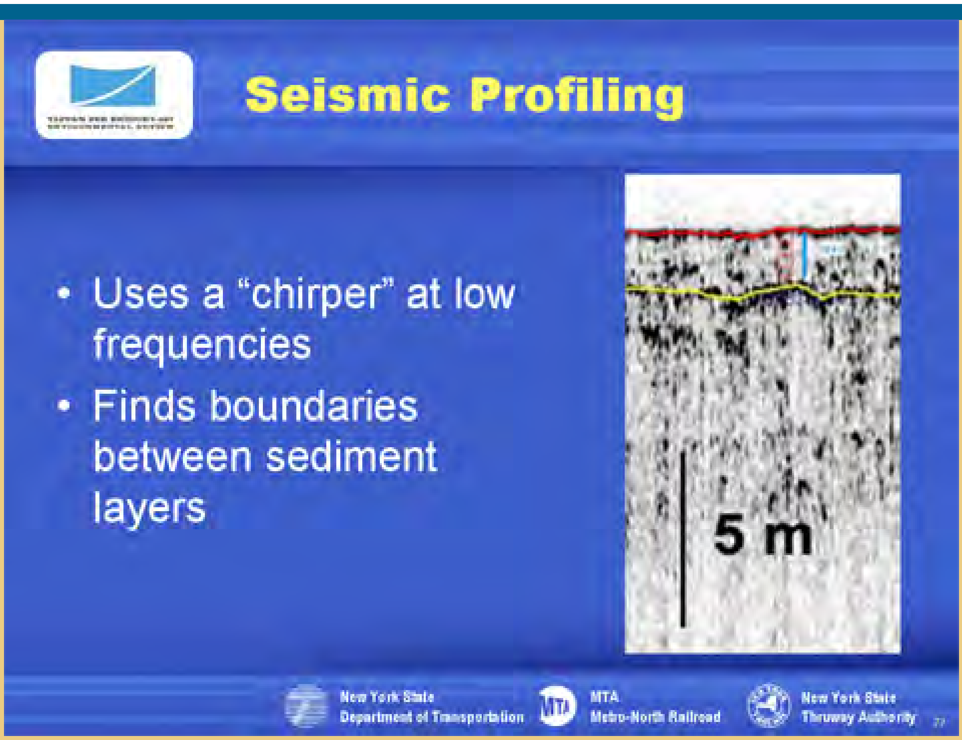


This typical far field, single beam bathymetric map is clearly less detailed than maps generated from the multi-beam survey system.

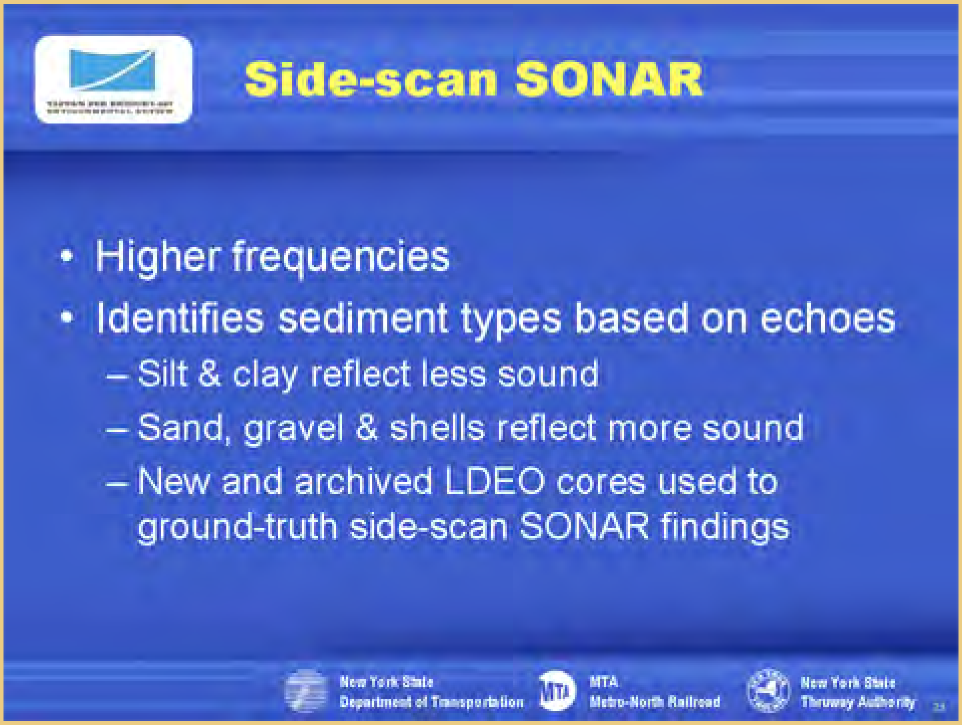
This part of the presentation focuses on the study's acoustic profiling effort.



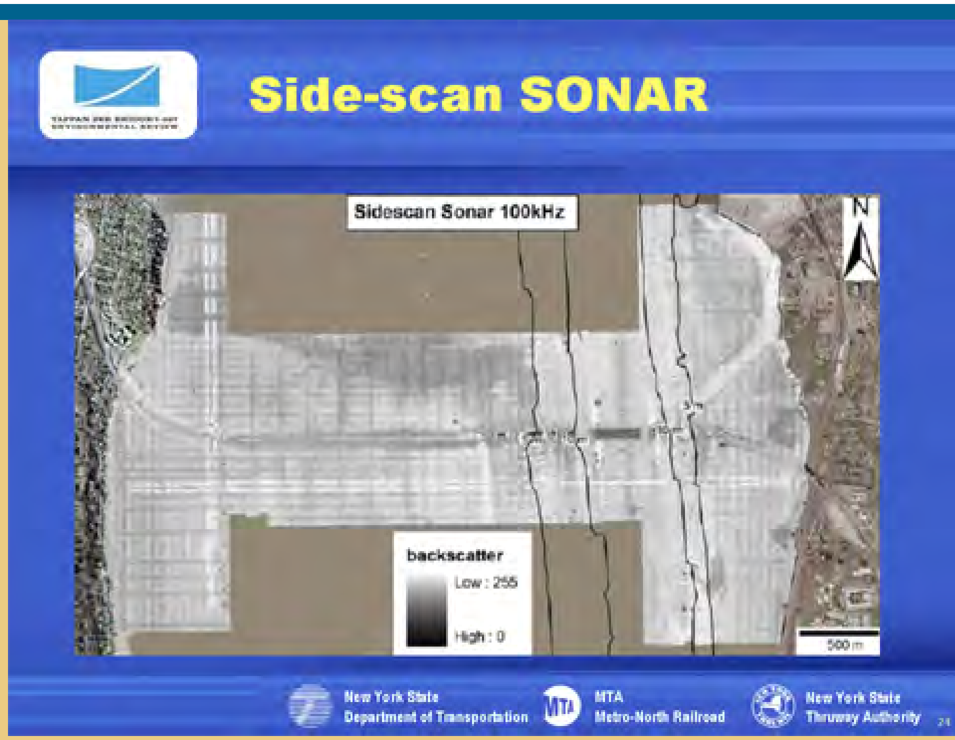
The acoustic profiling surveys were conducted by Lamont Doherty Earth Observatory to obtain an understanding of sediment depositional history in the vicinity of the Tappan Zee Bridge.
There are two parts to the LDEO effort: sub-bottom or seismic profiling and side scan sonar surficial profiling.
Sediment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



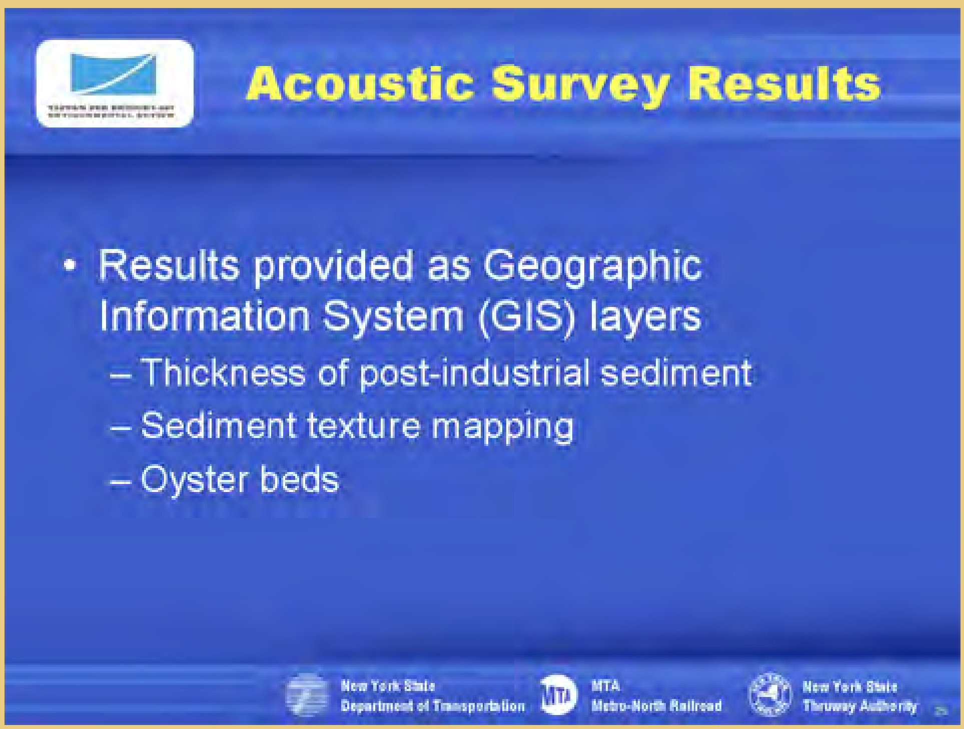
This illustration of the output of a typical sub-bottom profiling scan, and highlights the estimated boundary between recent and historic sediment deposits.



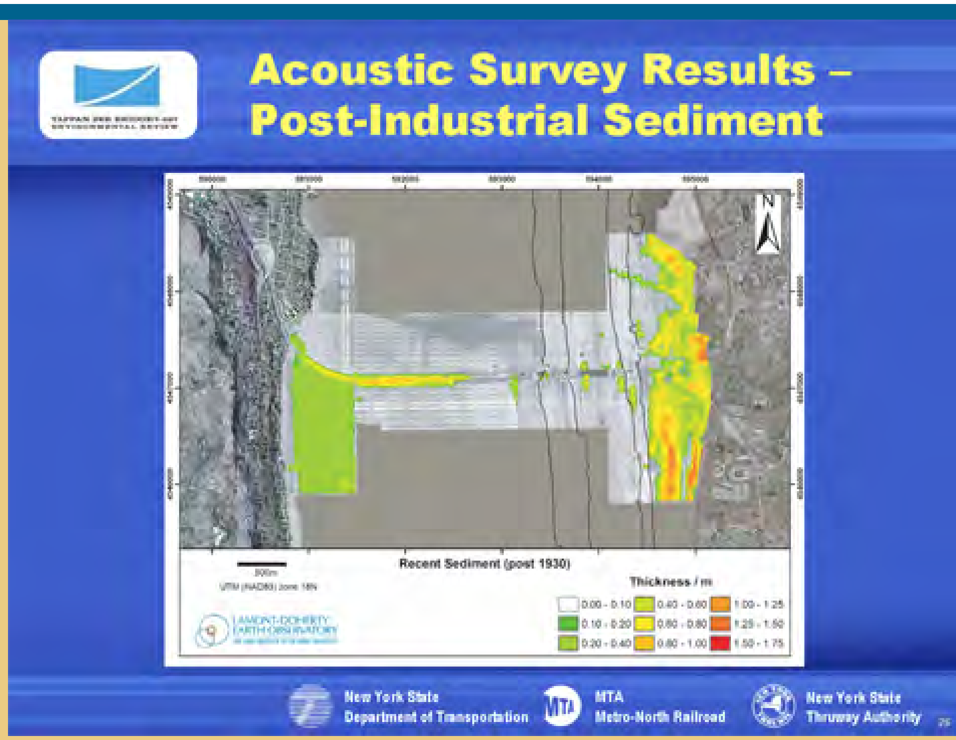
Side scan SONAR is used to establish surficial sediment types based on the strength of a reflected acoustic signal. Sands and gravels exhibit strong acoustic signal reflections while silts and clays do not reflect such signals well.
The side-scan and sub-bottom survey data were combined with data obtained 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.



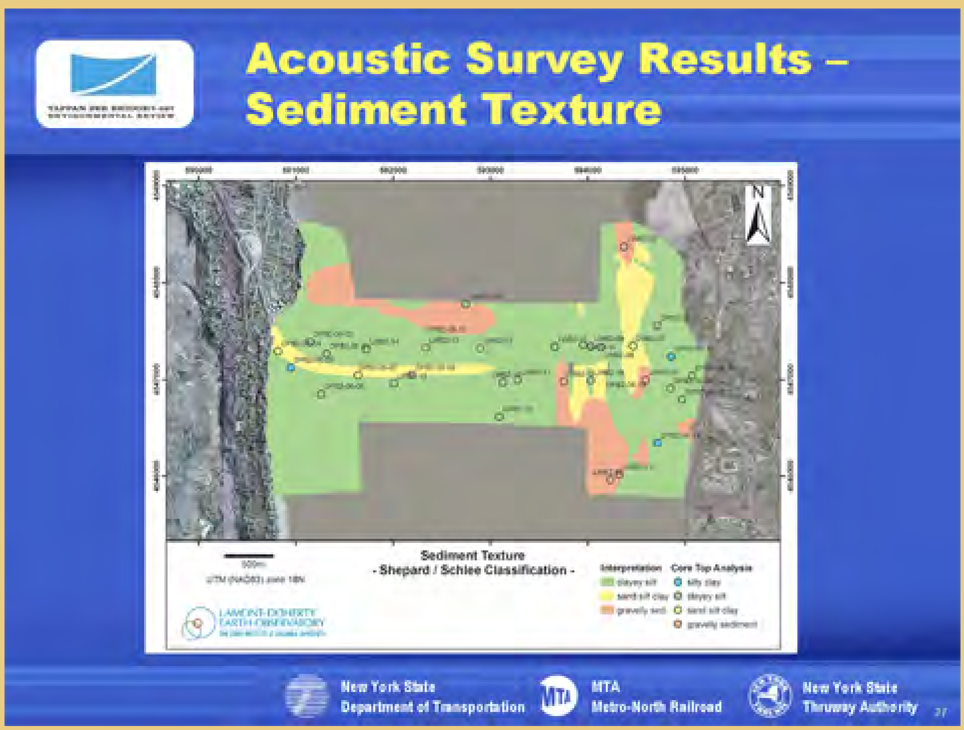
This side scan SONAR map of the vicinity of the Tappan Zee Bridge shows areas of high reflectivity (areas where surficial sediments are relatively coarse) and areas of low reflectivity (fine grained sediments).



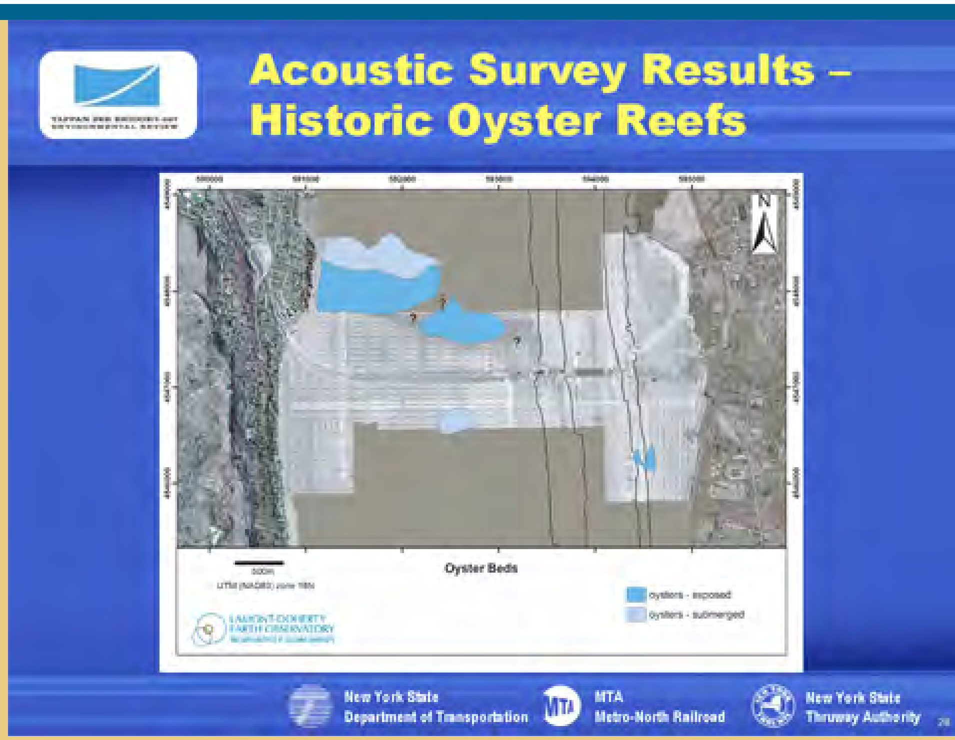
Results of the side scan SONAR and sub-bottom profiling surveys were mapped to show thickness of recent or industrial era sediment deposits. The maps also showed locations of features such as historic oyster beds.



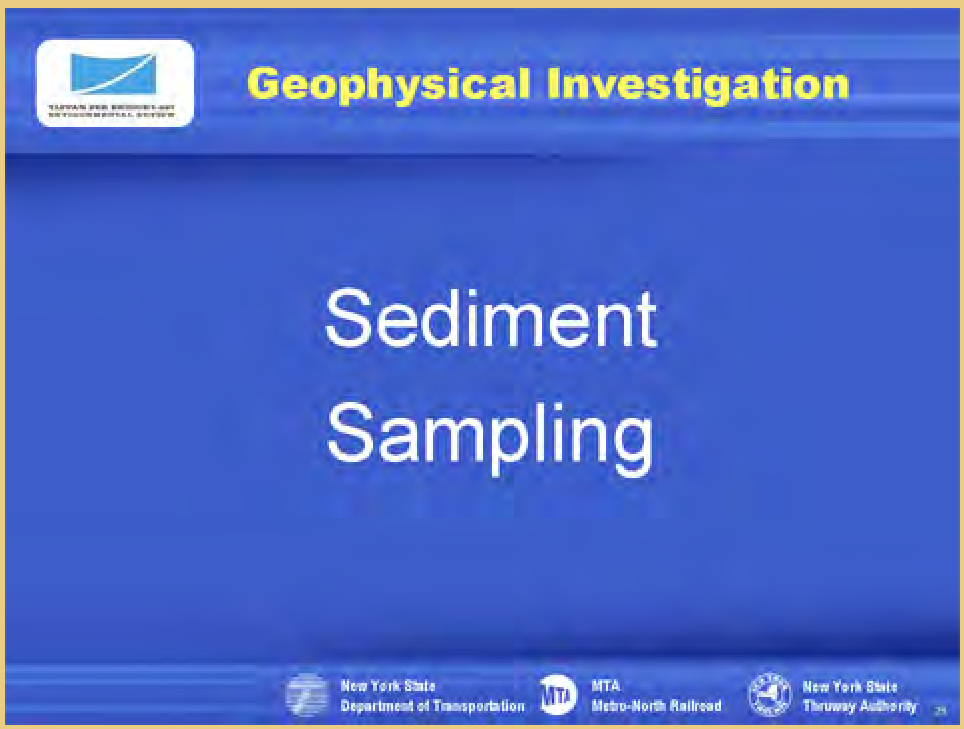
The estimated depth of recent sediment deposits in the Tappan Zee Bridge vicinity shows relatively thin (less than one foot thickness) deposits along the west shoreline area. Recent sediment deposits along the existing bridge alignment also are thin. Thicker, industrial era deposits occur on the east side of the river near Tarrytown. These deposits can be accounted for by streams discharging into the Hudson and also as a result of dredging activity.



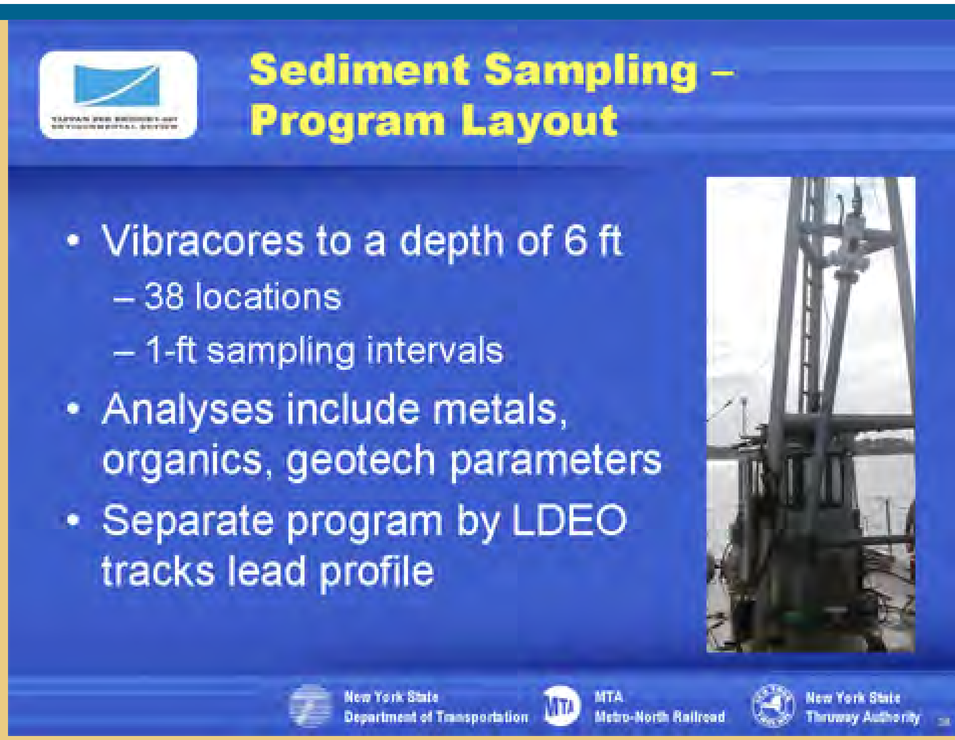
Illustrated here are surficial sediment texture classes, in the Bridge vicinity, as determined by the LDEO side scan SONAR survey and verified by a series of sediment samples taken by LDEO.



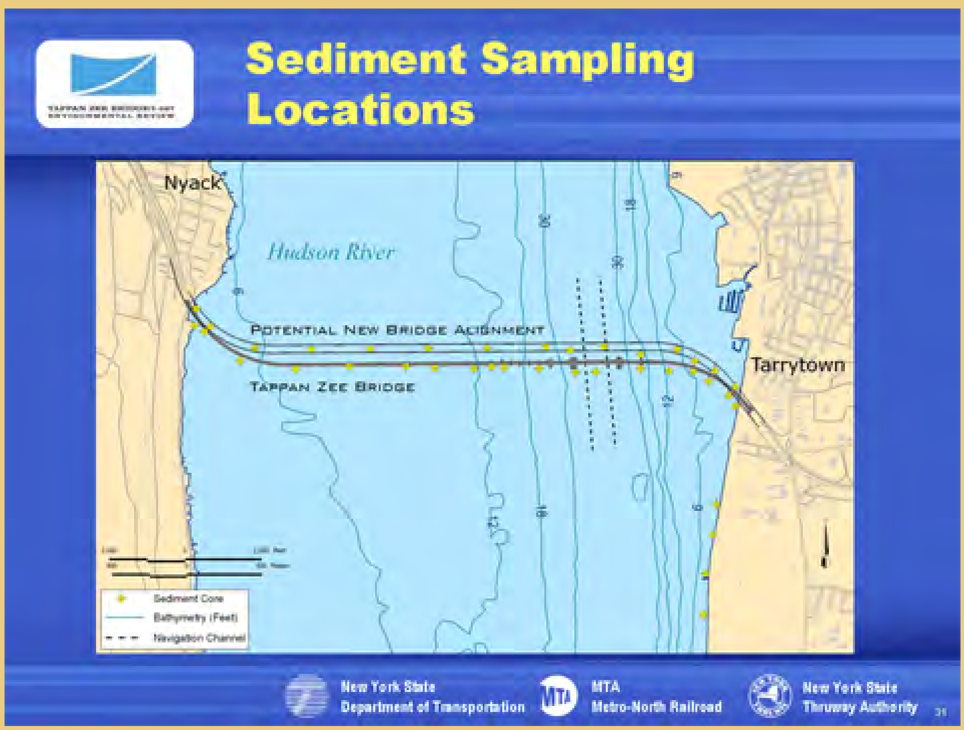
Location of historic oyster beds situated both north and south of the existing bridge.



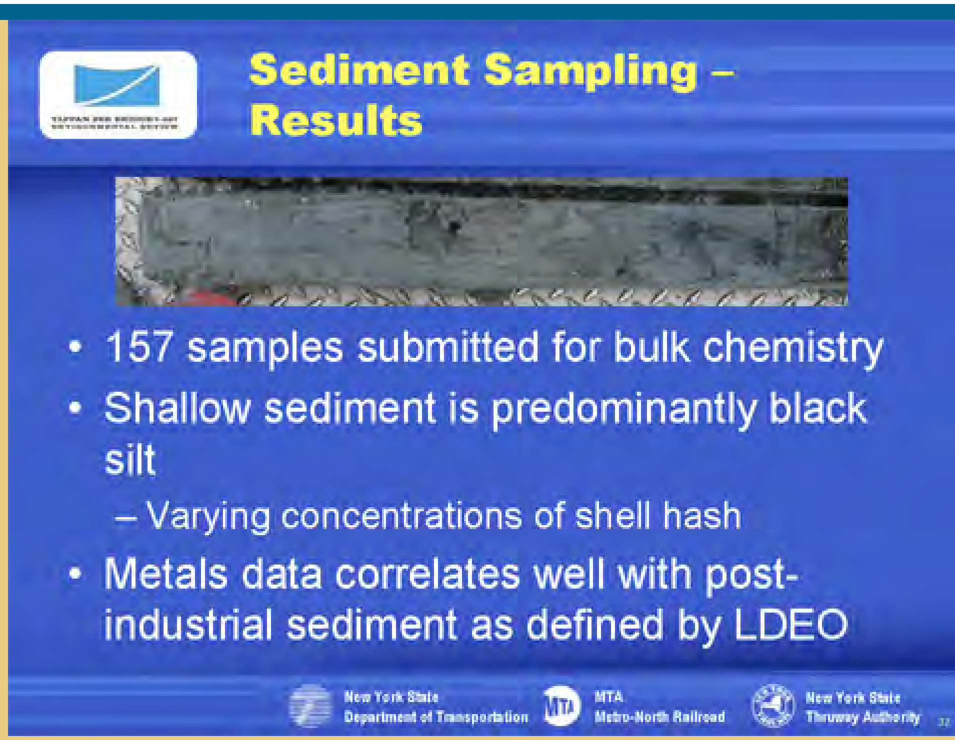
This section of the presentation focuses on sediment sampling and chemical analysis.



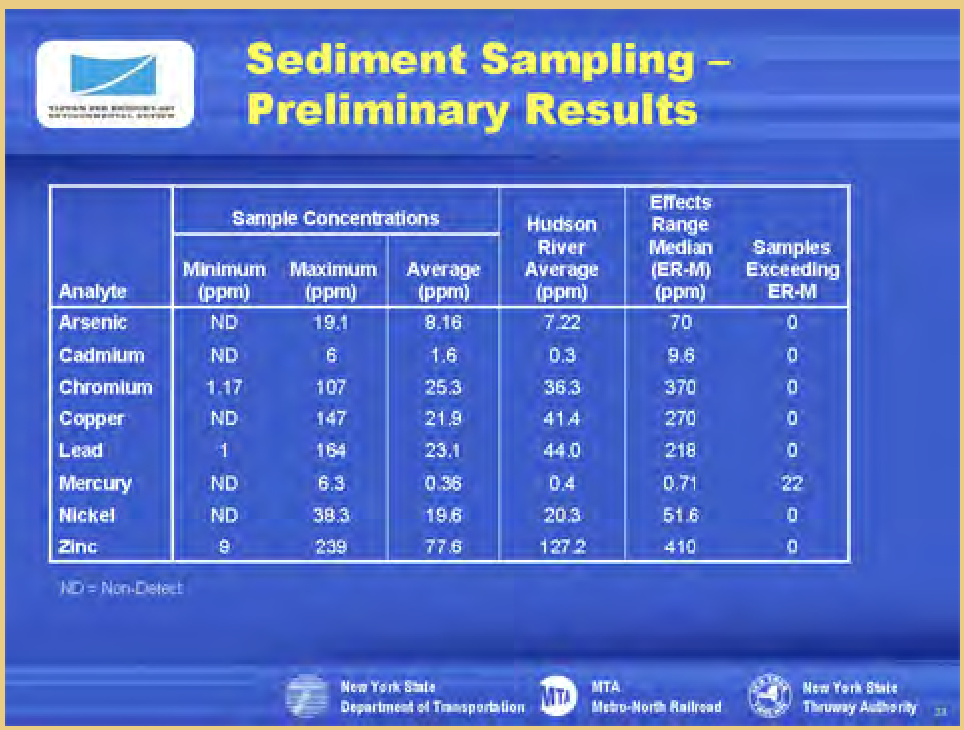
Sediment samples were obtained at 38 locations along the alignment of the existing bridge and along the potential alignment of a new bridge (samples obtained near the existing bridge are sufficient for the evaluation of the rehabilitation alternative). The chemical analyses were for metals, organics and geotechnical parameters.



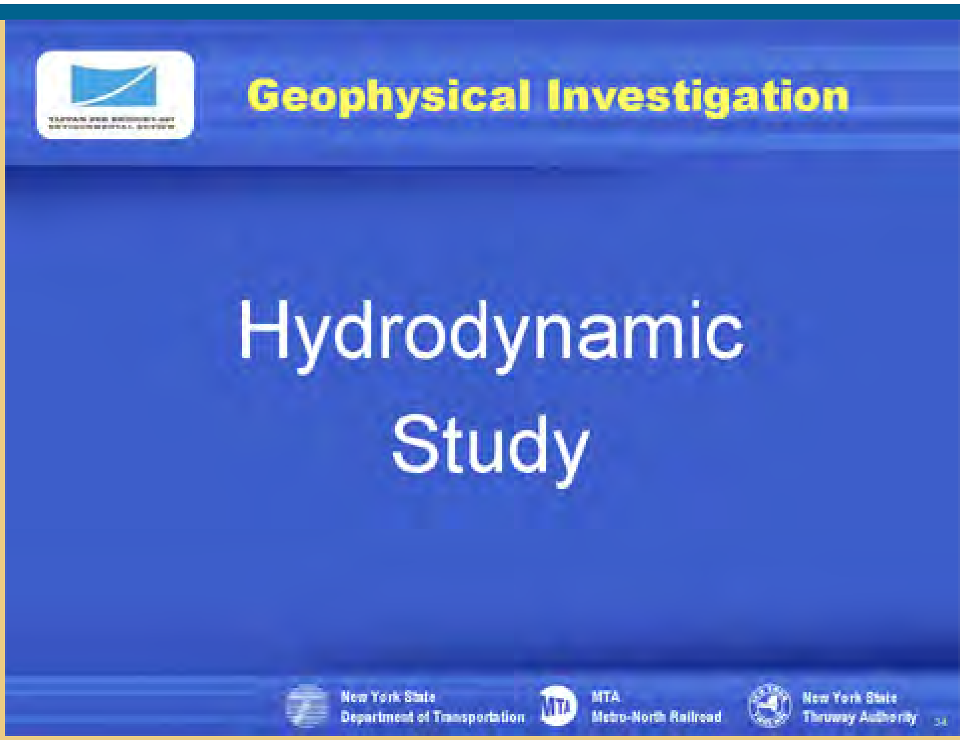
Locations where samples of sediment were taken.



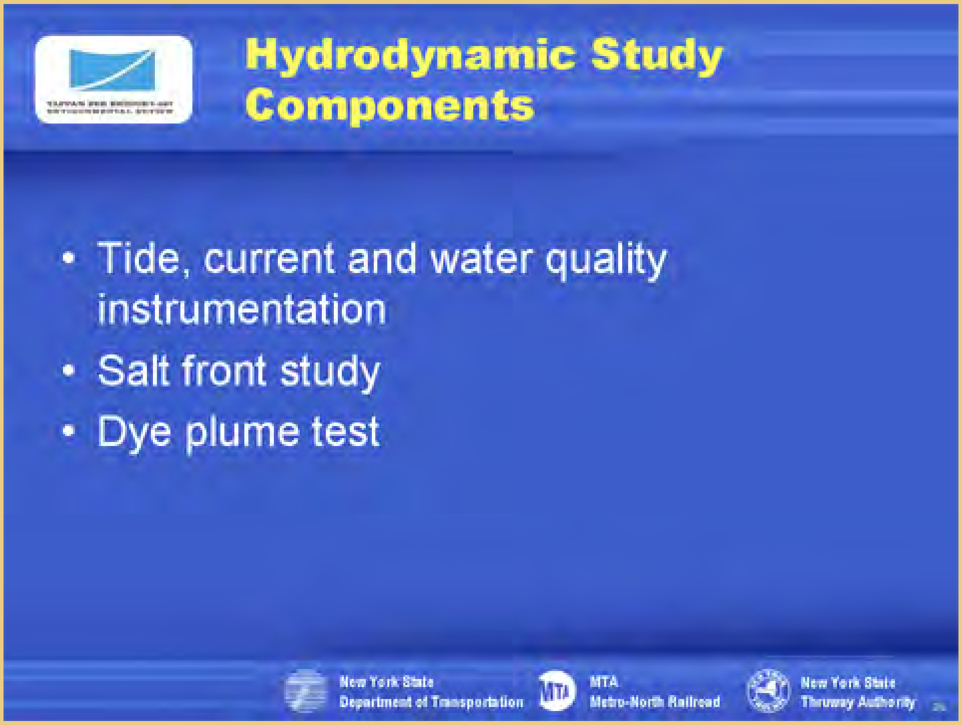
A typical sediment sample retrieved by vibra-coring methods.
157 one-foot-long sediment samples were generated from the 38 cores collected near the Tappan Zee Bridge. These samples were sent for laboratory analysis.



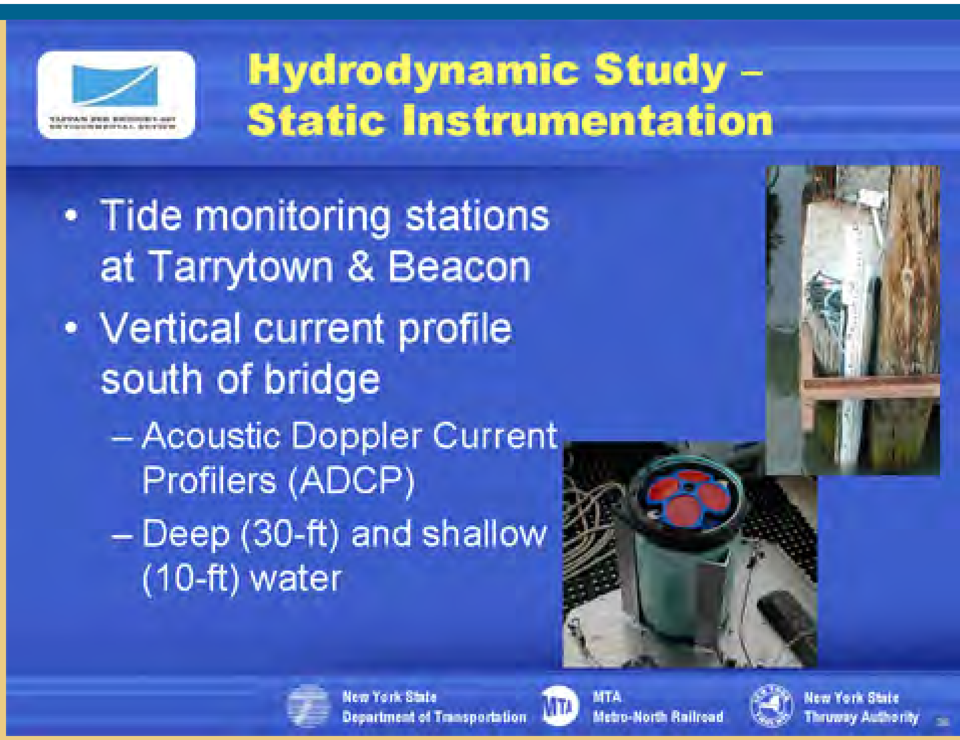
Results of the laboratory analyses of heavy metals.
This table shows the maximum and minimum concentrations of heavy metals found in Tappan Zee Bridge sediment samples. The heavy metal concentrations in the Bridge samples are compared to other Hudson River sediment samples and found to be generally similar.
In addition, the table compares the Tappan Zee Bridge samples to the NYSDEC ER-M values. The bridge samples do not exceed the ER-M values except for mercury levels in a fraction of the samples.



This slide introduces the hydrodynamic studies conducted in the Hudson River.

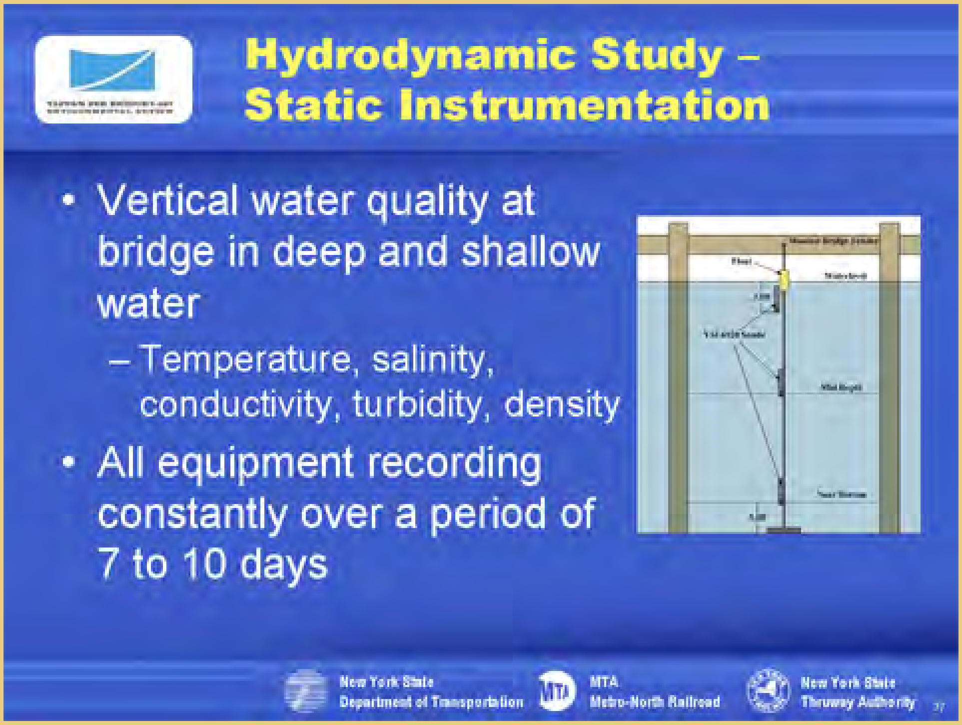


The hydrodynamic studies included tide-current-water quality measurements, a salt front study, and a dye plume test. The purpose of the program was to obtain data for calibration of a multi-dimensional hydrodynamic model that will be used to assess the impacts of bridge construction.

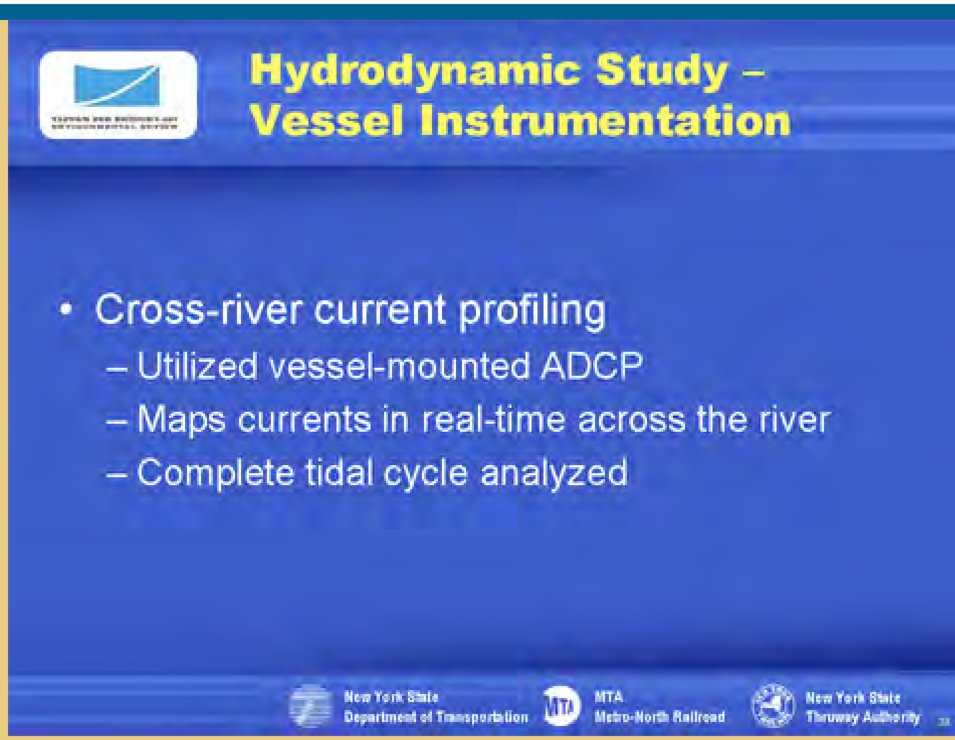


This hydrodynamic survey program relied heavily on the use of acoustic Doppler Current Profilers (ADCP) for data acquisition. The ADCP is a sophisticated and expensive instrument that measures water velocities across a column of moving water.

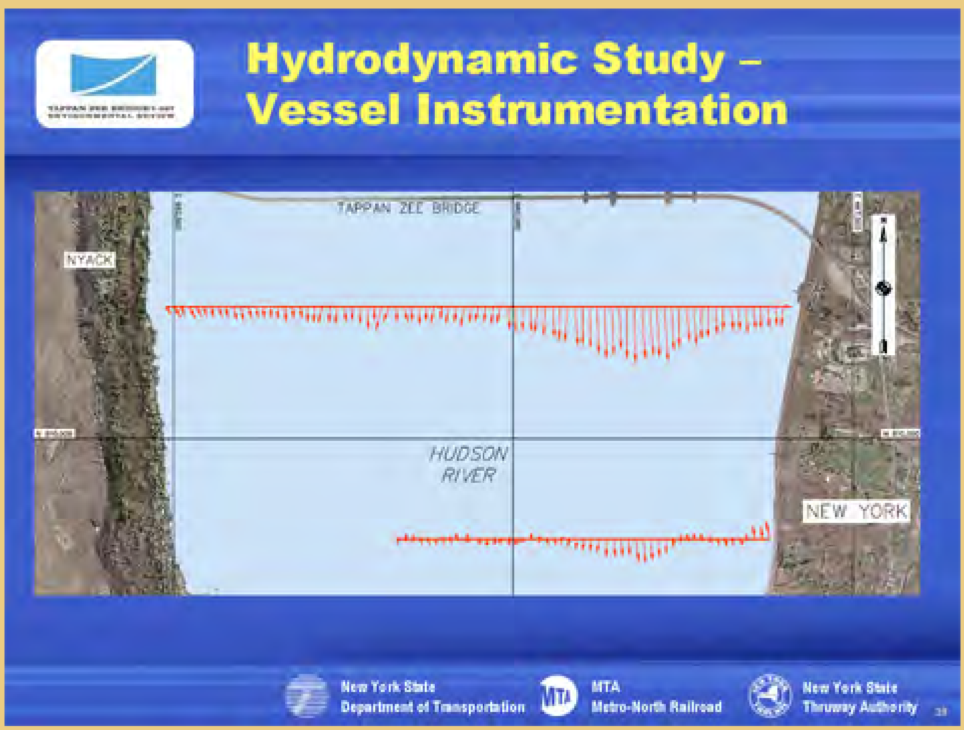
Two fixed station ADCPs were employed near the TZ Bridge: one in a deeper section of the river and one in shallower water.



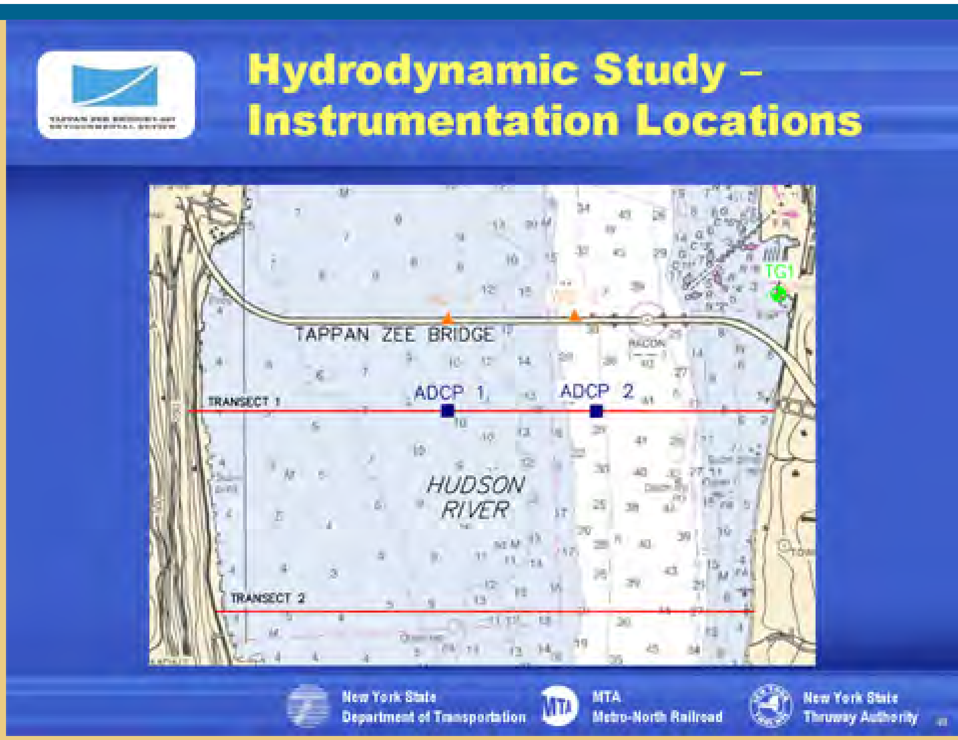
Fixed water quality sensors also were place in the river in deep and shallow water. The parameters measured included temperature, salinity, conductivity, turbidity, and density. All fixed station equipment recorded continuously for 7 to 10 days.



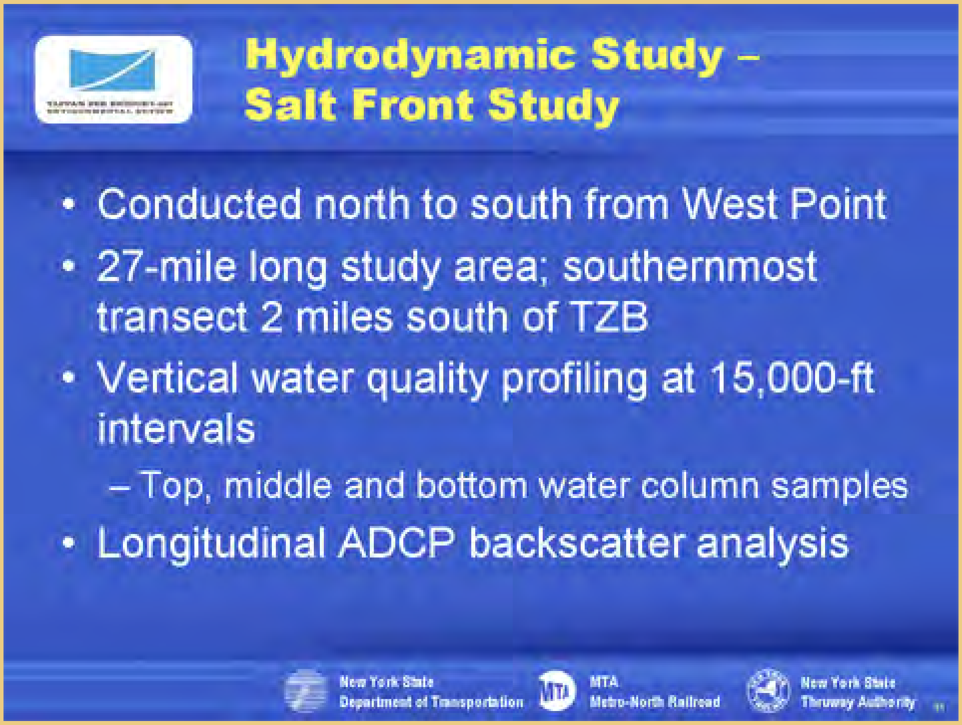
A vessel-mounted ADCP also was employed and mapped currents in real time across the river during a complete tidal cycle.



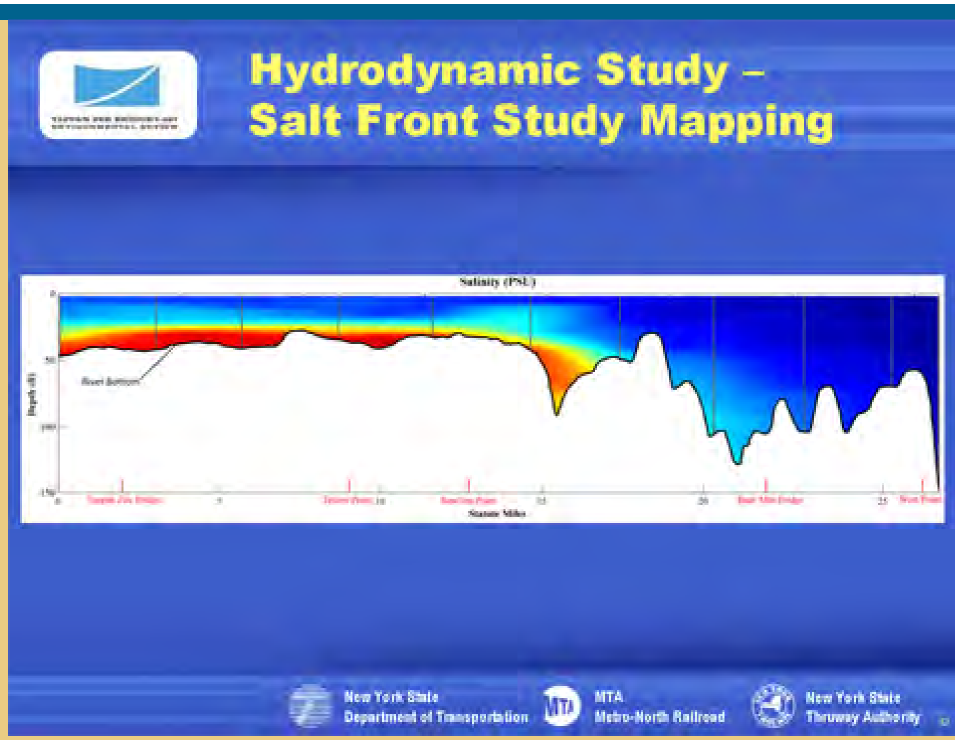
This typical image generated by the vessel-mounted ADCP shows that currents are strongest in the center channel and weakest near the river shorelines as would be expected.



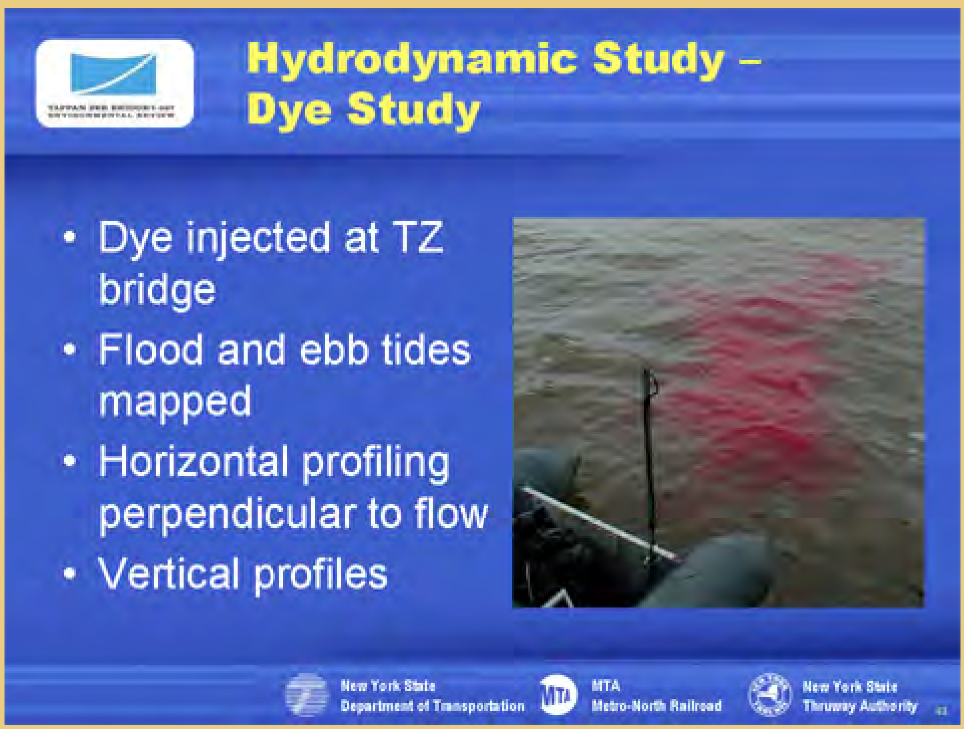
This slide shows where the fixed station ADCPs were located and the location of the transects followed by the vessel-mounted ADCP.



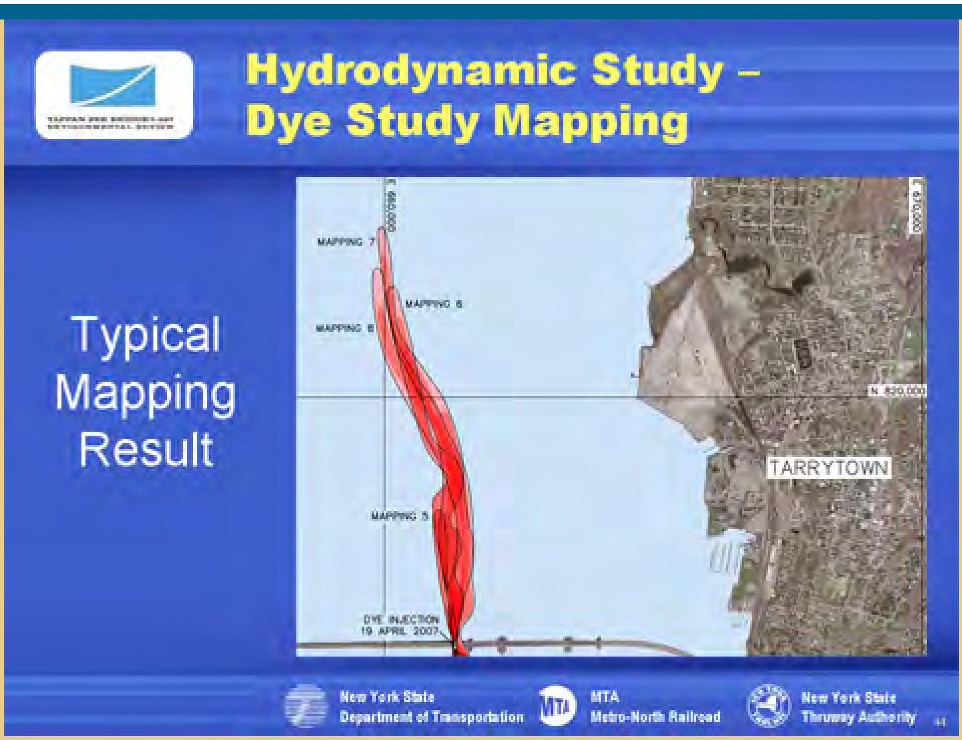
A salt front study also was undertaken using vessel-mounted equipment. The study ranged from West Point to 2 miles south of the Tappan Zee Bridge. Water quality samples were taken at three depths at discrete stations along the longitudinal axis of the river. A vessel-mounted ADCP was also employed as part of this survey.



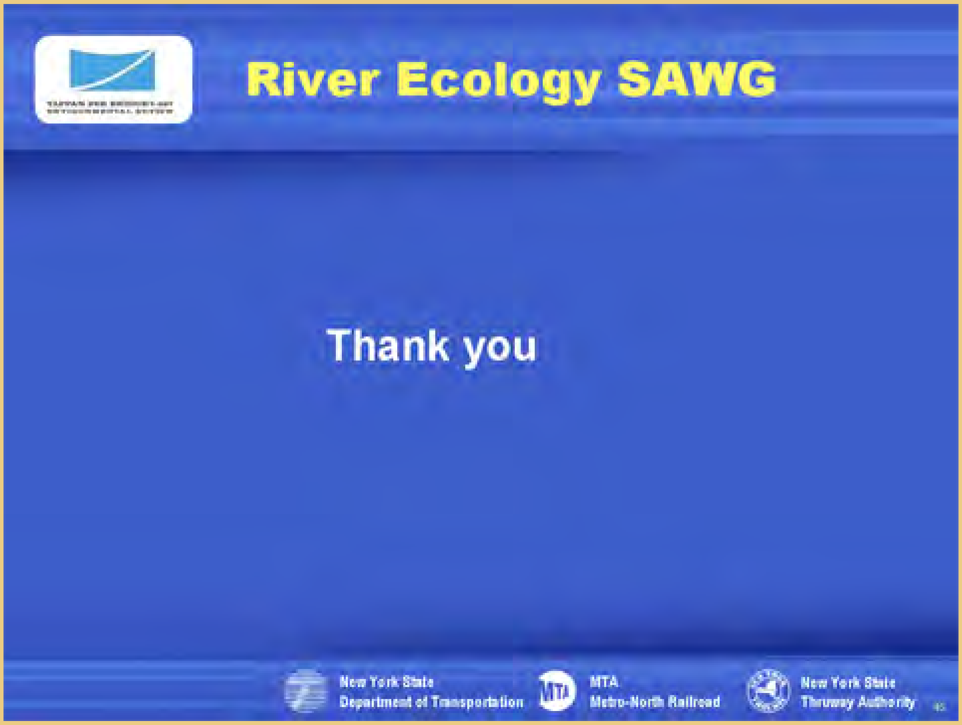
The position of the salt front, as measured during the salt front survey, shows that the salt front did not penetrate up-river beyond approximately mile point 43. The stratification between dense salt water and freshwater was highly discernible in the survey results.



The objective of the dye study whose was to provide further data for calibration of the multi-dimensional hydrodynamic mathematical model. Dye was injected into the river during both flood and ebb tidal conditions. Dye concentrations were then monitored over a period of hours to obtain an understanding of the dispersiveness of the Hudson River at the Tappan Zee Bridge.



The formation of the dye plume under incoming tide conditions.



Thank you!