FACTS ABOUT

THE METROWEST WATER SUPPLY TUNNEL PROJECT

A MASSACHUSETTS WATER RESOURCES AUTHORITY PUBLICATION

A turn of the faucet is end of the journey for water traveling halfway across Massachusetts to the homes of nearly 2.5 million people and over 5,500 businesses in communities served by MWRA. Our customers use approximately 250 million gallons of water per day. Water is necessary for our daily lives, public safety and a healthy economy. Maintaining a safe and reliable water system is an important element of MWRA's work.

MWRA operates an elaborate system of over 400 miles of water tunnels and distribution mains, which in turn feed another 6,700 miles of community-owned water distribution pipes. Portions of this system have been in service since the mid 19th Century and are in great need of repair. MWRA is building the MetroWest Water Supply Tunnel to avert the damage that could be caused by a major break or failure of the water system that the region relies on for basic health and safety.

While the MetroWest Tunnel will not replace the water transmission system that is in place today, it will enhance its capacity to serve the region dependably for decades to come.

THE SYSTEM TODAY

The Hultman Aqueduct is the backbone of MWRA's water transmission system, delivering water from MWRA's two source reservoirs – the Quabbin and Wachusett Reservoirs in Central Massachusetts.

This surface pipeline stretches 17.8 miles from the western edge of Southborough to the I-90/Route 128 intersection on the Newton-Weston line, where it connects to the City Tunnel. Completed in 1940, the Hultman was originally designed to be the first half of a double-barreled aqueduct. The advent of World War II and decades of under-funding prevented the building of a second pipeline.

As a result, Greater Boston is the only major American metropolitan area to rely on a single water supply conduit to deliver over 85% of its drinking water. Without a dual system in place, routine repairs and proper maintenance work are impossible, leaving the Hultman Aqueduct at the risk of steady deterioration.

According to experts, the economic impact of a water supply interruption could be $65 to $100 million per day. But the risk to public health and public safety could not be measured in monetary terms.

THE METROWEST WATER SUPPLY TUNNEL WILL STRENGTHEN AND ANCHOR THE SYSTEM

When complete in 2003, the MetroWest Water Supply Tunnel will link MWRA's reservoirs and water treatment and storage facilities to the City Tunnel, local distribution pipes and the people they serve. The tunnel project is part of MWRA's $1.7 billion Integrated Water Supply Improvement Program. This program will ensure that MWRA continues to meet the region's demand for safe and abundant water.

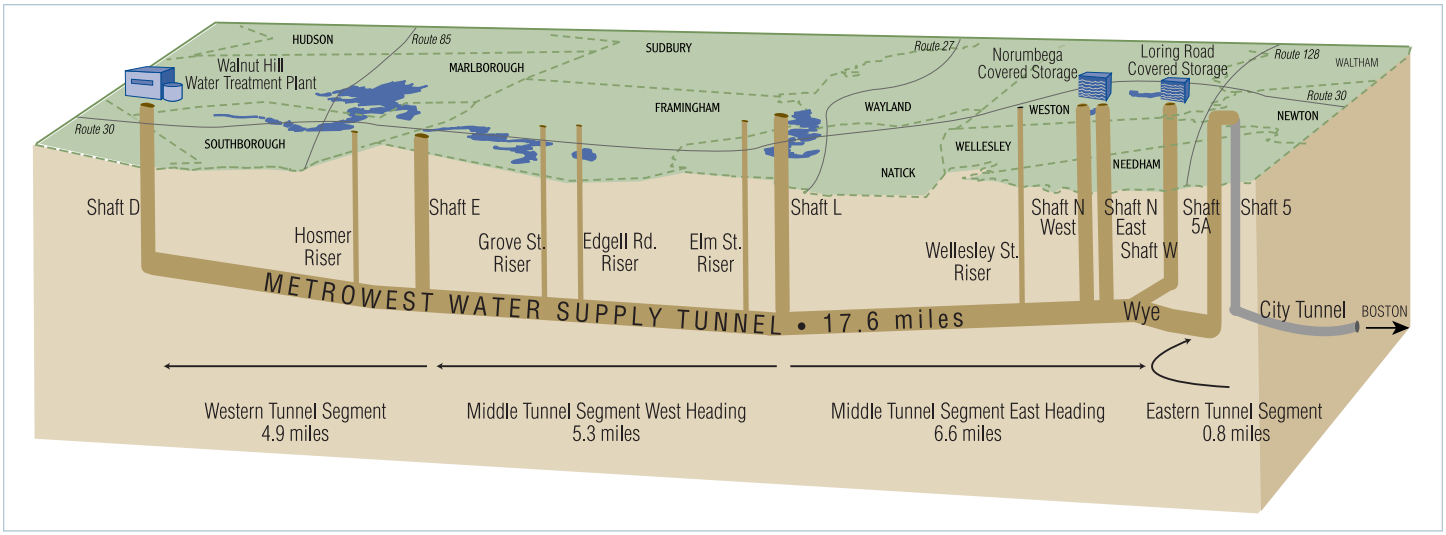
CONSTRUCTION LOGISTICS AND SAFETY

The MetroWest Water Supply Tunnel is a seven-year, $728 million project. Costs include design, construction, inflation and a reserve for contingencies.

The tunnel crosses five communities: Framingham, Marlborough, Southborough, Wayland and Weston. It was excavated 200-500 feet below ground, using state-of-the-art tunnel boring machines (TBMs). The first two TBMs, built by the Robbins Company, arrived in June 1997. A third, made by Construction Tunnel Services, Inc., joined the project in April 1998. All mining was complete in October 2000.

In an agreement between MWRA and the Town, the Framingham Fire Department is providing a tunnel res-

Tunnel workers – 'Sandhogs' – finished mining the MetroWest Water Supply Tunnel in October 2000. The hole-through shift poses in front of the Tunnel Boring Machine they used to do the job.



cue team that has been specially trained and equipped to respond to below-surface emergencies at every MetroWest Tunnel site. A Deputy Fire Chief is stationed at the site full-time to coordinate safety issues, including permits, blasting and tunnel rescue. Security is present at all MetroWest Tunnel sites around the clock.

MWRA'S PROGRAM TO IMPROVE YOUR WATER

The Integrated Water Supply Improvement Program starts with with the increased protection of watersheds and the quality of our source reservoirs. MWRA is proud to offer the high-quality water that is provided by these vast natural resources.

Another part of the program is the construction of a new drinking water treatment plant, which is being built at Walnut Hill in Marlborough, to be complete in 2004. This facility will employ advanced ozonation technology to treat drinking water in compliance with state and federal regulations.

The MetroWest Water Supply Tunnel will carry treated water from the new plant to 39 customer communities. In addition, the MetroWest Tunnel will carry treated water to covered storage tanks at the Norumbega Reservoir and adjacent to Loring Road in Weston. Tanks have also been constructed at the Fells Reservoir in Stoneham and in Ludlow.

MWRA is replacing uncovered distribution reservoirs with covered water storage facilities because they offer superior protection against airborne contaminants, bacteria and algae. The tanks will also allow MWRA to maintain a protected supply of water for summer water peaks and emergency demands (such as fire-fighting flows), without resorting to putting old brick aqueducts into service.

After the MetroWest Tunnel is complete and tested, the Hultman Aqueduct will be taken off line and rehabilitated. The two pipelines will then be connected to each other. Together, the MetroWest Tunnel and the Hultman will provide MWRA customers with the dual water transmission system first envisioned in the 1940s. The dual system will reinforce MWRA's capacity to deliver water to residents, businesses, hospitals and industries – even if one of its components needs maintenance.

What happened to all that rock? Over the life of the MetroWest Water Supply Tunnel Project, approximately 1.4 million cubic yards of rock were removed from the tunnel. About 850,000 cubic yards were removed from Shaft L, Framingham. Roughly 680,000 cubic yards were used as backfill for the project's worksite, owned by New England Sand and Gravel. The remaining material was processed and sold by the New England Sand and Gravel Company. Tunnel rock from the other shafts was sold by MWRA's contractors as clean backfill and aggregate.

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TIMELINE

1940 The Hultman Aqueduct, planned as the first phase of a double-barreled water delivery system, was built.

WORLD WAR II Construction of the second half of the Hultman was deferred.

1980S MDC resumed planning for water system reliability.

1985 MWRA continued MDC's studies, evaluating the costs and environmental impacts of various options.

1990S MWRA, assisted by design firm Sverdrup Civil, Inc., concluded that the construction of a hard rock tunnel would be the best approach.

METROWEST WATER SUPPLY TUNNEL CONSTRUCTION: A SYSTEM OF CONNECTIONS

The MetroWest Water Supply Tunnel is being constructed hundreds of feet underground in three main segments that join to form a single, 17.6-mile-long conduit.

Before the tunnel segments were mined lengthwise, deep, vertical holes called *shafts* were excavated. Workers and their equipment access the tunnel's subterranean worksites by being lowered down the shafts. The land surrounding a shaft is often used as a staging area for equipment and temporary project offices. Some MetroWest Tunnel shafts are being used to connect the tunnel to surface facilities. Others ("riser" shafts) will be used to provide water to communities along the tunnel's alignment.

MetroWest Water Supply Tunnel construction began in June 1996 when its first tunnel shaft, Shaft L, was excavated. Mining was completed on schedule in October 2000. Concrete lining began as soon as the excavation of each segment was completed.

Steel forms positioned around the diameter of the tunnel are ready to receive the concrete mix that forms the tunnel lining.

LINING THE TUNNEL

The 17.6 miles of the MetroWest Water Supply Tunnel are being lined with about 200,000 cubic yards of concrete. The lining of the tunnel must be smooth and without leaks to withstand the pressure of water traveling through the main tunnel and its shafts.

The lining operation begins with the placement of steel forms. These curved forms are positioned around the diameter of the tunnel walls. Once the forms are set up in a segment of the tunnel, the miners pump a concrete mix into the space between the rock surface and the steel form, which is known as the annulus.

The concrete is supplied from on-site batch plants and concrete suppliers in the area of the tunnel. Concrete must be delivered to each site quickly, before it can set and cure. A batch plant located next to Shaft E supplies the western portion of the tunnel, including the Western Segment (CP-1), Shaft D, Marlborough to Shaft E, Southborough. A second batch plant at Shaft L in Framingham supplies the mix for the Middle Tunnel Segment (CP-2), including Shaft L, Framingham west to Shaft E and a segment of the tunnel to the east of Shaft L.

The eastern sections of the tunnel, east from Shaft L to the Wye and Weston, were supplied concrete from ready mix trucks through three designated drop holes. They were located near the Mass Turnpike toll booths, at Shaft N in Weston and behind the Mass State Police barracks in Weston. The last three three miles were done from Shaft L using Moran cars, except for the last 0.6 miles, closest to Shaft L, which were completed with surface pumping from Shaft L.

After an area of the tunnel has been lined with concrete, the contractor goes back over the area and completes one or more steps in a grouting process. *Contact grouting* reinforces the circular seal between the rock and the tunnel face. *Consolidation grouting* is the next step in areas where there is unstable rock or fractured rock. In this case, the contractor drills and injects concrete grout into the rock formation to consolidate and strengthen the rock mass. If any leaks remain, the contractor applies more grout to the tunnel surface lining using a technique called *pressure grouting.* The miners pump grout at high pressure into holes drilled in areas where water is flowing to improve the water tightness of the liner and cut off the leaks.

In a few segments of the tunnel, there are poor ground conditions or unstable rock. The contractor installs a steel liner in these places to support the rock. Steel reinforcement was also used to strengthen the liner in areas with unsuitable rock.

1990-1995	DECEMBER 1995	JUNE 1996	MAY 1999	OCTOBER 2000	SPRING 2002
Environmental review process for the MetroWest Water Supply Tunnel; Construction Manager – Stone & Webster hired in June 1995.	MWRA Board of Directors unanimously approved the start of MetroWest Water Supply Tunnel construction.	Construction began at Shaft L, Framingham.	Production mining was underway in three major tunnel headings.	All 17.6 miles of tunnel mining were completed on October 27, when workers 'holed through' to join the Middle and Eastern Tunnel Segments.	Over % of the tunnel has been lined with concrete; work continues to progress toward final completion in 2005.

READYING THE TUNNEL

Before the MetroWest Tunnel comes on line, MWRA must take a series of steps to test for leaks then clean and disinfect the tunnel.

When the tunnel has been lined and all of the equipment removed, MWRA and its contractors will prepare the tunnel to accept drinking water. The tunnels and shafts are washed with a high-pressure spray to remove any fine particles that remain from construction. This wash water is then collected, pumped out of the tunnel and treated before it is released.

It will take about 105 million gallons of water to fill the MetroWest Tunnel and its shafts. Water is introduced to the tunnel in segments, with strict control measures to prevent any cross-connections (to protect local community systems that connect to the tunnel). This is a complex process: desired pressures have to be reached gradually. Then tests will be conducted to look for leaks that need repair.

Disinfection, the next step, eliminates any bacteria in the tunnel, shafts and surface conduits. MWRA will use the slug method to complete the disinfection. This involves displacing water that remains in the tunnel after pressure testing with a slowly moving slug of water that is dosed with chlorine, which kills the bacteria. The level of chlorine is monitored as it moves through the tunnel to maintain a safe level.

Finally, the chlorinated water will pass through granular activated carbon filters to neutralize the chlorine in the water. The dechlorinated water can be safely released into the environment. The pH of the water – which represents its level of alkalinity – will be adjusted at every discharge location.

With the completion of these steps in the fall of 2003, the new tunnel will be completed for service. When other elements of the Integrated Water Supply Improvement Program are ready, the MetroWest Tunnel will carry water from the Wachusett Reservoir in Clinton to the City Tunnel in Weston.

PUBLIC PARTICIPATION

MWRA is committed to keeping people informed about its design and construction projects. We publish a newsletter about water project progress, history and events; the 24-hour MetroWest Water Supply Tunnel hotline (1-888-TUNNEL 2) is available if you would like to ask a question or voice a concern about the project.

Communication with citizen interest groups, municipal officials and other interested parties in Framingham, Weston and Southborough is also important to us. Working groups have been formed to discuss issues concerning construction activities. Coordination between MWRA and working groups helps to resolve quickly any concerns that may arise during construction. As the project progresses, periodic meetings will be held in each impacted community.

The MetroWest Water Supply Tunnel's neighbors have been instrumental in developing Memorandums of Agreement, which address project host communities' concerns about safety and the environment. Each project contractor is required to comply with these agreements. The project's construction management consultant, Stone and Webster, Inc., employs professionals who help to enforce the agreements by monitoring all construction activities.

MWRA Communities Who Benefit from the MetroWest Water Supply Tunnel Project

Arlington	Lexington	Needham	Swampscott
Bedford	Lynn	Newton	Wakefield
Belmont	Lynnfield	Norwood	Waltham
Boston	Malden	Peabody	Watertown
Brookline	Marblehead	Quincy	Wellesley
Cambridge	Marlborough	Revere	Weston
Canton	Medford	Saugus	Winchester
Chelsea	Melrose	Somerville	Winthrop
Everett	Milton	Southborough	Woburn
Framingham	Nahant	Stoneham	

MWRA offers a wide variety of informational materials on the region's water and sewer systems and the natural environment. To find out what's available,

- **CALL US:** MWRA Public Affairs Department 617-788-1170
- **VISIT OUR WEB SITE:** www.mwra.com
- **WRITE TO US:** PUBLIC INFORMATION UNIT • Massachusetts Water Resources Authority • Charlestown Navy Yard • 100 First Avenue • Boston MA 02129

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If you have specific MetroWest Tunnel Project complaints or concerns, please call our 24-hour, toll-free hotline:

1-(888)-TUNNEL-2

1-888-886-6352