CONSTRUCTION OF I-95 FORT McHENRY TUNNEL

Baltimore, Maryland

Maryland Department of Transportation

The Fort McHenry Tunnel

The largest project in the history of the National Interstate and Defense Highway program is underway in Baltimore's historic harbor. It was here, during the British attack on Fort McHenry in 1814, that Francis Scott Key wrote the words to the "Star Spangled Banner". A critical link to complete I-95 was needed across the harbor, but a bridge would adversely affect Fort McHenry and the Locust Point Community. Therefore, the City, the State, and the Federal governments, working together, have begun the 1.7 mile, eight lane Fort McHenry Tunnel under Baltimore's harbor.

Funding

The Federal Highway Administration will fund 90% of the cost of the tunnel and will advance the 10% local share to the City of Baltimore during the project's construction period. The Maryland Department of Transportation will repay the advance by operating the tunnel as a toll facility. The tunnel will become toll free after the local share is recovered.

The tunnel is estimated to cost $825 million and will be opened to traffic in 1985.

Design

The Tunnel was designed by the Joint Venture of Sverdrup & Parcel and Parsons, Quade, Brinckerhoff, & Douglas under the direction of the Interstate Division for Baltimore City (IDBC) and the Federal Highway Administration. The SPB Joint Venture included several subconsultant firms; Delon Hampton & Associates; Whitman, Requardt and Associates; Rummel, Klepper & Kahl; RTKL Associates, Inc.; Purdum & Jeschke; The Leon Bridges Company; and Ecological Analysts, Inc.

Construction Coordination

The design and construction of the tunnel is an engineering achievement which requires extraordinary planning and coordination of eleven construction contracts. The largest and most complex of these contracts is the construction and placement of the prefabricated steel shell tubes that form the major portion of the tunnel. Each stage of the construction process must be orchestrated precisely to keep the construction moving forward. Any one delay could have a ripple effect of expensive delays throughout later stages of the project.

Dredge Disposal Site

Construction of the Fort McHenry Tunnel began in the summer of 1980 with the dredge disposal site at Canton/Seagirt, one and one-half miles southeast of the tunnel. The disposal site has been enclosed by 5600 linear feet of cellular cofferdams, each 62 feet in diameter.

The disposal site is constructed so that it can be converted into a marine terminal in the future by others. The disposal site is ideally located near the main ship channel with direct highway access to I-95.

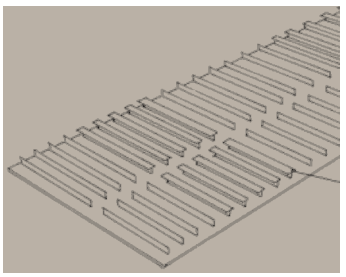
The hydraulic dredge is excavating a trench in the harbor bottom for the tunnel.

Dredging a Trench

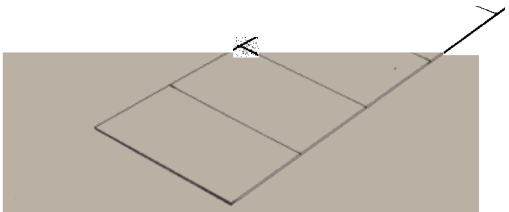
Operations to dredge a trench on the bottom of the harbor got underway in 1981. The trench, which is approximately 180 feet wide at the base and, in places, reaches a depth of 115 feet, should be completed by the summer of 1982. Trench excavation is being accomplished by a 27 inch hydraulic dredge, working somewhat like a vacuum cleaner. Dredged material, in a fluid state, is transported to the disposal site by pipeline.

The 146 acre Canton/Seagirt Dredge Disposal Site will hold 3½ million cubic yards of material dredged from the harbor bottom. It is anticipated that the site will be converted by others into a marine terminal in the future.

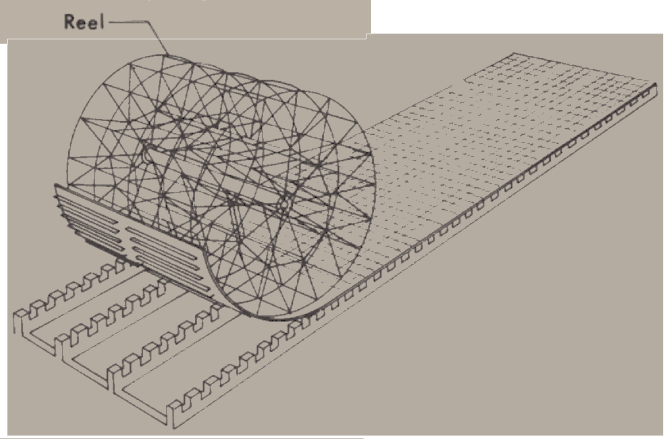
al stiffeners are added for
Shell Plate Pane



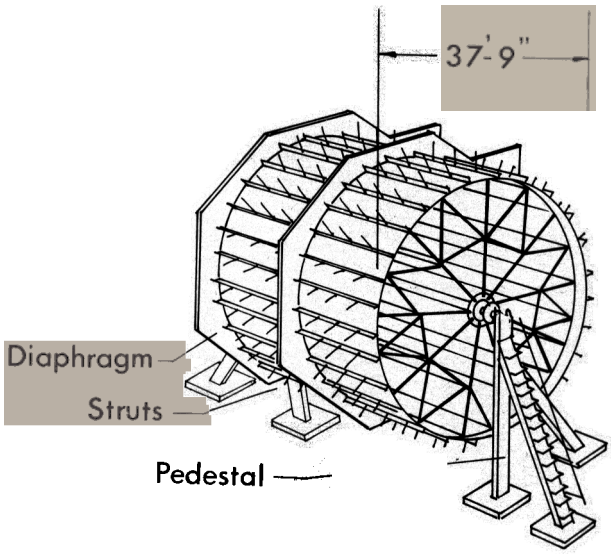
Stiffeners



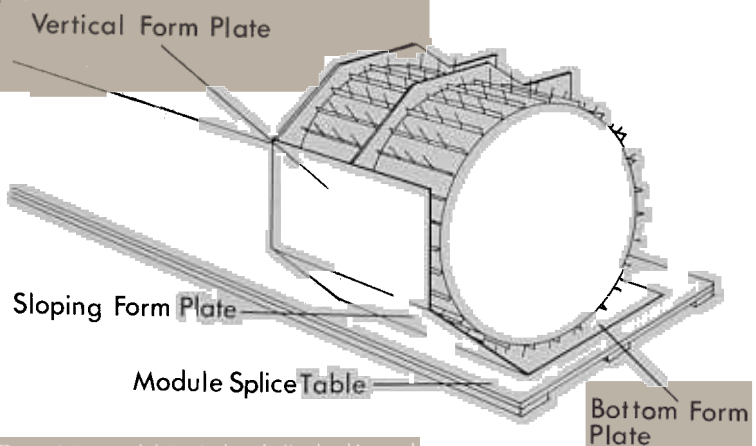
3. Shaping a module begins by wrapping the welded steel plate around a specially designed reel.



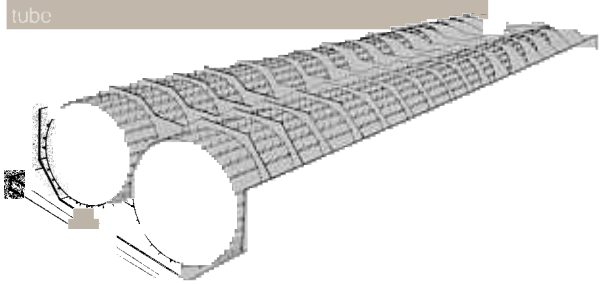
4. The reel and steel shell are transferred to a pedestal where more structural pieces are added.



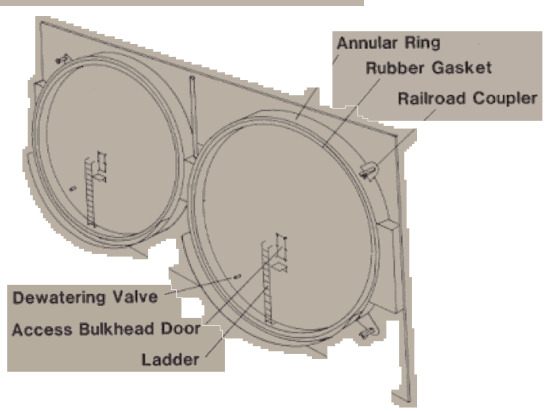
5. The reel is collapsed from inside the module and the module is transferred to a table where bottom, sloping, and vertical form plates are added.



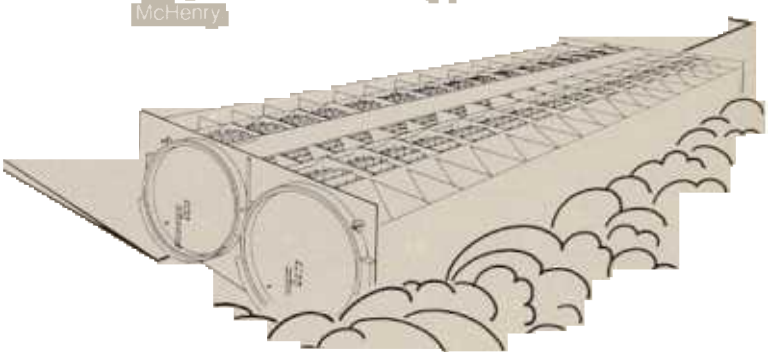
6. 16 of the modules (8 for each tube) are joined on the shipway to form a section of the double barreled tube.



7. Dam plates are fabricated and attached to seal each end of the tube.

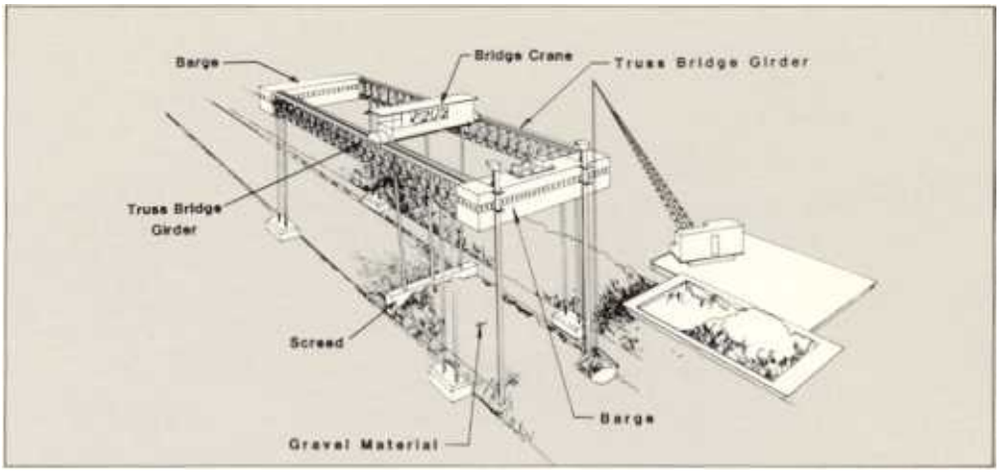


8. Keel concrete is placed to add strength and rigidity and the double barreled tubes are side launched for the 12-hour tow to the outfitting pier near Fort McHenry.



Screeding Operation

Next, gravel material is deposited into the dredged trench and carefully spread by a screed barge. The screeding operation is continuously monitored by sounding the trench bottom. The two foot thick gravel bed serves as a leveling course and as the foundation for the tubes.



The screed barge. Suspended from the bridge crane is the actual screed, a heavy plow-like beam which spreads and levels the gravel material.

Tube Fabrication

The major element in the construction of the tunnel is the fabrication of 32 steel tube sections. Work on the tubes is underway at Wiley Manufacturing on the Susquehanna River in Port Deposit, Maryland. More than 800 Wiley employees are involved in the fabrication operation which continues around the clock, seven days a week

Lowering The Tubes

The tubes are towed from the outfitting pier to the lay barge for lowering. The lay barge is anchored and a temporary survey tower is mounted on the outboard end of the tube. The temporary survey tower extends above the water line when the tube rests on its foundation and is used as a sighting target for accurate alignment of the tube during placement.

Each tube is lowered to within a few feet of the tube already in place. A diver connects the tubes using railroad coupler-type devices. Hydraulic jacks draw the lowered tube against the tube already in place. The dewatering valves at the tube joint are opened and the thousands of tons of external water pressure created by opening the valves move the tube slightly to its final position.

At the outfitting pier, near the tunnel site, concrete is added to interior and exterior portions of the tubes.

A plate is welded around the interior of the joint, and the area behind the plate is filled with concrete for final water tightness. After each pair of tubes is properly located and joined, backfill material is placed around and on top of the tubes to lock them in position and provide protection.

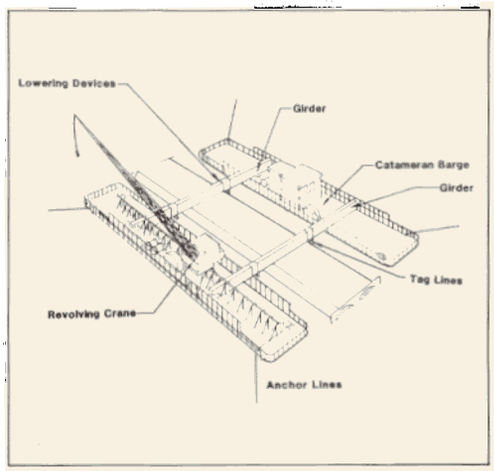
Construction Completion

The work required to construct the approaches to the tunnel include: an open approach roadway, a section of cut and cover tunnel, and the below ground portions of the ventilation buildings. Both the east and west approach structures extend well below the ground water table. Therefore, the ground water is lowered temporarily with a system of well points so that construction can proceed in dry land. Sheeting is driven before the excavation begins. Tiebacks are installed where necessary as the excavation continues to the required depth. Massive "gravity slabs" of concrete are constructed to overcome the buoyant effect of ground water that will occur after the temporary well points are removed. The retaining walls are completed, backfilled and the sheeting and well points are removed.

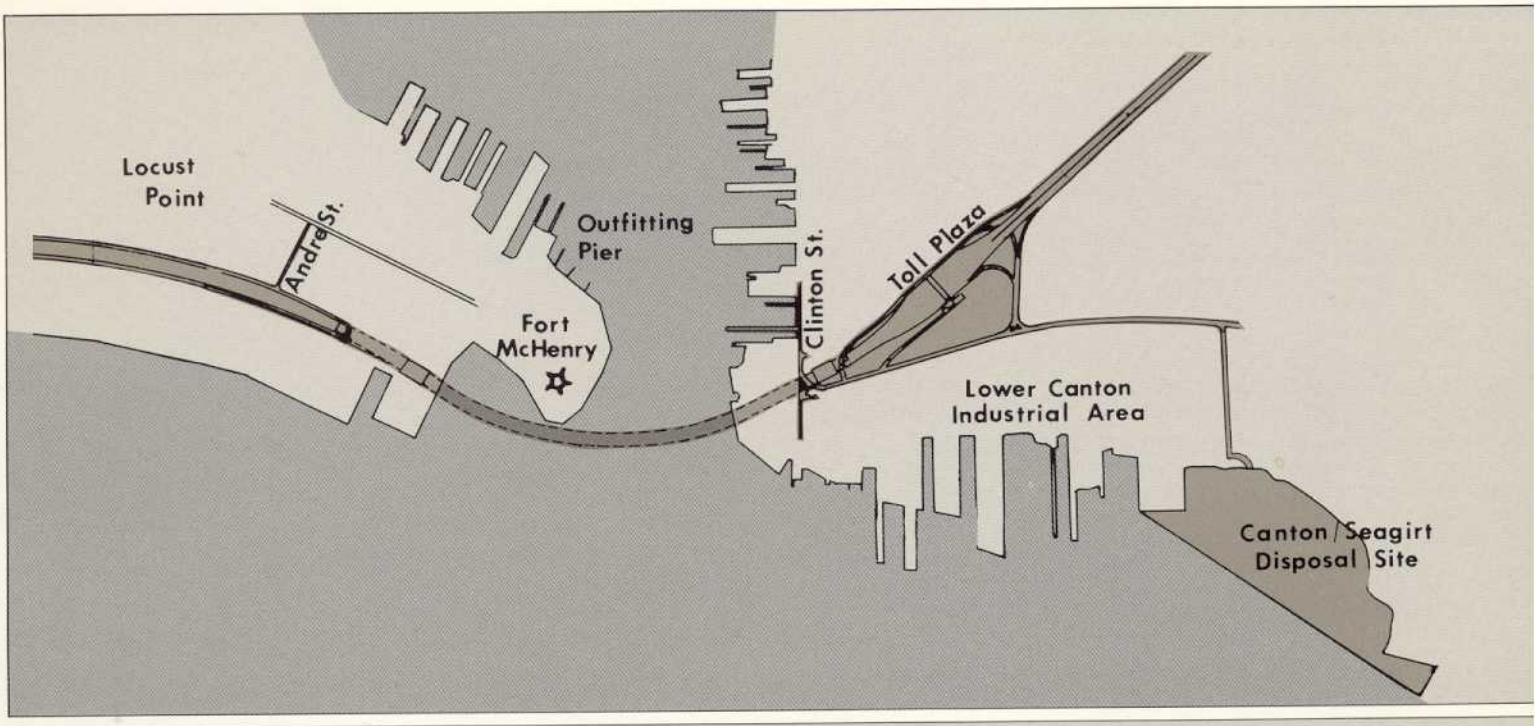
Ventilation buildings are built at each end of the tunnel. The east ventilation building is a steel structure with precast panels. The west ventilation building includes a brick facing to assure aesthetic compatibility with the historic fort area. A berm approximately 10 feet high is constructed around part of the west building. The berm is landscaped with both deciduous and evergreen plantings. In the summer, an observer from Fort McHenry will perceive only trees along the shore line. In winter, the building will appear as a 15-ft-high brick wall behind a planting of evergreens.

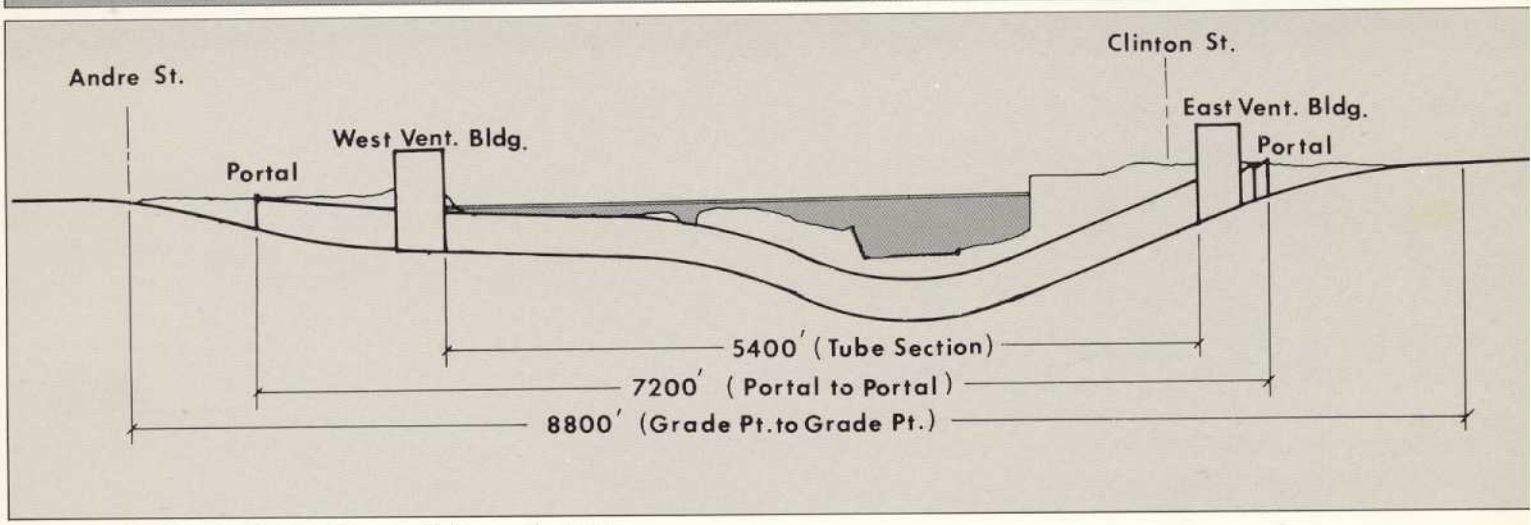
The final stage of the construction includes the mechanical, electrical, and finish work. Pump installations, fire fighting equipment, lighting fixtures, television cameras for monitoring traffic flow in the tunnel, and traffic sensors and signals are added. The tunnel walls are tiled and white concrete filled panels are attached to form a roadway ceiling. The space above the ceiling becomes the duct through which fumes are exhausted. Fresh air is provided to the tunnel through the space below the roadway.

The last stage of the construction process includes building garages for the tunnel emergency vehicles, paving the roadway with asphalt, and constructing an administration building, maintenance complex, and toll booths.

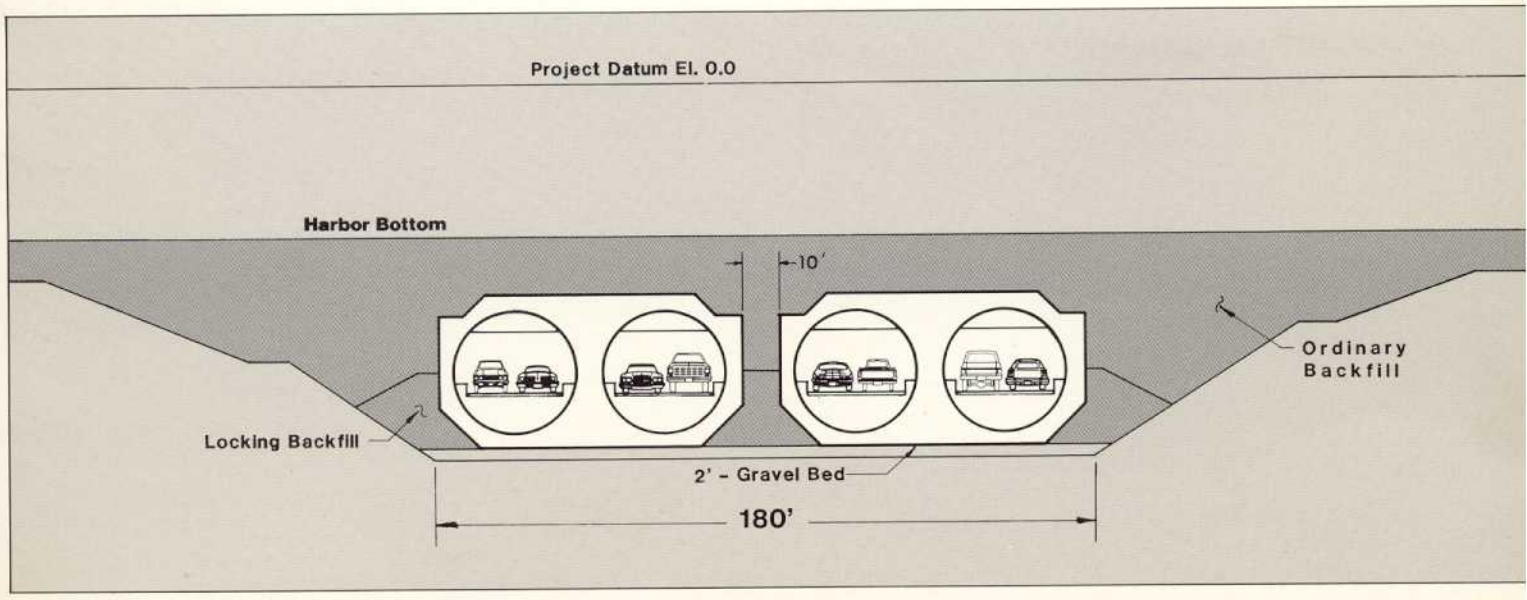


The Lay Barge. The tube is positioned for lowering between the catamaran barges of the lay barge. Additional concreting adds the proper weight for lowering the tube.





Plan and profile of the Fort McHenry Tunnel in Baltimore, Maryland.



Cross section of the 8-lane tunnel.

Construction Facts:

Years under construction	1980-1985
Length of the tunnel:	
Grade point to grade point length	8800 feet
Portal to portal length	
Length of tube section	
Depth of dredged trench (at deepest point)	115 feet
Prefabricated tubes:	
Number of tubes for tunnel	32
Weight of steel in one tube	
Concrete required for each tube	2,660 cubic yards
Tube weight with concrete	31,882 tons
Fans (24 supply and 24 exhaust) total capacity	6,684,000 cubic feet per minute
Pumps (28 total) total capacity	44,000 gallons per minute
Approximate quantities of major items:	
Structural steel	101,659,700 lbs.
Reinforcement (all types)	42,504,730 lbs.
Concrete (all mixes)	904,580 cubic yards
Piling (berth restoration & disposal site)	35,000,000 lbs.
Dredged material	3,524,820 cubic yards
Ceramic tiling	1,800,000 square feet
Backfill (all types)	2,488,400 cubic yards

For More Information Call Interstate Division for Baltimore City 301-396-8345