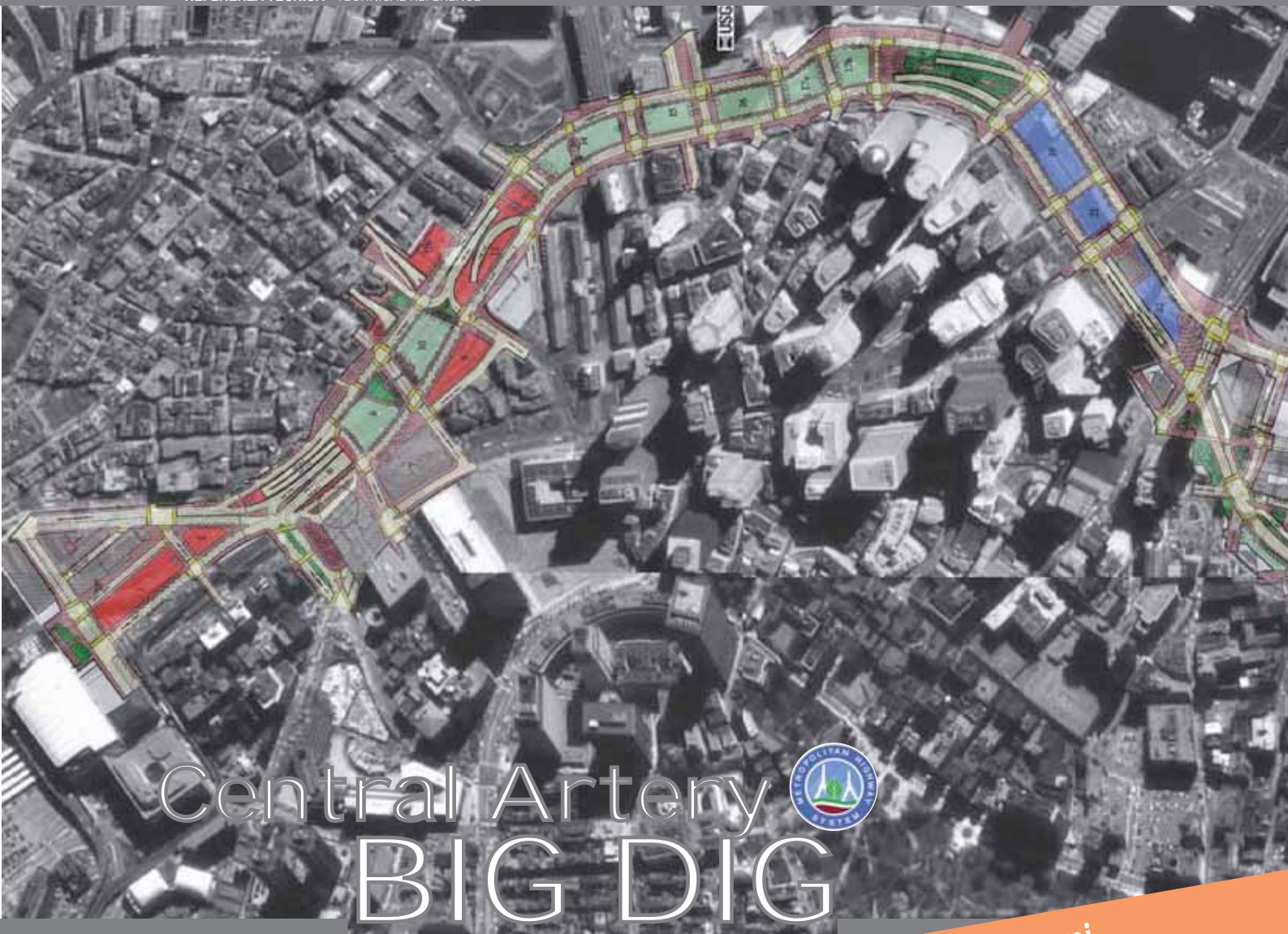


worldwide leader in the foundation engineering field



REFERENZA TECNICA - TECHNICAL REFERENCE



Central Artery BIG DIG

Boston (MA), USA



Diaframmi
Slurry Walls

Jet Grouting
Jet Grouting

Cliente :
Owner : The Commonwealth of Massachusetts
Highway Dept. Ten Park Plaza - Boston MA

Contrattista principale :
Main Contractor : TREVIICOS

Durata dei lavori :
Duration of works: 1997 - 2000

Introduzione

Introduction

In the 1930s, city planners in Boston, pressured to make their downtown more easily accessible by automobile, proposed the construction of an elevated freeway through the center of the city. Thirty years later, the aptly named Central Artery was fully realized and carried about 75,000 vehicles a day between the Charles River and the southern side of the city. By the 1980s, however, the Central Artery had already become obsolete, with more than 150,000 vehicles traversing the six-lane thoroughfare each day.

Faced with dire traffic predictions for the near future, Boston's city planners went back to the drawing board. This time, instead of a highway in the sky, as the artery was sometimes called, the planners envisioned a vast system of tunnels beneath the city—a system so



A Contract: **C09 A4**

Owner:
J.F.White - Slattery - Interbeton - Perini J.V.

Works:
Slurry walls-Jet grouting-Soilmixing for the 139-190 interchange

B Contract: **C09 A7**

Owner:
PKA J.V.

Works:
Slurry walls for excavation support of 190 tunnel

C Contract: **C15 A1**

Owner:
J.F. White - Perini - Slattery

Works:
Slurry walls for excavation support of the Central Artery Tunnel between Chardon and North Street

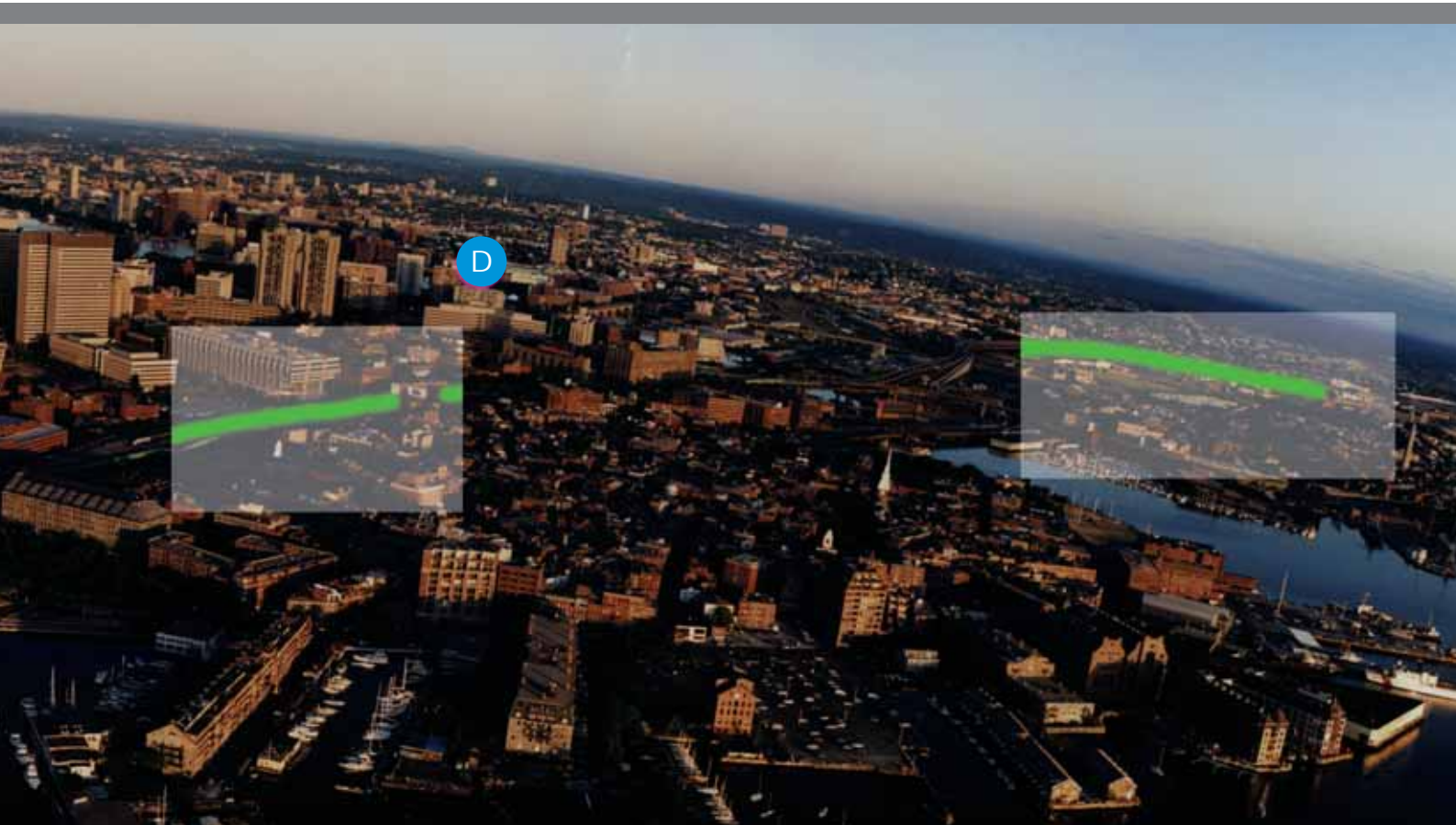
D Contract: **C17 A9**

Owner:
Moder Continental - Obayashi J.V.

Works:
Slurry walls for excavation support of the Central Artery Tunnel from High to State Street

sweeping that it promised to transform the character of Boston.

*The final master plan for the **Central Artery/Tunnel Project**, also known as the **Big Dig**, called for construction of a 1.5 mi (2.4 km) long tunnel 8 to 10 lanes wide directly beneath the Central Artery; two new bridges across the Charles River at the northern edge of the city; and a 1.6 mi (2.6 km) long tunnel south of the downtown area that would begin at the interchange of the interstates 90 and 93 and take motorists beneath South Boston and Boston Harbor to Logan International Airport.*



E

Contract:
C17 B1

Owner:
Moder Continental - Obayashi J.V.

Works:
Slurry walls for excavation support in State Street

G

Contract:
C19 B8

Owner:
J.F. White - Slattery - Interbeton J.V.

Works:
Drilled shafts for I93 viaduct

F

Contract:
C17 E1

Owner:
Moder Continental

Works:
Drilling, grouting and drilled caisson for the I93 leverett circle/storrow drive connectors

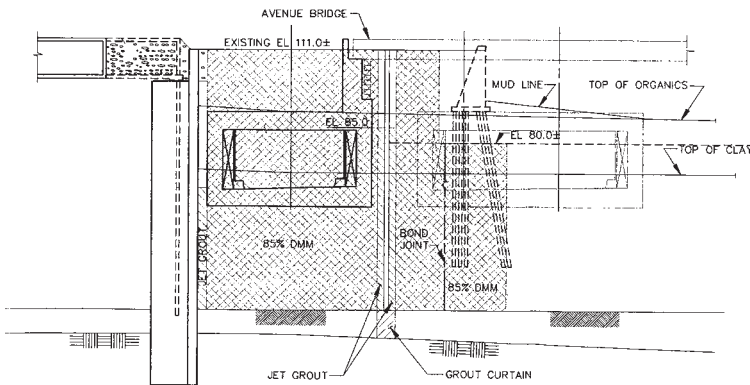
C9 A4 Contract

Owner: **Massachusetts Highway Department/
Department of Transportation FHA**

Construction Manager: **Bechtel/Parsons Brinckerhoff**

Engineer: **WeidlingerAssociates, GEI Consultants**

General Contractor: **J.F. White/interbeton/ Slattery/Perini, JV**



Works executed:

Slurry Walls (Post-Tensioned & T-Panels)

Area: 448,000 sf
 Thickness: 36 & 48 in
 Tendons: 671 each
 Max Depth: 115 ft

Jet Grouting

Volume: 53,000 cy
 Diameter: 6 ft
 Max Depth: 80 ft

Soil Stabilization

Volume: 15,000 cy
 Diameter: 5 ft

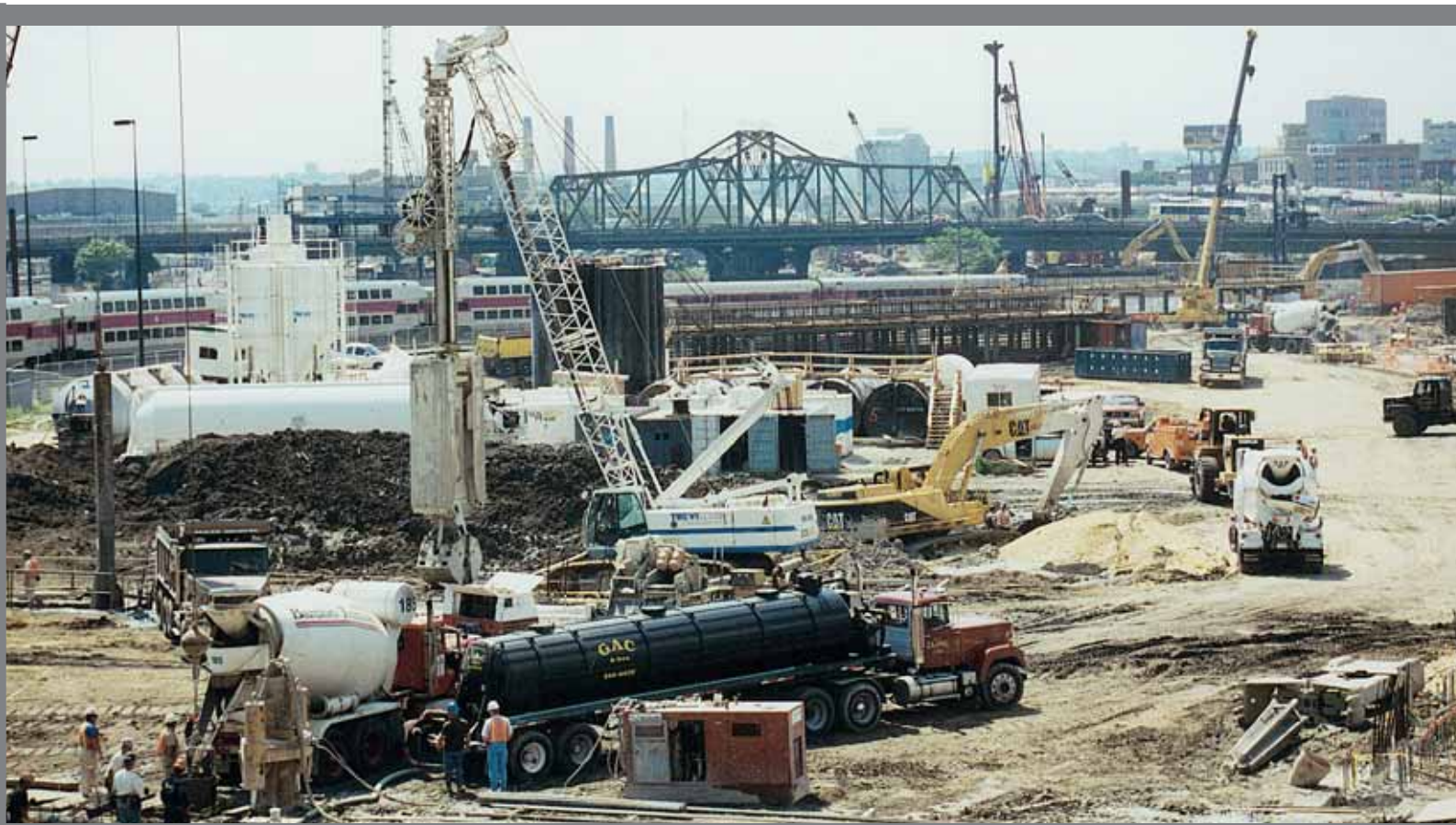
The C09A4 Project involved the construction of several ramps, as part of the reconfiguration of the 1-9011-93 Interchange and of a portion of 1-93 Northbound Central Artery. To complete the work, the project required three "pits" to be excavated in order to build and jack tunnel box sections under the MBTA and AMTRAK railroad lines that service Boston's South Station Terminal. The three tunnels will handle all traffic using the Ted Williams Tunnel to and from points North, South and West of Boston. In addition to the slurry walls and jet grouting for the pits, TREVIICOS installed slurry walls for a tunnel for Northbound traffic to the Ted Williams Tunnel.

Before excavation of the tunnel "jacking pits" could begin, slurry walls needed to be installed, to provide the excavation lateral support system. Originally, all the slurry walls on the project were designed as Soldier Piles Tremie Concrete Slurry Walls (SPTC walls). However, TREVIICOS proposed a design change of the panels as post-tensioned, reinforced concrete straight panels, reinforced concrete T-Panels and some SPTC walls, as a Value Engineering Cost Proposal (VECP). TREVIICOS worked two rigs during day shift and one rig during night shift to complete the

work and, at times, poured two panels a day.

Once the slurry wall was completed for each of the jacking pits, TREVIICOS started a jet grouting program to form a twenty foot thick mat of jet grouted soil below the level of the future reinforced concrete base slab. The mat was to act as a strut to minimize the levels of bracing required to support the slurry wall and to allow unimpeded space for the construction and jacking of the tunnel box sections. The combination of post-tensioned slurry walls and jet grouting allowed an unsupported span of 46 feet between the top struts and the jet grouted mat. TREVIICOS worked two rigs 24 hours a day to complete the operation.

The final challenge for TREVIICOS was another VECIP proposal for the construction of the Ramp L Tunnel. Our VECIP eliminated a deep soil mix program and drilled shafts keyed in rock to support the tunnel box and replaced them with a combination of shallow soil stabilization and slurry walls with 10 foot wide "legs", located at the center of the panels, which transferred the load to bedrock without requiring the entire panel length



to extend to rock.

Prior to the installation of the Ramp L slurry walls, the organic sediment at the bottom of the channel needed to be stabilized. TREVIICOS worked one 8-hour shift each day using a specifically designed grout mix to obtain a soil strength of 30 psi.

TREVIICOS devised a creative and unique method for overcoming the challenge of performing soil stabilization on the channel floor from the channel shoreline. Once a portion of the channel bed was stabilized, fill was then pushed out from the shoreline, creating a stable work platform over the previously stabilized sediment. Work progressed outward in this fashion until the channel bed was stabilized and the required area was filled. Slurry walls were successfully installed through the stabilized organics, the underlying clay layer and into the rock, with the extended center legs.

C15 A1 Contract

Owner:	Massachusetts Highway Department/ Department of Transportation FHA
Construction Manager:	Bechtel/Parsons Brinckerhoff
Engineer	Sverdrup Civil
General Contractor:	J.F. White/interbeton/ Slattery/Perini, JV



Works executed: SPTC Walls
Area: 355,000 sf
Length: 3,565 ft
Thickness: 45 in
Max Depth: 115 ft

TREVIICOS was chosen by the joint venture of J.F. White, Slattery and Perini to construct the structural walls and load bearing elements for the Central Artery contract C15A1. Winding through the heart of Boston's historical district, the site was sandwiched between the sensitive neighborhoods of Haymarket Square to the west and the North End to the east. The project, with over 350,000 square feet of slurry wall requiring nearly 50 construction personnel for a 2 year duration, was the largest contract performed by TREVIICOS on the Central Artery Project.

From the start, this 1/4 mile stretch of the new 8 lane Central Artery presented TREVIICOS with many new obstacles to overcome, in order to install this difficult slurry wall. Specially designed low headroom equipment including excavation cranes, hydromills, clamshell buckets and chisels allowed TREVIICOS to excavate slurry wall panels averaging 90' in depth with only 21' of headroom. Although the excavation of the overburden was hampered by obstructions such as corrugated steel piles, wood piles and thick layers of boulders, the excavation of the rock went nearly flawlessly.

Using a new hydromill fitted with 4 cutting wheels driven by two engines

capable of generating up to 5900 ft/lbs of torque each, rock was ground down at a top rate of 240 sq. ft./hr. This machine also eliminated the normally separate process of desanding, which saved the project countless hours of construction time.

When the excavation and steel placement were completed, concrete was poured through tremie pipes to the appropriate grade. The average panel pour lasted 4 hours and took 160 cubic yards of concrete.

To place the steel soldier pile sections that give the slurry wall its strength, TREVICOS used a 50-ton hydraulic crane called a Mantis, ideal for working in tight quarters along with a Caterpillar 980 Loader, outfitted with a material handling boom. The soldier piles, weighing up to 40 tons, consisted of up to 8 separate segments requiring the assembly of over 2000 bolts.











Central Artery/Tunnel Project Milestones

- 1982: Work begins on Final Environmental Impact Statement/Report (FEIS/R)
- 1985: Final Environmental Impact Statement/Report (FEIS/R) filed and approved early the next year.
- 1986: Bechtel/Parsons Brinckerhoff begins work as management consultant.
- 1987: Congress approves funding and scope of Project. Building acquisition and business relocation process begins (no private homes taken).
- 1988: Final design process under way. Exploratory archaeology digs begin.
- 1989: Preliminary/final design and environmental review continue.
- 1990: Congress allocates \$755 million to project.
- 1991: Federal Highway Administration issues Record of Decision, the construction go-ahead. Final Supplemental Environmental Impact Statement/Report (FSEIS/R) approved. Construction contracts begin to be advertised and awarded. Construction begins on Ted Williams Tunnel and South Boston Haul Road.
- 1992: More than \$1 billion in design and construction contracts under way. Dredging and blasting for the Ted Williams Tunnel ongoing. Downtown utility relocation to clear path for Central Artery tunnel construction begins. Archaeologists find 17th and 18th century artifacts at a North End dig.
- 1993: South Boston Haul Road opens. All 12 tube sections for Ted Williams Tunnel are placed and connected on harbor floor.
- 1994: Charles River Crossing revised design and related FSEIS/R approved. New set of loop ramps open in Charlestown.
- 1995: Ted Williams Tunnel opens to commercial traffic.
- 1996: Downtown slurry work under way for I-93 tunnels.
- 1997: Overall utility work 80 percent complete.
- 1998: Enter peak construction years. Construction begins on the Charles River Crossing.
- 1999: Overall construction 50 percent complete. New Broadway Bridge opens. Leverett Circle Connector Bridge opens.
- 2000: Nearly 5,000 workers employed on the Big Dig
- 2001: Overall construction 70 percent complete.
- 2002: Leonard P. Zakim Bunker Hill Bridge completed.
- 2003: I-90 Connector from South Boston to Rt. 1A in East Boston opens in January. I-93 Northbound opens in March. I-93 Southbound opens in December.
- 2004: Dismantling of the elevated Central Artery (I-93). Opening of the tunnel from Storrow Drive to Leverett Circle Connector, which provides access to I-93 North and Tobin Bridge.
- 2005: Full opening of I-93 South. The opening of the completely renovated Dewey Square Tunnel, including new exit and entrance ramps. Opening of the two cantilevered lanes on Leonard P. Zakim Bunker Hill Bridge. Opening of permanent ramps and roadways at I-90/I-93 Interchange and in other areas.
- 2006: Reached substantial completion of the Central Artery/Tunnel Project in January. Spectacle Island Park opens to the public.
- 2007: Restoration of Boston city streets. Continued construction of the Rose Kennedy Greenway and other parks. Construction on development parcels will continue after the Central Artery/Tunnel Project is finished.

OLD CIRCULATION

NEW CIRCULATION

