

# URBAN PROBLEMS



# UNDERGROUND SOLUTIONS





# LANE COVE TUNNEL

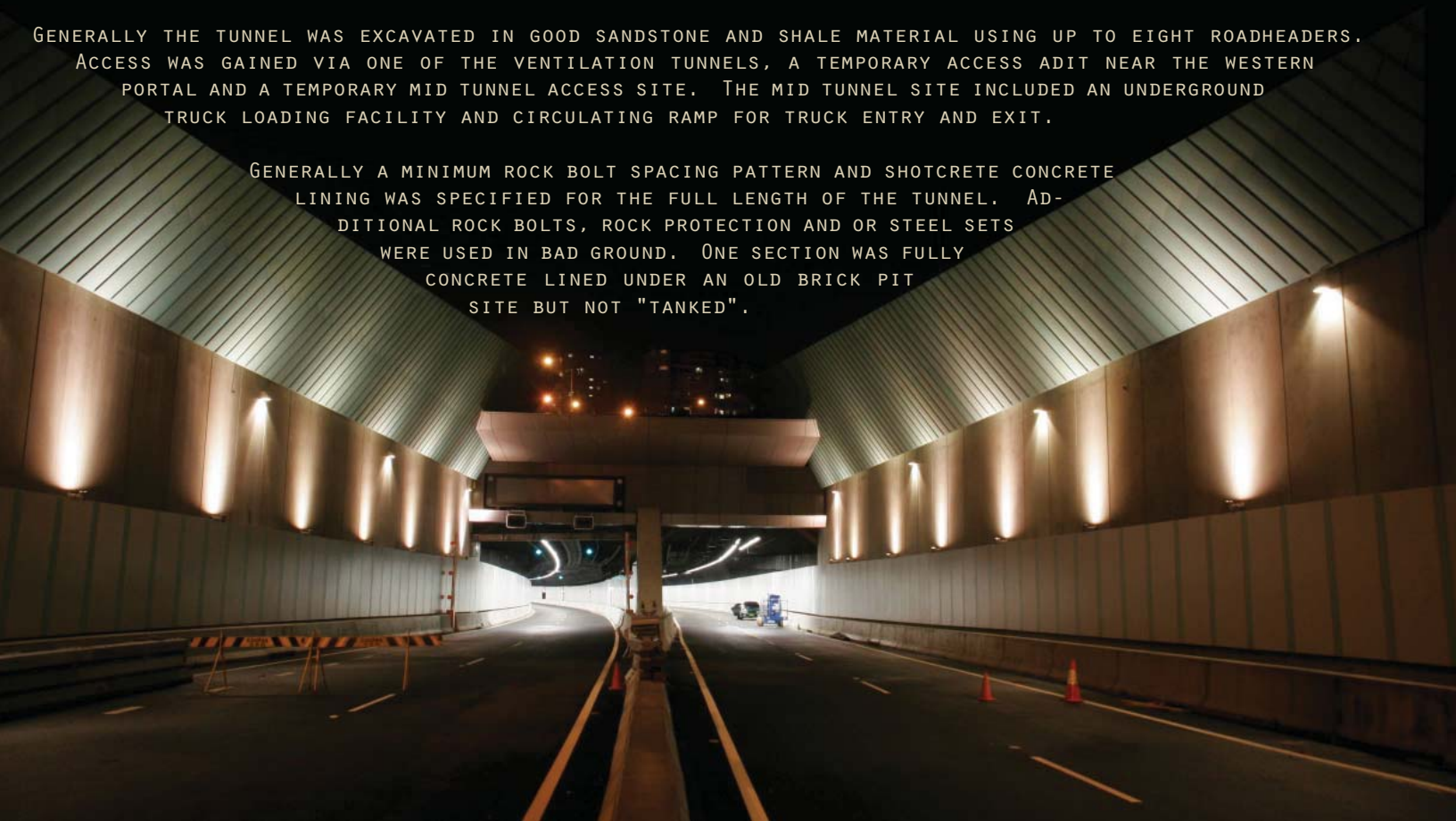
OWNER: CONNECTOR MOTORWAYS PTY LTD

DESIGNER: PARSONS BRINCKERHOFF  
CONTRACTOR: THIESS JOHN HOLLAND JOINT VENTURE

TWIN  
TWO/THREE LANE TUNNELS 3.4KMS IN LENGTH UP TO 30 METRES BELOW SURFACE. LONGITUDINAL VENTILATION SYSTEM WITH 120 JET FANS AND TWO STACKS FOR TUNNEL EXHAUST. TUNNEL VENTILATION SYSTEM WAS DESIGNED FOR BOTH TUNNELS TO BE FULLY CONGESTED.

GENERALLY THE TUNNEL WAS EXCAVATED IN GOOD SANDSTONE AND SHALE MATERIAL USING UP TO EIGHT ROADHEADERS. ACCESS WAS GAINED VIA ONE OF THE VENTILATION TUNNELS, A TEMPORARY ACCESS ADIT NEAR THE WESTERN PORTAL AND A TEMPORARY MID TUNNEL ACCESS SITE. THE MID TUNNEL SITE INCLUDED AN UNDERGROUND TRUCK LOADING FACILITY AND CIRCULATING RAMP FOR TRUCK ENTRY AND EXIT.

GENERALLY A MINIMUM ROCK BOLT SPACING PATTERN AND SHOTCRETE CONCRETE LINING WAS SPECIFIED FOR THE FULL LENGTH OF THE TUNNEL. ADDITIONAL ROCK BOLTS, ROCK PROTECTION AND OR STEEL SETS WERE USED IN BAD GROUND. ONE SECTION WAS FULLY CONCRETE LINED UNDER AN OLD BRICK PIT SITE BUT NOT "TANKED".



## URBAN ISSUES

- ARCHITECTURE
- SERVICE
- SAFETY
- PUBLIC TRANSIT
- TRAFFIC
- TRAVEL TIME
- NOISE LEVELS
- POLLUTION
- NATURAL HAZARDS
- LAND USE
- SERVICEABILITY
- CONSTRUCTION
- MULTI-USE
- INTRA-TRANSIT
- SEISMIC
- OTHER

TOTAL COST: \$1.1 BILLION (AU)

### PLANNING

Nov. '00 - Dec. '03

### CONSTRUCTION

Dec. '03 - Mar '07

A NEED TO IMPROVE THE EFFICIENCY OF EAST-WEST TRAVEL ALONG THE CORRIDOR FOR ROAD BASED TRANSPORT MODES THROUGH A REDUCTION IN CONGESTION AND IMPROVED TRAVEL TIMES.

A NEED TO IMPROVE AIR QUALITY AND REDUCE TRAFFIC NOISE, PARTICULARLY ALONG THE ARTERIAL ROAD NETWORK, THROUGH A REDUCTION IN SURFACE TRAFFIC VOLUMES AND CONGESTION.

A NEED TO IMPROVE CONNECTIVITY AND ACCESS FOR PEDESTRIANS AND CYCLISTS ON EPPING ROAD, IMPROVING LOCAL ACCESS BY REDUCING RESTRICTIONS ON TRAFFIC TURNING MOVEMENTS ON EPPING ROAD, ENHANCING THE URBAN FABRIC OF THE LOWER NORTH SHORE;





## SOLUTION

ENERGY  
HOUSING  
RAIL  
**ROAD**  
PEDESTRIAN  
PARKING  
VENUE  
SHOPPING  
MULTI-USE  
STORAGE  
PIPELINE  
SEWER  
TREATMENT  
RECREATION

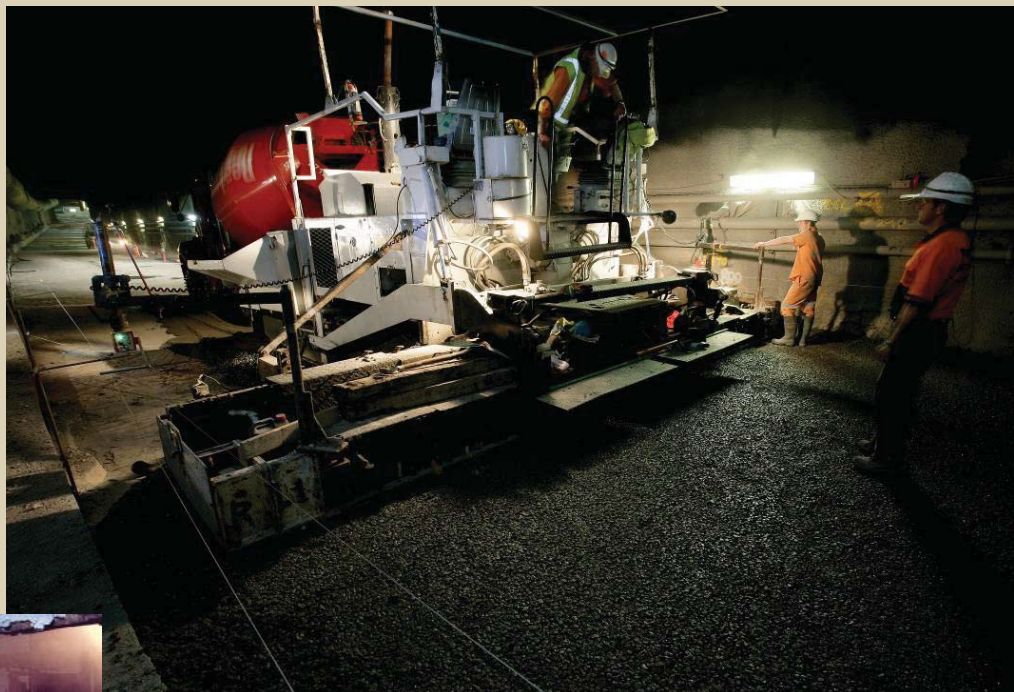
TWIN 3.4KM TUNNELS WITH ENTRY/EXIT RAMPs FROM PACIFIC HIGHWAY.  
WIDENING OF 1.5 KM OF ROAD WEST OF THE TUNNEL FROM THREE LANES TO FOUR LANES WEST-BOUND.  
WIDENING OF 3 KM OF GORE HILL FREEWAY EAST OF THE TUNNEL TO PROVIDE A T2 TRANSIT LANE IN EACH DIRECTION.  
RECONFIGURATION OF 3 KM OF EPPING ROAD (SURFACE ROAD ABOVE THE TUNNEL) TO PROVIDE A BUS LANE IN EACH DIRECTION AND A SHARED PEDESTRIAN/CYCLE PATH.  
RECONSTRUCTION OF THE FALCON STREET INTERCHANGE WITH WARRINGAH FREEWAY TO PROVIDE NEW NORTH FACING TOLLED RAMPs.

## BENEFITS

COMPLETED THE MISSING LINK IN THE 110 KM SYDNEY ORBITAL ROAD NETWORK.  
REMOVED TRAFFIC FROM LOCAL ROADS AND ARTERIAL ROADS.  
PROVIDED OPPORTUNITIES FOR PUBLIC TRANSPORT IMPROVEMENTS.

## KEYS TO SUCCESS

EARLY PLANNING AND ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROJECT.  
WELL DEFINED SCOPE OF THE PROJECT STILL ALLOWED INNOVATION IN DETAILED DESIGN AND CONSTRUCTION.  
PROJECT DELIVERED AT LEAST COST TO GOVERNMENT.

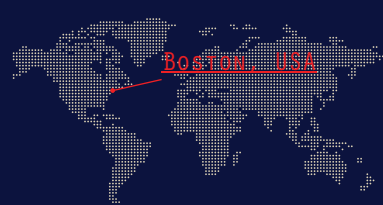


## FURTHER INFORMATION

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# CENTRAL ARTERY

OWNER: MASS. TURNPIKE AUTHORITY

DESIGNER: BECHTEL/PARSONS BRINCKERHOFF  
CONTRACTOR: TBD

7.8 MILES OF HIGHWAY, 161 LANE MILES IN ALL, ABOUT HALF IN TUNNELS. ALL TOLD, THE CA/T PLACED 3.8 MILLION CUBIC YARDS OF CONCRETE - THE EQUIVALENT OF 2,350 ACRES, ONE FOOT THICK - AND EXCAVATED MORE THAN 16 MILLION CUBIC YARDS OF SOIL. THE LARGER OF THE TWO CHARLES RIVER BRIDGES, A TEN-LANE CABLE-STAYED HYBRID BRIDGE, IS THE WIDEST EVER BUILT AND THE FIRST TO USE AN ASYMMETRICAL DESIGN. IT HAS BEEN NAMED THE LEONARD P. ZAKIM BUNKER HILL BRIDGE. [ENGLISH UNITS TO BE CONVERTED!]

THE PROJECT ALSO INCLUDES FOUR MAJOR HIGHWAY INTERCHANGES TO CONNECT THE NEW ROADWAYS WITH THE EXISTING REGIONAL HIGHWAY SYSTEM. AT LOGAN AIRPORT, A NEW INTERCHANGE CARRIES TRAFFIC BETWEEN I-90 AND ROUTE 1A AS WELL AS ONTO THE AIRPORT ROAD SYSTEM. IN SOUTH BOSTON, A MOSTLY UNDERGROUND INTERCHANGE CARRIES TRAFFIC BETWEEN I-90 AND THE FAST-DEVELOPING WATERFRONT AND CONVENTION CENTER AREA. AT THE NORTHERN LIMIT OF THE PROJECT, A NEW INTERCHANGE CONNECTS I-93 NORTH OF THE CHARLES RIVER TO THE TOBIN BRIDGE, STORROW DRIVE, AND THE NEW UNDERGROUND HIGHWAY.

AT THE SOUTHERN END OF THE UNDERGROUND HIGHWAY, THE INTERCHANGE BETWEEN I-90 AND I-93 IS BEING COMPLETELY REBUILT ON SIX LEVELS -- TWO SUBTERRANEAN -- TO CONNECT WITH THE UNDERGROUND CENTRAL ARTERY AND THE TURNPIKE EXTENSION THROUGH SOUTH BOSTON. BY MID-2005 THE INTERCHANGE CARRIED A TOTAL OF 28 ROUTES, INCLUDING HIGH OCCUPANCY VEHICLE LANES, AND CHANNEL TRAFFIC TO AND FROM LOGAN AIRPORT TO THE EAST. A FIFTH INTERCHANGE, AT MASSACHUSETTS AVENUE ON I-93, HAS BEEN REBUILT BY THE PROJECT.



## URBAN ISSUES

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- MULTI-USE
- INTRA-TRANSIT
- SEISMIC
- OTHER

TOTAL COST: \$10+ BILLION (US)

PLANNING	CONSTRUCTION
1982 - 1991	1991 - 2007

ORIGINAL ELEVATED CENTRAL ARTERY CARRIED 200,000 VEHICLES PER DAY, TRAFFIC CONGESTION 10 HOURS PER DAY, FOUR TIMES THE NATIONAL ACCIDENT RATE, \$500 MILLION ANNUAL COSTS DUE TO ACCIDENTS, AND TRAFFIC JAMS.

RECONNECT NORTH END AND WATERFRONT NEIGHBORHOODS WITH DOWNTOWN, REDUCE CITYWIDE CARBON MONOXIDE LEVELS BY 12%, CREATE 260 ACRES OF OPEN LAND.





## SOLUTION

ENERGY  
HOUSING  
RAIL  
**ROAD**  
PEDESTRIAN  
PARKING  
VENUE  
SHOPPING  
MULTI-USE  
STORAGE  
PIPELINE  
SEWER  
TREATMENT  
RECREATION

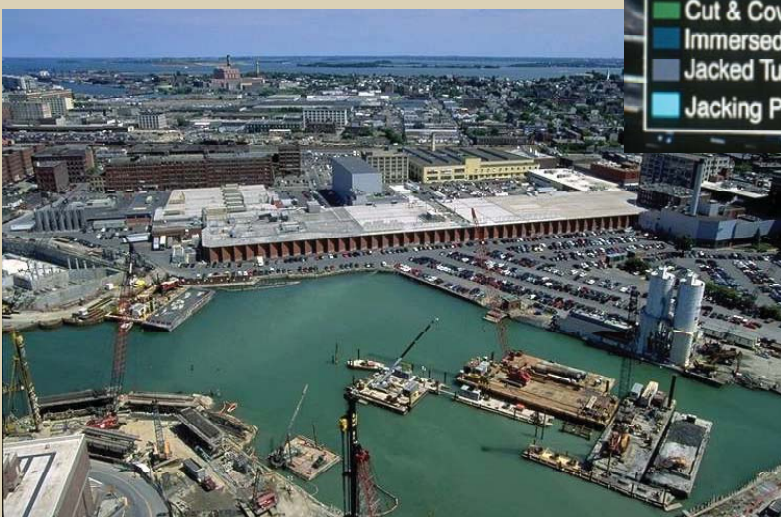
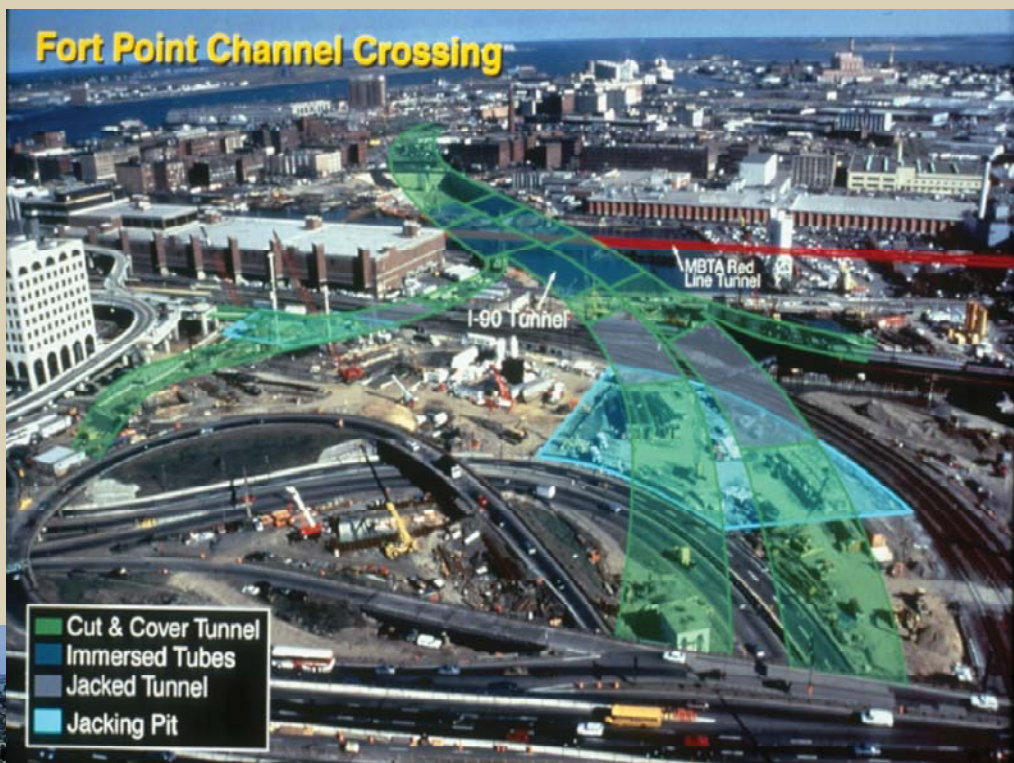
26,000 FEET OF SLURRY WALL (5 MILES) WERE USED DURING CONSTRUCTION. THESE WALLS WERE USED TO SUPPORT THE OLD ELEVATED FREEWAY DURING CONSTRUCTION AS WELL AS SERVING AS GROUND SUPPORT FOR TRENCHING OPERATIONS DIRECTLY UNDERNEATH THE OLD FREEWAY. THREE CONCRETE "JACKING PITS" WERE USED TO EXCAVATE BENEATH NINE MAJOR RAILROAD TRACKS, THE LARGEST USE OF TUNNEL JACKING IN THE WORLD. UNDERPINNING USED TO SUPPORT RED LINE SUBWAY DURING CONSTRUCTION AT DEWEY SQUARE. IMMERSED TUBE TUNNELS USED TO CROSS SEVERAL BODIES OF WATER.

## BENEFITS

RECONNECTED NEIGHBORHOODS SEVERED BY THE OLD ELEVATED HIGHWAY. REDUCED CONGESTION AND POLLUTION BY MOVING TRAFFIC MORE EFFICIENTLY. CREATED OPEN SPACE IN THE CITY.

## KEYS TO SUCCESS

USE OF NEW TECHNOLOGIES SUCH AS SLURRY WALLS AND GROUND FREEZING. USE OF "TOP DOWN" METHODS, ALLOWING TRAFFIC TO BE MAINTAINED ON OLD SYSTEM. CONTINUOUS COMMUNITY RELATIONS AND TRAFFIC INFORMATION PROVIDED TO THE PUBLIC THROUGH A COMMAND CENTER WITH LIVE VIDEO FEED, AND CONSTRUCTION INFORMATION.



## FURTHER INFORMATION

TBD

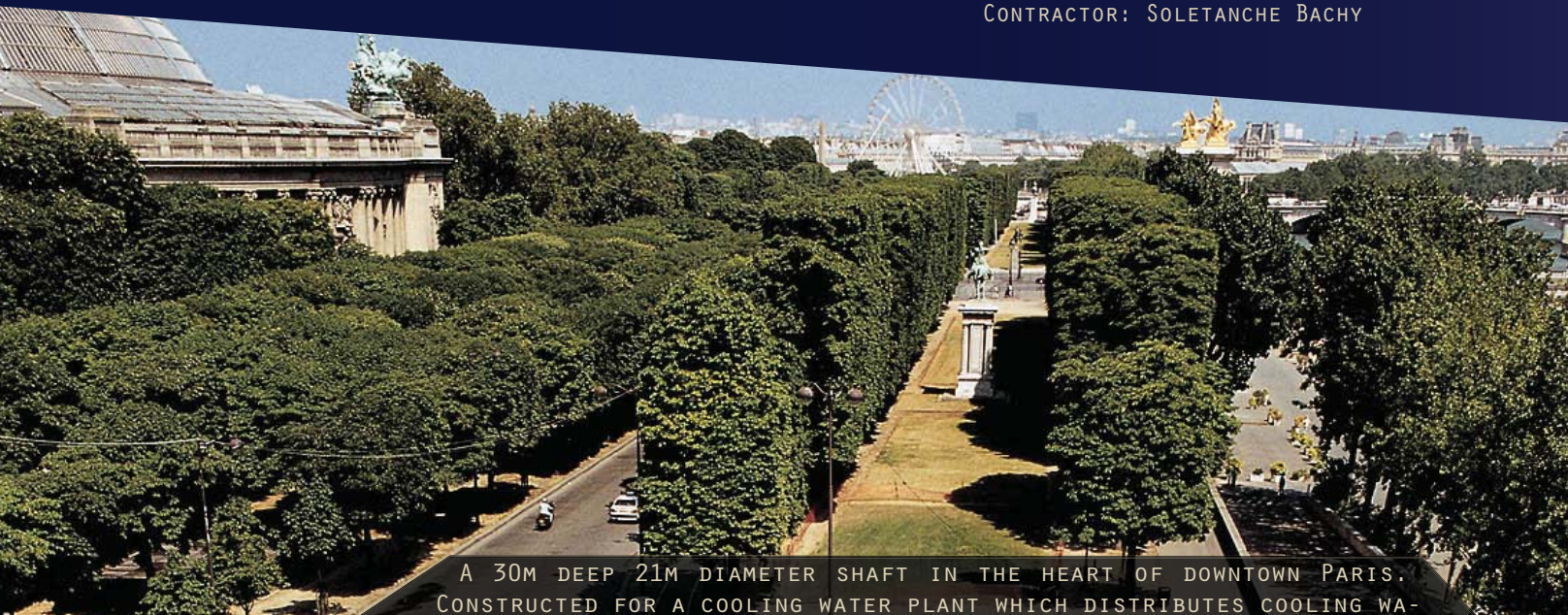


# CANADA PLANT

OWNER: CLIMESPACE

DESIGNER: INGEVALOR

CONTRACTOR: SOLETANCHE BACHY



A 30M DEEP 21M DIAMETER SHAFT IN THE HEART OF DOWNTOWN PARIS. CONSTRUCTED FOR A COOLING WATER PLANT WHICH DISTRIBUTES COOLING WATER THROUGHOUT THE CITY. NAMED "CANADA PLANT" AFTER THE PLACE DU CANADA; THE PLAZA IN WHICH IT WAS CONSTRUCTED. THE SHAFT WAS EXCAVATED INSIDE A 35M DEEP .82M THICK DIAPHRAGM WALL WITH .3% SPECIFIED VERTICALITY. THIS REQUIRED THE USE OF A REAL-TIME CONTINUOUS VERTICALITY MEASUREMENT SYSTEM AS WELL AS CORRECTION DEVICES SUCH AS MOBILE FLANGES.

THE REFRIGERATION UNIT IS INSTALLED ON 5 LEVELS COVERED WITH A TOP CONCRETE SLAB SO THAT NOTHING IS VISIBLE ABOVE GROUND. THIS WAS A PRIMARY CONDITION IMPOSED BY THE PARIS CITY AUTHORITY IN ORDER TO MAINTAIN THE CHARACTER OF THE PRESTIGIOUS CHARACTER OF THE DISTRICT. THE COST OF BURYING THE STATION WAS APPROXIMATELY 20-25% HIGHER THAN A SIMILAR STATION INSTALLED IN A LESS CENTRAL LOCATION. THESE COSTS WERE OFFSET BY THE SHORTER LENGTH AND REDUCED COST IN DISTRIBUTION PIPES.

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- SEISMIC
- OTHER

TOTAL COST: €25 MILLION

### PLANNING

Nov. '00 - Dec. '03

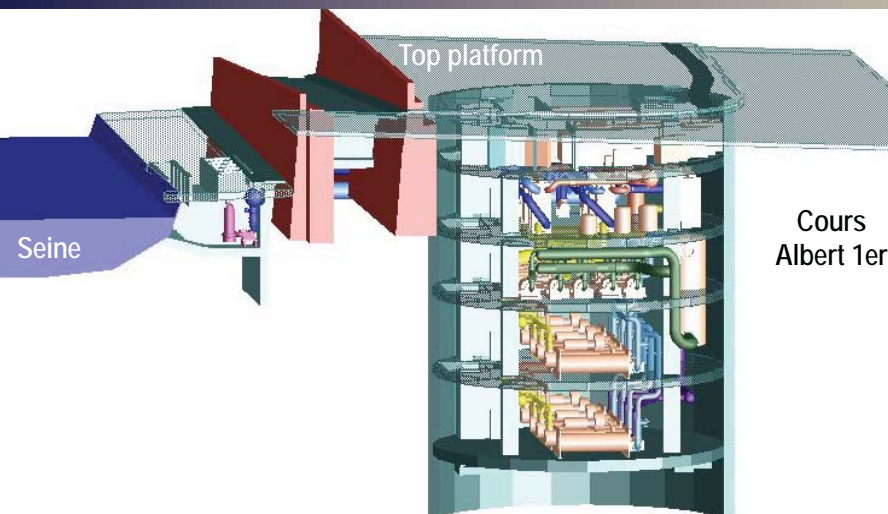
### CONSTRUCTION

Dec. '03 - MAR '07

NEAR THE GRAND PALAIS AND OPPOSITE THE ALEXANDRE III BRIDGE, IT WAS OF HIGHEST IMPORTANCE TO KEEP THE REFRIGERATION UNIT COMPLETELY HIDDEN. EVEN THE GARDENS HAVE BEEN UPGRADED ONCE THE UNDERGROUND COOLING UNIT WAS COMPLETED. NOTHING IS VISIBLE FOR THE PEOPLE CROSSING THE GARDENS UNDER WHICH THE UNIT IS INSTALLED

DURING THE CONSTRUCTION OF THE DIAPHRAGM-WALL, A MAXIMUM OF CARE WAS TAKEN TO KEEP THE NOISE LEVEL AS LOW AS POSSIBLE (USE OF SILENT-PROOF CRANES - NO CHISELING) AND ALL PRECAUTIONS WERE TAKEN FOR KEEPING THE PLACE AS CLEAN AS POSSIBLE (MUCK AWAY TRUCKS AND READYMIX CONCRETE TRUCKS WERE KEPT CLEAN BY SYSTEMATICAL WASHING WHEN GOING OUT THE JOBSITE).





## SOLUTION

ENERGY  
HOUSING  
RAIL  
ROAD  
PEDESTRIAN  
PARKING  
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MULTI-USE  
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PIPELINE  
SEWER  
TREATMENT  
RECREATION

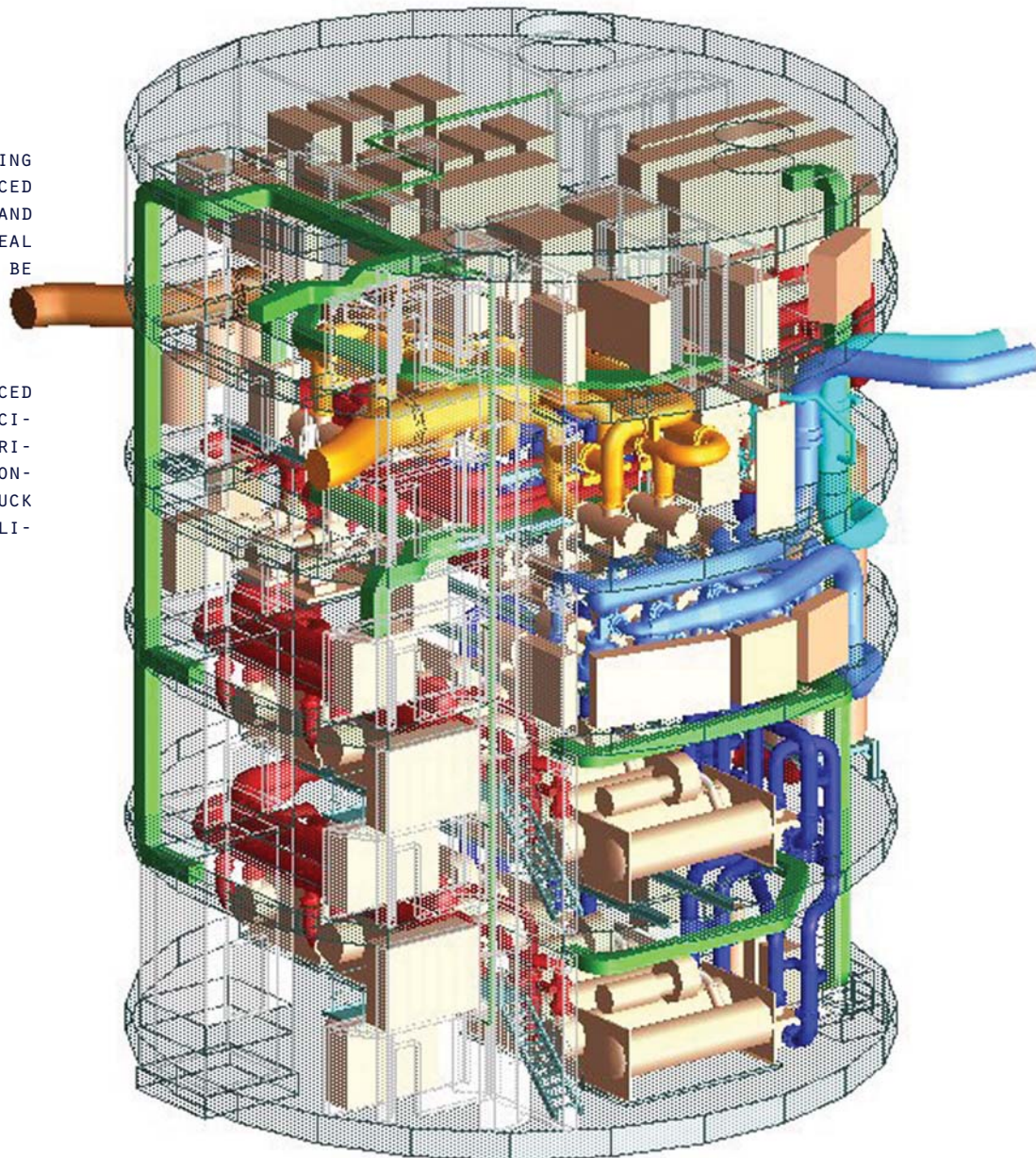
THE CANADA PLANT USES WATER FROM THE RIVER SEINE THAT IS CHILLED TO 5 DEGREES CELSIUS AND THEN DISTRIBUTES THE WATER THROUGHOUT THE CITY TO BUSINESSES, HOMES, AND PUBLIC BUILDINGS, INCLUDING THE LOUVRE. BY PLACING THE ENTIRE PLANT UNDERGROUND THE FACILITY COULD BE LOCATED NEARER THE CITY CENTER THEREBY REDUCING THE LENGTH OF PIPE AND RESULTANT ENERGY LOSS.

## BENEFITS

REDUCED CFC OUTPUT BY CONSOLIDATING COOLING EQUIPMENT. INCREASED EFFICIENCY AND REDUCED COSTS. AREA ABOVE FACILITY REVITALIZED AND PARK UPGRADED, INCREASING AESTHETIC APPEAL OF AREA RATHER THAN DECREASING AS WOULD BE THE CASE WITH AN ABOVE GROUND FACILITY.

## KEYS TO SUCCESS

USE OF NEW TECHNOLOGIES SUCH AN ADVANCED DIAPHRAGM WALL DESIGN ALLOWING FOR PRECISION CONTROL OF EXCAVATION ON A GEOMETRICALLY CONSTRAINED SITE. MITIGATION OF CONSTRUCTION IMPACTS THROUGH THE USE OF TRUCK WASHES, AND STRINGENT CONTROLS ON CLEANLINESS IN AND AROUND THE JOB SITE.



## FURTHER INFORMATION

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# PRAGUE METRO

OWNER: INŽENÝRING DOPRAVNÍCH STAVEB

DESIGNER: METROPROJEKT PRAHA  
CONTRACTOR: METROSTAV/SKANSKA

THE NEW METRO TRACK LEADS FROM THE EXISTING TERMINUS, LÁDVÍ TO THE NEW TERMINUS, LETNANY BY WAY OF TWO NEW STATIONS, STRÍŽKOV, AND PROSEK. A TEMPORARY PARK-AND-RIDE YARD WITH 203 PARKING PLACES IS PLANNED FOR THE STRÍŽKOV STATION. AT THE NEW TERMINUS LETNANY, WHICH HAS TWO VESTIBULES, A BUS TERMINAL STATION IS PLANNED WITH A LARGE PARKING AREA AND A PARK-AND-RIDE YARD WITH 683 PARKING PLACES IS ALSO PLANNED. THE NEW METRO STATION LETNANY IS DESIGNED FOR FUTURE CONNECTION TO THE PLANNED PRAGUE EXHIBITION GROUND. TECHNICAL PARAMETERS: DOUBLE TRACK METRO LINE EXTENSION, TOTAL LENGTH OF 4,6 KM, TUNNEL SECTION CONSTRUCTED BY NRTM METHOD (CROSS SECTION OF DOUBLE TRACK TUNNEL IS 64 M2) AND PARTLY IN OPEN AIR CONSTRUCTION PIT, DEPTH BELOW SURFACE 11,0 – 17,0 M, GROUND WATER PRESSURE ABOUT 0,15 MPA, GEOLOGY - SEDIMENTARY STRATIFIED ROCKS WITH VARYING LEVEL OF UNDERGROUND WATER.



## URBAN ISSUES

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- LAND USE
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- MULTI-USE
- INTRA-TRANSIT
- SEISMIC
- OTHER

TOTAL COST: €517 MILLION

### PLANNING

MAY '98 - DEC. '07

### CONSTRUCTION

MAY '04 - MAY '08

THE NEW EXTENSION WILL INCREASE THE SERVICE AREA OF THE PRAGUE METRO SYSTEM, EASING TRAFFIC TO AND FROM THE NEW SERVICE AREA.

REDUCTION OF TRAFFIC AND CONGESTION REDUCES OVERALL POLLUTION, USE OF ELECTRIC CARS CREATES MINIMAL POLLUTION.





## SOLUTION

ENERGY  
HOUSING

**RAIL**

ROAD

PEDESTRIAN

PARKING

VENUE

SHOPPING

MULTI-USE

STORAGE

PIPELINE

SEWER

TREATMENT

RECREATION

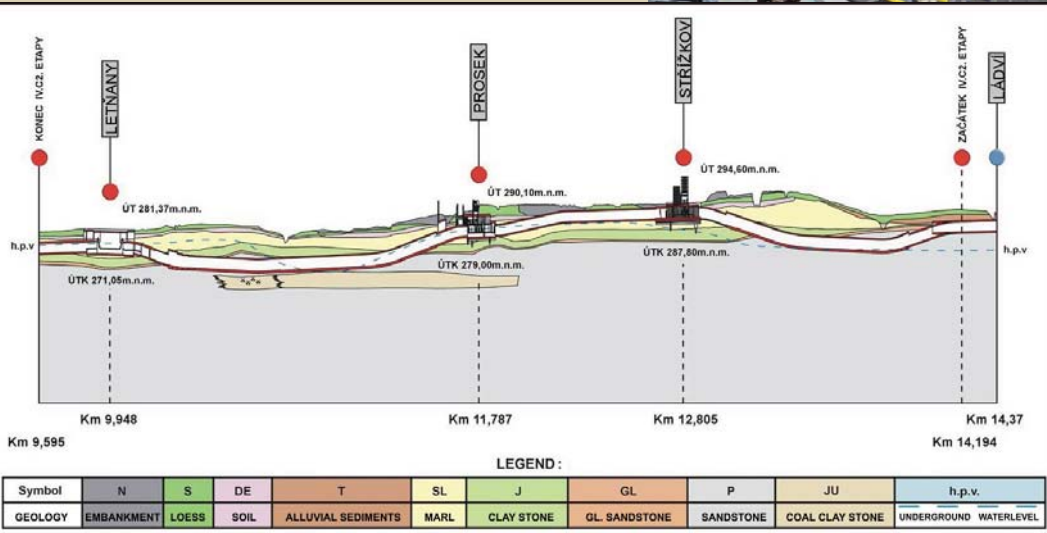
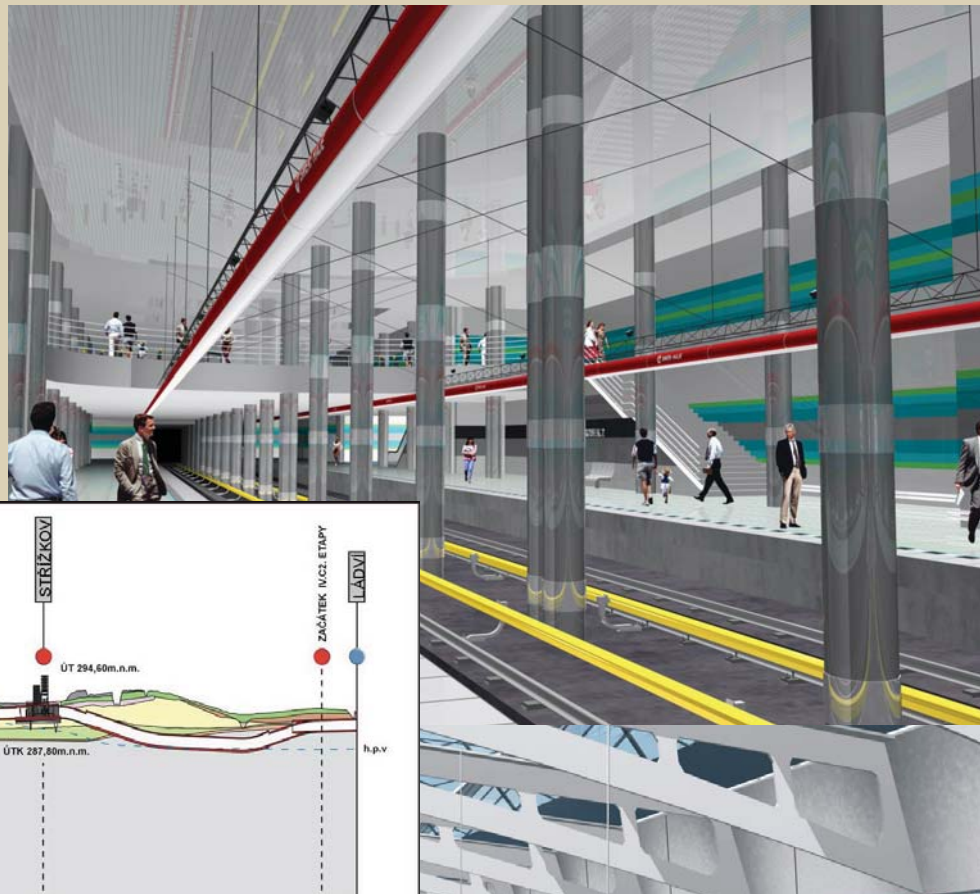
UNDERGROUND DOUBLE TRACK METRO RAIL LINE WITH AN OPERATING LENGTH OF 4.42 KM, AND THREE STATIONS. AVERAGE DISTANCE BETWEEN STATIONS IS 1413 M, TRAIN SET 100 M LONG CONSISTS OF 5 METRO CARS. OPERATING COMMERCIAL HEADWAY - 120 SEC, DESIGNED HEADWAY - 90SEC. TRAIN SET CAPACITY - 845 PERSONS (4 STANDING PERSONS/M<sup>2</sup>), OPERATION CAPACITY (PERS./KM) = 90.1 MIL/YEAR. INVESTMENT COST € 103 MIL/KM. ELECTRICAL ENERGY CONSUMPTION 15,181 MWH/YEAR (TRACTION), OPERATING EXPENSES €1,25/CAR.KM.

## BENEFITS

4 BUS LINES WILL BE ELIMINATED AND THEIR ROUTES SERVICED BY THE NEW SUBWAY. THIS WILL RESULT IN SIGNIFICANT COST SAVINGS AS WELL AS DECREASED CONGESTION, POLLUTION, ACCIDENTS, AND SHORTER TRAVEL TIMES FOR CUSTOMERS.

## KEYS TO SUCCESS

TBD



## FURTHER INFORMATION

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SRAMEK@METROSTAV.CZ







# NORTHSIDE STORAGE

OWNER: SYDNEY WATER CORPORATION

DESIGNER: CONNELL WAGNER PTY LTD  
CONTRACTOR: JOHN HOLLAND PTY LTD

**FUNCTION:**  
STORAGE / TRANSFER TUNNEL FOR PRE-VENTION OF POLLUTION OF SYDNEY HARBOUR BY INTERCEPTING MAJOR WET WEATHER OVERFLOWS FROM A LARGE URBAN SEWER AND CONVEYING TO SEWAGE TREATMENT PLANT FOR TREATMENT AND OCEAN DISPOSAL.

**TOTAL TUNNEL LENGTH:** 21 KILOMETERS, PLUS 2 KILOMETERS OF ACCESS DECLINES AND UNDERGROUND CAVERNS

**MAIN TUNNEL DIAMETER:** VARIES FROM 6.6 METRES TO 3.8 METRES

**DEPTH BELOW SURFACE:** UP TO 187 METRES

**DEPTH BELOW SEA LEVEL:** 40 METRES TO 100 METRES

**TOTAL VOLUME:** 512,000 M3

**GROUND CONDITIONS:** MEDIUM TO HIGH STRENGTH SANDSTONE AND SILT-STONE. HIGHLY WATERCHARGED ZONES BENEATH SEDIMENT-FILLED PALEO-CHANNELS FORMING PARTS OF SYDNEY HARBOUR

**CONSTRUCTION METHOD:** ACCESS DECLINES AND CAVERNS – FIVE ROADHEADERS (2 VOEST ALPINE AM105, 2 MITSUI S300, 1 MITSUI S200). MAIN TUNNEL – FOUR OPEN FACE TUNNEL BORING MACHINES (WIRTH 6.6 M DIA., WIRTH 6.3 M DIA., ROBBINS 6.0 M DIA., WIRTH 3.8 M DIA.)

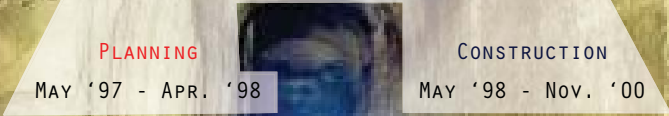
**SPOIL HANDLING AND DISPOSAL:** CONTINUOUS CONVEYOR SYSTEM FROM ALL 4 TBMS, OUTLOADED TO BARGES AT TWO HARBOURSIDE LOADING POINTS (ONE POINT VIA 187 M VERTICAL CONVEYOR AND DEDICATED 1.5 KM, 3.8 M DIA. CONVEYOR TUNNEL), TRANSPORTED 18 KM ACROSS SYDNEY HARBOUR BY BARGE TO RAILHEAD, LOADED ONTO TRAINS AND TRANSPORTED 52 KM TO RE-USE SITE.

**TOTAL TUNNEL SPOIL RE-USED** 1.8 MILLION TONNES.

## URBAN ISSUES

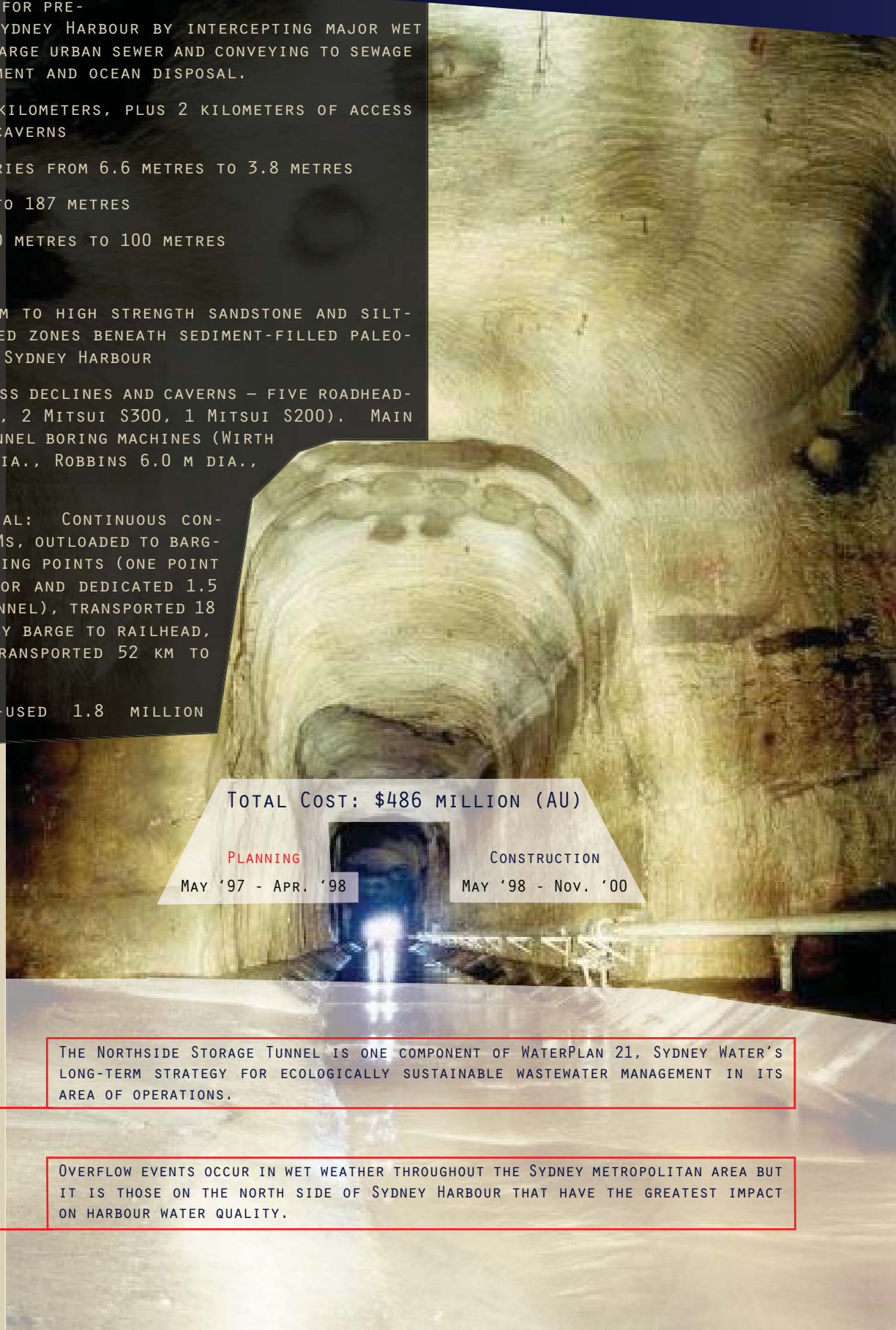
- ARCHITECTURE
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- SEISMIC
- OTHER

TOTAL COST: \$486 MILLION (AU)



THE NORTHSIDE STORAGE TUNNEL IS ONE COMPONENT OF WATERPLAN 21, SYDNEY WATER'S LONG-TERM STRATEGY FOR ECOLOGICALLY SUSTAINABLE WASTEWATER MANAGEMENT IN ITS AREA OF OPERATIONS.

OVERFLOW EVENTS OCCUR IN WET WEATHER THROUGHOUT THE SYDNEY METROPOLITAN AREA BUT IT IS THOSE ON THE NORTH SIDE OF SYDNEY HARBOUR THAT HAVE THE GREATEST IMPACT ON HARBOUR WATER QUALITY.

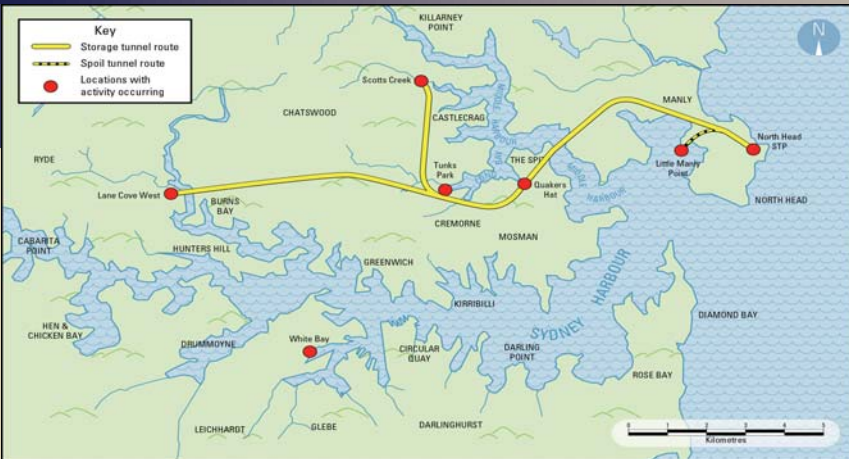




## SOLUTION

ENERGY  
HOUSING  
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SEWER  
TREATMENT  
RECREATION

THE LOCATIONS OF THE FOUR MAJOR WET WEATHER SEWERAGE OVERFLOWS ON SYDNEY'S NORTH SIDE SUGGESTED THAT EFFECTIVE CAPTURE AND STORAGE COULD BE PROVIDED BY A TUNNEL SYSTEM. THE ROUTE OF THE MAIN TUNNEL COMMENCES ON THE WESTERN SIDE OF THE LANE COVE RIVER AND EXTENDS SOME 16 KM EASTERLY TO NORTH HEAD SEWAGE TREATMENT PLANT. APPROXIMATELY HALF WAY ALONG THE MAIN TUNNEL, A BRANCH TUNNEL EXTENDS 3.5 KM NORTHERLY TO SCOTTS CREEK. AS PART OF THE PROJECT, A 1.5 KM SPOIL CONVEYOR TUNNEL WAS CONSTRUCTED BETWEEN NORTH HEAD AND LITTLE MANLY POINT ON SYDNEY HARBOUR.



## BENEFITS

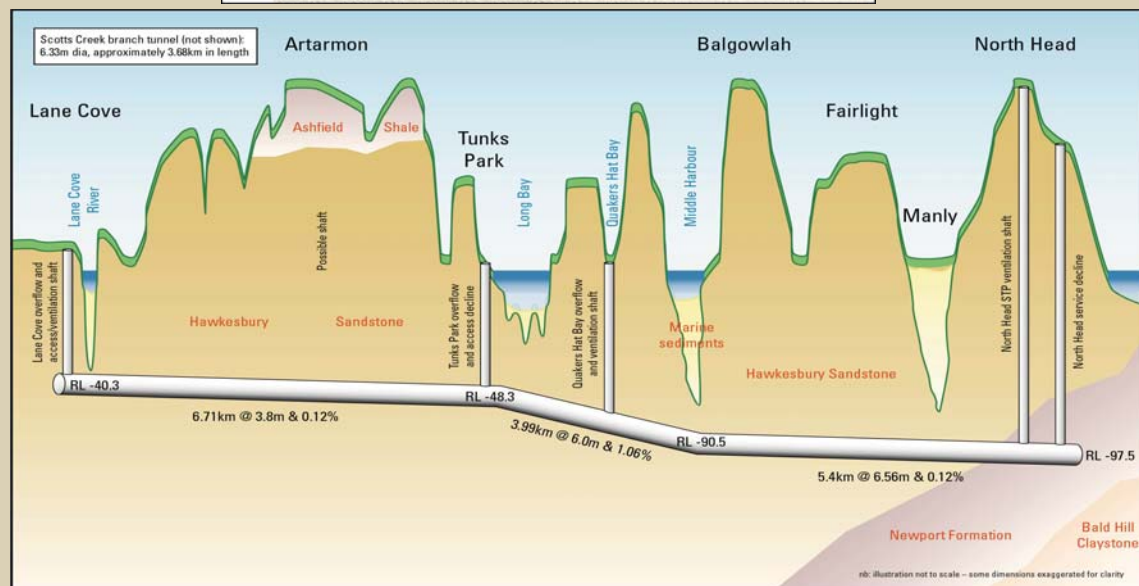
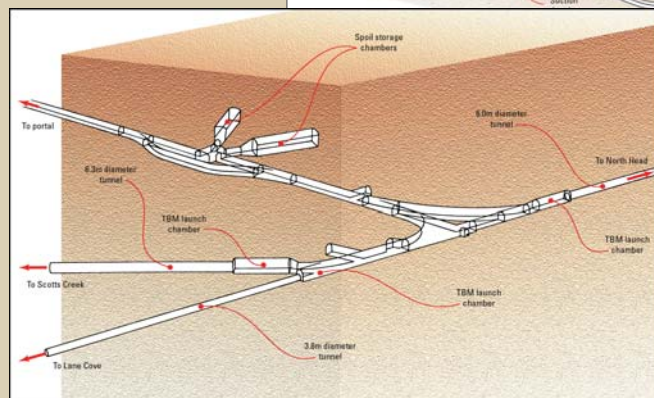
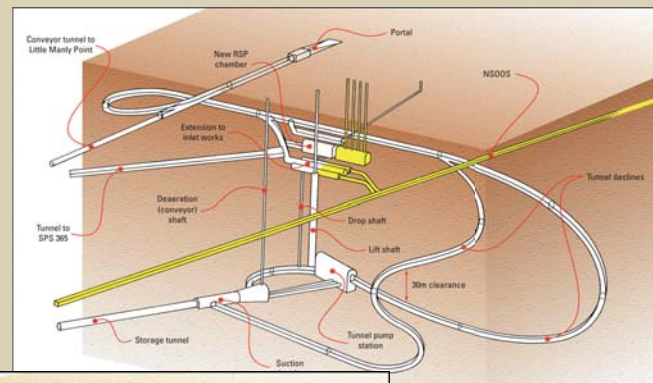
TUNNEL SOLUTION PROVIDED BOTH NECESSARY STORAGE CAPACITY AND MEANS OF TRANSPORT OF WASTE WATER TO TREATMENT PLANT. FLEXIBILITY OF TUNNEL ALIGNMENT ALLOWED LOCATION BENEATH MAJOR OVERFLOW POINTS. ALTERNATIVE SOLUTION INVOLVING LOCALIZED TREATMENT OF OVERFLOWS UNACCEPTABLE IN HIGHLY DEVELOPED RESIDENTIAL AREAS.

## KEYS TO SUCCESS

PROJECT DELIVERED BY AN ALLIANCE FORMED BY PUBLIC UTILITY (OWNER), TWO ENGINEERING CONSULTANT COMPANIES AND A CONSTRUCTION COMPANY. THIS WAS THE FIRST PUBLIC SECTOR ALLIANCE PROJECT IN AUSTRALIA.

TUNNEL LOCATED SUFFICIENTLY DEEP TO BE TOTALLY WITHIN ROCK STRATA SUITABLE FOR TBM EXCAVATION.

CONSTRUCTED WITHIN HIGHLY DEVELOPED URBAN RESIDENTIAL AREA, REQUIRING NOISE, DUST, TRAFFIC, ETC., IMPACTS TO BE FULLY ADDRESSED. GOVERNMENT POLICIES REQUIRE WASTE MINIMISATION TO BE ADDRESSED.



## FURTHER INFORMATION

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# MARSEILLE CITY HALL

OWNER: MARSEILLES MUNICIPALITY

DESIGNER: FRANCK HAMMOUTENE

CONTRACTOR: BETEREM

THE MARSEILLES CITY HALL IS A 17TH CENTURY BUILDING ON THE BANK OF THE "VIEUX PORT" (OLD HARBOR).

IT NEEDED A LARGE MEETING ROOM, VERY CLOSE TO THE MAIN BUILDING, WITHOUT ANY ALTERATION OF THE SETTINGS AROUND.

THE UNDERGROUND PROPOSAL BY ARCHITECT FRANCK HAMMOUTENE WAS RETAINED,, AND WON THE SILVER T-SQUARE PRIZE OF ARCHITECTURE

THE EXTENSION IS BUILT UNDER A MULTI-STEP ESPLANADE ALONG THE 10 M DIFFERENCE OF LEVEL FROM HÔTEL-DIEU HOSPITAL TO VIEUX PORT QUAY, AROUND THE ANCIENT BUILDING, THE SETTINGS OF WHICH IS FULLY PRESERVED AND GREATLY VALORISED

THE FAN-SHAPED DELIBERATION HALL OFFERING 300 SEATS HAS BEEN ISOLATED FROM NOISES AND VIBRATIONS ON THE PUBLIC SQUARE ON ITS CEILING. A HIGH NAVE ON ITS SIDE MAY SERVE AS A MEETING PLACE FOR REPRESENTATIVES DURING ASSEMBLY TIME, AND OTHERWISE ACCOMMODATES EXHIBITIONS.

SURFACE 8,300 SQ M

CONSTRUCTION IN OPEN CUT

## URBAN ISSUES

ARCHITECTURE

SERVICE

SAFETY

PUBLIC TRANSIT

TRAFFIC

TRAVEL TIME

NOISE LEVELS

POLLUTION

NATURAL HAZARDS

LAND USE

SERVICEABILITY

CONSTRUCTION

MULTI-USE

INTRA-TRANSIT

SEISMIC

OTHER

TOTAL COST: TBD

PLANNING

TBD - TBD

CONSTRUCTION

TBD - TBD

RATHER THAN OCCUPYING AN OPEN PUBLIC SPACE, THE NEW UNDERGROUND DELIBERATION HALL CONSTRUCTION PRESERVED THE PARK WHILE CREATING AN AWARD WINNING ARCHITECTURAL SPACE BELOW. BY PLACING THE HALL UNDERGROUND, DIRECT ACCESS FROM CITY HALL IS POSSIBLE, INCREASING SAFETY, AND SECURITY.

A KEY REQUIREMENT OF THE PROJECT WAS NOT AFFECTING THE ARCHITECTURE AND SURROUNDING GROUNDS OF THE CITY HALL WHILE CREATING A LARGE HALL CONNECTING TO IT. THEREFORE THE FACILITY WAS PLACED UNDERGROUND AND THE SPACE ABOVE RESTORED AFTERWARD.





## SOLUTION

ENERGY  
HOUSING  
RAIL  
ROAD  
PEDESTRIAN  
PARKING  
VENUE  
SHOPPING  
MULTI-USE  
STORAGE  
PIPELINE  
SEWER  
TREATMENT  
RECREATION

TBD

## BENEFITS

BUILDING UNDERGROUND PRESERVED THE ARCHITECTURAL QUALITIES OF THIS HISTORIC DISTRICT WHILE ALLOWING FOR THE NEEDS OF THE COMMUNITY TO BE MET.

## KEYS TO SUCCESS

TBD



## FURTHER INFORMATION

TBD

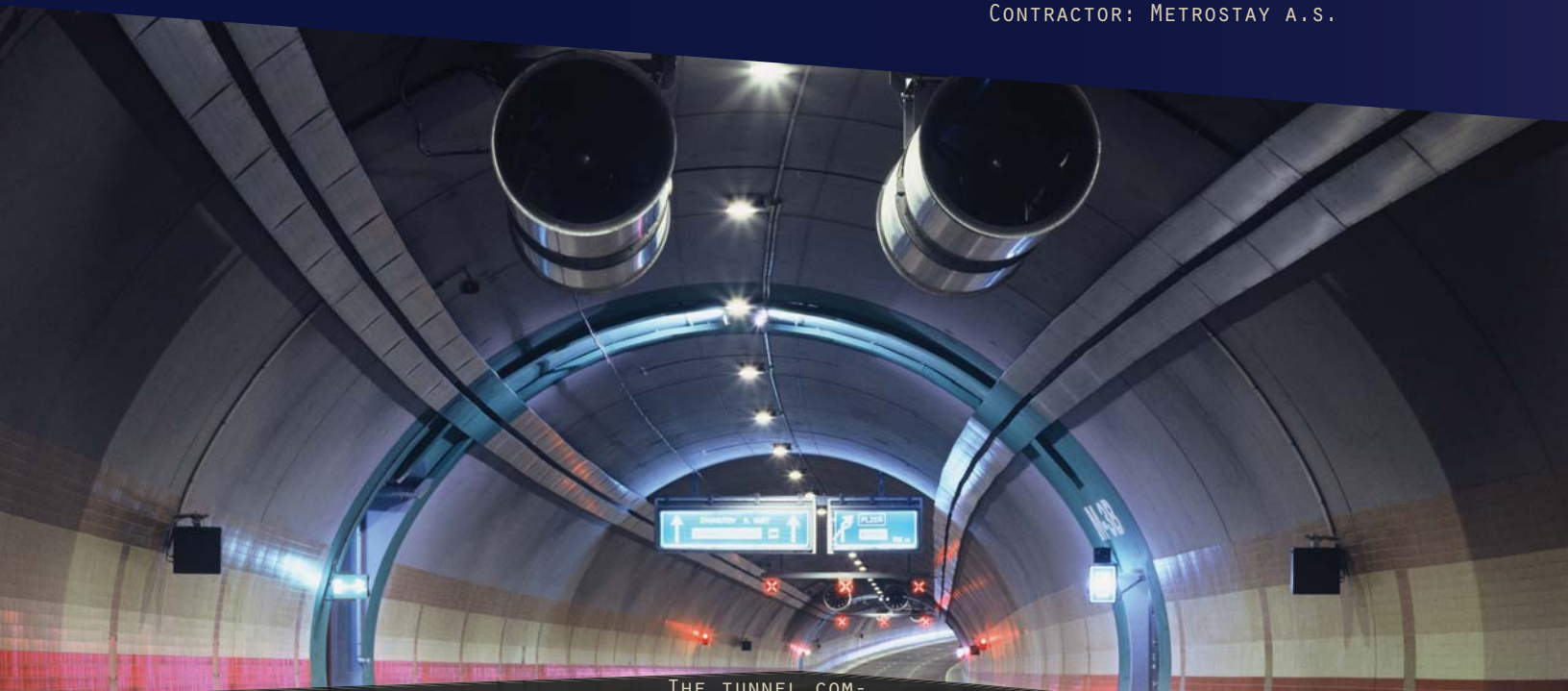




# PRAGUE RING ROAD

OWNER: THE CAPITAL CITY OF PRAGUE

DESIGNER: SATRA, SPOL. S.R.O.  
CONTRACTOR: METROSTAY A.S.



THE TUNNEL COM-  
PLEX IS LOCATED INSIDE THE CITY OF PRAGUE, ON THE  
WESTERN PART OF THE CITY CIRCLE ROAD (CCR). THE INITIAL DESIGN DRAFTS FOR THIS SECTION OF THE CCR  
PROJECT FROM THE 1990S GRADUALLY SWITCHED FROM SUBSURFACE ROADS TO TUNNEL STRUCTURES.  
THE TOTAL LENGTH OF THE TUNNEL AMOUNTS TO 1300M FOR THE WESTERN TUBE AND 1254M FOR THE EASTERN TUBE. THE MAJOR PART OF  
THE TUNNEL WAS BUILT BY MINING METHODS.  
THE MAIN UNDERGROUND VENTILATION PLANT AND TRANSFORMER STATION, ARE LOCATED IN A CAVERN EXCAVATED UNDER PAVÍ HILL,  
AND A VENTILATION TUNNEL AND SHAFT CONNECT THE CAVERN WITH AN AT-GRADE EXHAUST STRUCTURE. BOTH MAIN TUNNEL TUBES ARE  
INTERCONNECTED BY A TOTAL OF SIX CROSS PASSAGES.  
TWO PARALLEL THREE-LANE MINED TUNNEL TUBES ( DRIVEN BY NRTM) RUN FROM THE NORTHERN PORTAL. BOTH THREE-LANE TUBES SPLIT  
IN BIFURCATION CHAMBERS INTO DOUBLE-LANE MINED TUNNELS, WHICH CONTINUE ALONG THE ALIGNMENT OF THE CITY CIRCLE ROAD,  
AND SINGLE-LANE BRANCHES, WHICH ARE CONNECTED TO RADLICKÁ STREET. THE CUT-AND-COVER TUNNELS ARE CONNECTED TO THE MINED  
DOUBLE-LANE TUNNELS AT THE PORTALS IN RADLICKÁ STREET.

## URBAN ISSUES

- ARCHITECTURE
- SERVICE
- SAFETY
- PUBLIC TRANSIT
- TRAFFIC
- TRAVEL TIME
- NOISE LEVELS
- POLLUTION
- NATURAL HAZARDS
- LAND USE
- SERVICEABILITY
- CONSTRUCTION
- MULTI-USE
- INTRA-TRANSIT
- SEISMIC
- OTHER

TOTAL COST: €235 MILLION

### PLANNING

JAN. '92 - AUG. '04

### CONSTRUCTION

DEC. '98 - AUG. '04

THE BASIC ROAD SYSTEM OF CAPITAL PRAGUE IS FORMED BY THREE RINGS WHICH ARE CUT ACROSS BY RADIAL ROADS. BUILD-UP OF THE MIDDLE RING WAS STARTED BY CONSTRUCTING A BRIDGE ACROSS THE RIVER VLTAVA, AND THE STRAHOVSKY TUNNEL. THEN IT WAS NECESSARY TO FIND AN APPROPRIATE MEANS OF CONNECTING THESE TWO PROJECTS. INITIALLY A SURFACE ROAD ARRANGEMENT WAS PROPOSED. HOWEVER, FURTHER ANALYSIS SHOWED SERIOUS DISADVANTAGES TO A SURFACE SOLUTION. WITH AN EXPECTED 50,000 CARS/DAY, SPLITTING OF ADJACENT URBAN AREA BY HEAVY TRANSPORT AND TRAFFIC CONGESTION FORECASTED UNACCEPTABLE IMPACT TO THE ENVIRONMENT THROUGH NOISE AND AIR POLLUTION. FINALLY AN UNDERGROUND OPTION WAS ACCEPTED BY THE CITY AUTHORITY. THIS TUNNEL CONNECTION ENABLES SMOOTH TRAFFIC FLOW THAT LEADS TO A REDUCTION IN EMISSIONS, NOISE AND TRAVEL TIME.



## SOLUTION

ENERGY  
HOUSING  
RAIL  
ROAD

PEDESTRIAN  
PARKING  
VENUE  
SHOPPING  
MULTI-USE  
STORAGE  
PIPELINE  
SEWER  
TREATMENT  
RECREATION

UTILIZING A ROAD TUNNEL COMPLEX SOLVES THE PROBLEM OF PROVIDING TRANSPORT IN A RESIDENTIAL AREA THE CITY. IN SPITE OF ITS HIGHER INITIAL INVESTMENT COST THE UNDERGROUND SOLUTION WAS APPROVED BY TOWN DECISION MAKERS. FINANCIAL ASSESSMENT OF ENVIRONMENTAL ASPECTS OF THE PROJECT PROVED THE BENEFITS OF THE PROPOSED SOLUTION OUTWEIGHED THE HIGHER COSTS.

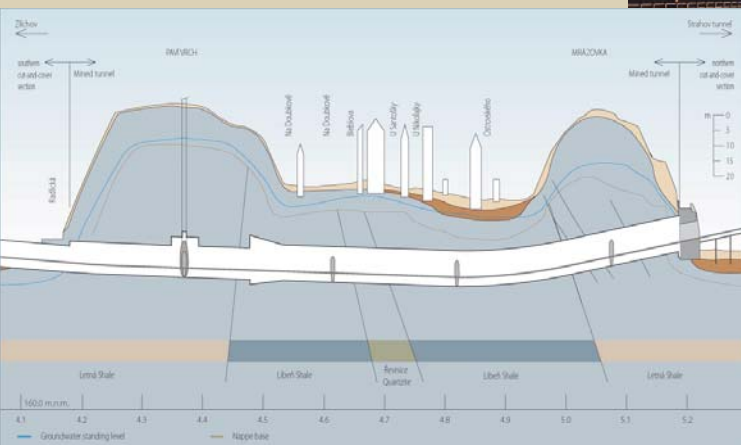


## BENEFITS

MINIMIZED DISRUPTION TO SURROUNDING RESIDENTIAL NEIGHBORHOOD WHILE ENABLING HIGH SPEED ACCESS THROUGHOUT THE AREA. REDUCTIONS IN AIR AND NOISE POLLUTION. LOWERED ACCIDENT FREQUENCY SINCE TRAFFIC IN THE TUNNEL IS UNAFFECTED BY RAIN OR SNOW.

## KEYS TO SUCCESS

USE OF NEW TECHNOLOGIES, SUCH AS THE NATM. HIGH TECH TUNNEL MONITORING AND COMMAND CENTER, ABLE TO REMOTELY DEAL WITH EMERGENCIES WITHIN THE TUNNEL AND PROVIDE ACCURATE INFORMATION TO EMERGENCY CREWS AS TO THE LOCATION OF ANY PROBLEMS.



## FURTHER INFORMATION

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# YANGTZE RIVER

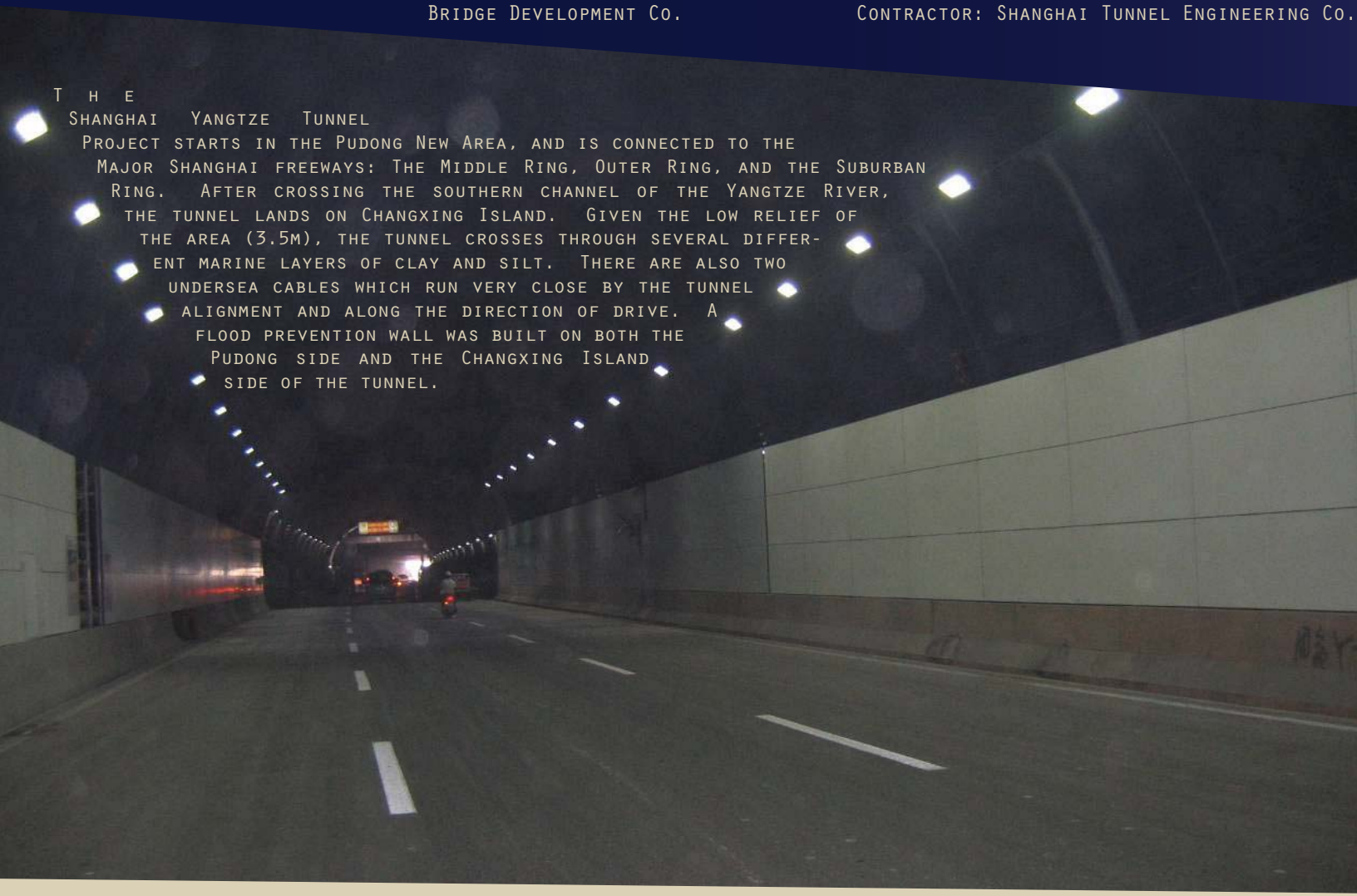
OWNER: SHANGHAI CHANGJIANG TUNNEL &  
BRIDGE DEVELOPMENT CO.

DESIGNER: STEDI  
CONTRACTOR: SHANGHAI TUNNEL ENGINEERING CO.

T H E

SHANGHAI YANGTZE TUNNEL

PROJECT STARTS IN THE PUDONG NEW AREA, AND IS CONNECTED TO THE MAJOR SHANGHAI FREEWAYS: THE MIDDLE RING, OUTER RING, AND THE SUBURBAN RING. AFTER CROSSING THE SOUTHERN CHANNEL OF THE YANGTZE RIVER, THE TUNNEL LANDS ON CHANGXING ISLAND. GIVEN THE LOW RELIEF OF THE AREA (3.5M), THE TUNNEL CROSSES THROUGH SEVERAL DIFFERENT MARINE LAYERS OF CLAY AND SILT. THERE ARE ALSO TWO UNDERSEA CABLES WHICH RUN VERY CLOSE BY THE TUNNEL ALIGNMENT AND ALONG THE DIRECTION OF DRIVE. A FLOOD PREVENTION WALL WAS BUILT ON BOTH THE PUDONG SIDE AND THE CHANGXING ISLAND SIDE OF THE TUNNEL.



## URBAN ISSUES

ARCHITECTURE

SERVICE

SAFETY

PUBLIC TRANSIT

TRAFFIC

TRAVEL TIME

NOISE LEVELS

POLLUTION

NATURAL HAZARDS

LAND USE

SERVICEABILITY

CONSTRUCTION

MULTI-USE

INTRA-TRANSIT

SEISMIC

OTHER

TOTAL COST: 6.3 BILLION RMB

PLANNING

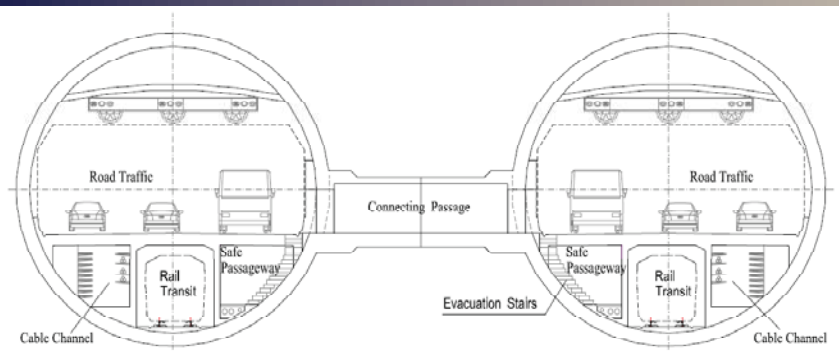
1993 - 2004

CONSTRUCTION

2004 - 2009

THE SHANGHAI YANGTZE RIVER TUNNEL IS LOCATED AT THE MOUTH OF THE YANGTZE RIVER IN THE NORTHEAST OF SHANGHAI. THE TUNNEL IS HAS BECOME A MAJOR PART OF THE NATIONAL EXPRESSWAY SYSTEM. THE TUNNEL IS PART OF THE LARGEST BRIDGE AND TUNNEL COMBINATION PROJECT IN THE WORLD. THE TUNNEL WILL MOVE TRAFFIC QUICKLY FROM THE NORTH OF THE JIANGSU PROVINCE, AND INCREASE ECONOMIC DEVELOPMENT IN THE YANGTZE RIVER DELTA.





## SOLUTION

ENERGY  
HOUSING  
RAIL  
**ROAD**

PEDESTRIAN  
PARKING  
VENUE  
SHOPPING  
MULTI-USE  
STORAGE  
PIPELINE  
SEWER  
TREATMENT  
RECREATION

THE INTERNAL FINISHED DIAMETER OF THE TUNNEL IS 13.7M. THE TUNNEL INCLUDES THREE LANES AND A DECK BELOW THEM TO SUPPORT FUTURE RAIL TRAFFIC. THE LEFT AND RIGHT SIDES OF THE TUNNEL ARE USED FOR EVACUATION AND CABLE SPACE RESPECTIVELY. THE AREA ABOVE THE ROADWAY IS USED FOR AIR EXCHANGE DUCTS.

## BENEFITS

NO DISRUPTION TO WATERWAY TRAFFIC. LOW ENVIRONMENTAL IMPACT, AND REDUCED NOISE, VIBRATION AND POLLUTION VERSUS TRADITIONAL EXCAVATION METHODS.

## KEYS TO SUCCESS

USE OF TWO EXTREMELY LARGE SLURRY TBMS WITH MANNED ENTRY AT UP TO 5.5 BAR. SPECIAL WEAR PROTECTION TO REDUCE THE NEED FOR MANNED ENTRIES. DOUBLE PRESSURE SEALS FOR THE MAIN BEARING.



## FURTHER INFORMATION

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# OPERA HOUSE CARPARK

OWNER: TBD

DESIGNER: DR PELLIS, MR. COLEFAX, MR. BARRY  
CONTRACTOR: THIESS PT LTD

AFTER THE OPERA HOUSE WAS COMPLETED IN 1973 THERE WAS A NEED FOR NEARBY PARKING. A 12 STORY, FREE STANDING, UNDERGROUND, DOUBLE HELIX STRUCTURE WAS BUILT NEARBY TO MEET THE REQUIREMENTS. THE CAVERN HAS AN OUTER DIAMETER OF 71.2M WITH A CENTRAL ROCK CORE 36.4M IN DIAMETER, WITH A 7-8M THICK CROWN PILLAR. THE CAVERN IS 34M DEEP AND HAS FOUR 6M WIDE TUNNELS CUT THROUGH THE CORE PILLAR TO PROVIDE CROSS CONNECTIONS BETWEEN HELICES. THE STRUCTURE ITSELF IS FREE STANDING WITHIN THE CAVERN, WHICH IS SUPPORTED BY ROCK ANCHORS AND DOWELS. THE ROOF IS COVERED WITH A 150MM LAYER OF SHOTCRETE. THE 34M HIGH WALLS ARE UNLINED AND THERE ARE NO FORMED CONCRETE LININGS ON ANY OF THE ACCESS AND VENTILATION TUNNELS OR ANY PART OF THE MAIN CAVERN.



## URBAN ISSUES

- ARCHITECTURE
- SERVICE
- SAFETY
- PUBLIC TRANSIT
- TRAFFIC
- TRAVEL TIME
- NOISE LEVELS
- POLLUTION
- NATURAL HAZARDS
- LAND USE
- SERVICEABILITY
- CONSTRUCTION
- MULTI-USE
- INTRA-TRANSIT
- SEISMIC
- OTHER

TOTAL COST: \$40+ MILLION (AU)

### PLANNING

1988 - 1990

### CONSTRUCTION

1992 - 1994

A SHORT ACCESS TUNNEL SO AS TO MINIMIZE THE PERCEPTION BY PATRONS THAT THEY WERE DRIVING DEEP INTO THE EARTH. A CLEAR SPAN OF 17.4M TO ALLOW FOR TWO ROWS OF PARKED CARS AND A CENTRAL AISLE

EXCAVATION TECHNIQUE HAD TO PERFORM TO ESTABLISHED NOISE AND VIBRATION CONSTRAINTS ESTABLISHED BY THE DEPARTMENT OF PUBLIC WORKS. PEDESTRIAN ACCESS FROM THE PARKING STATION TO THE FORECOURT OF THE OPERA HOUSE.





## SOLUTION

ENERGY  
HOUSING  
RAIL  
ROAD  
PEDESTRIAN  
**PARKING**  
VENUE  
SHOPPING  
MULTI-USE  
STORAGE  
PIPELINE  
SEWER  
TREATMENT  
RECREATION

ONE OF THE LARGEST SHALLOW ROCK CAVERNS IN THE WORLD WITH A SPAN OF BETWEEN 17.5 AND 19M WITH A 7-9M THICK CROWN PILLAR OF WEATHERED SANDSTONE SUPPORTED BY TENSIONED AND UNTENSIONED ANCHORS AS WELL AS A 150MM SKIN OF REINFORCED SHOTCRETE. THE DOUBLE HELIX DESIGN ALLOWS FOR QUICK ACCESS AND EGRESS FROM EVENTS AT THE OPERA HOUSE.

## BENEFITS

ALLOWED EASY PARKING ACCESS TO A WORLD RENOWNED STRUCTURE AND SYDNEY LANDMARK. DID NOT DISRUPT SURROUNDING AREA INCLUDING HARBOUR, AND MET ALL NOISE AND VIBRATION REQUIREMENTS DURING CONSTRUCTION.

## KEYS TO SUCCESS

FULLY PRIVATELY FINANCED.  
WORLD'S FIRST DOUBLE HELIX UNDERGROUND PARKING STRUCTURE.  
LARGE SPANS SUPPORTED IN SANDSTONE.



**FURTHER INFORMATION**  
ROADS AND TRAFFIC AUTHORITY, NSW  
LEVEL 4, 260 ELIZABETH STREET, SURRY HILLS NSW 2010 AUSTRALIA  
WWW.RTA.NSW.GOV.AU  
MARK ANDREW  
(02) 9218 6225  
MARK.ANDREW@RTA.NSW.GOV.AU





# EXPO POWER STATION

OWNER: SHANGHAI MUNICIPAL ELECTRIC Co.

DESIGNER: XD-AD

CONTRACTOR: TBD

T H E

SHANGHAI WORLD EXPO

500kV UNDERGROUND TRANSMISSION AND SUBSTATION, SIT-

UATED IN THE CENTRAL DISTRICT OF SHANGHAI IS AN IMPORTANT PROJECT LEADING UP TO

THE 2010 SHANGHAI WORLD EXPO. THE PROJECT CONSISTS OF A FOUR LEVEL, 130M DIAMETER SHAFT. THE TOTAL DEPTH OF

THE SHAFT IS 34M AND IT WAS CONSTRUCTED IN DIFFICULT MARINE LAYERS VARYING FROM SOFT CLAY AND SAND; WITH A GROUND-

WATER TABLE APPROXIMATELY 0.3-1.5M BELOW THE GROUND SURFACE. THE EXCAVATION WAS MADE POSSIBLE THROUGH THE USE OF

CYLIDRICAL DIAPHRAGM WALLS WITH A THICKNESS OF 1.2M AND LENGTH OF 57.5M. SHAFT-GROUTED PILES WITH A LENGTH OF 48.6M

WERE USED TO COMBAT UPLIFT WATER PRESSURES.



## URBAN ISSUES

ARCHITECTURE

SERVICE

SAFETY

PUBLIC TRANSIT

TRAFFIC

TRAVEL TIME

NOISE LEVELS

POLLUTION

NATURAL HAZARDS

LAND USE

SERVICEABILITY

CONSTRUCTION

MULTI-USE

INTRA-TRANSIT

SEISMIC

OTHER

TOTAL COST: 480 MILLION RMB

### PLANNING

JUL. '04 - DEC. '05

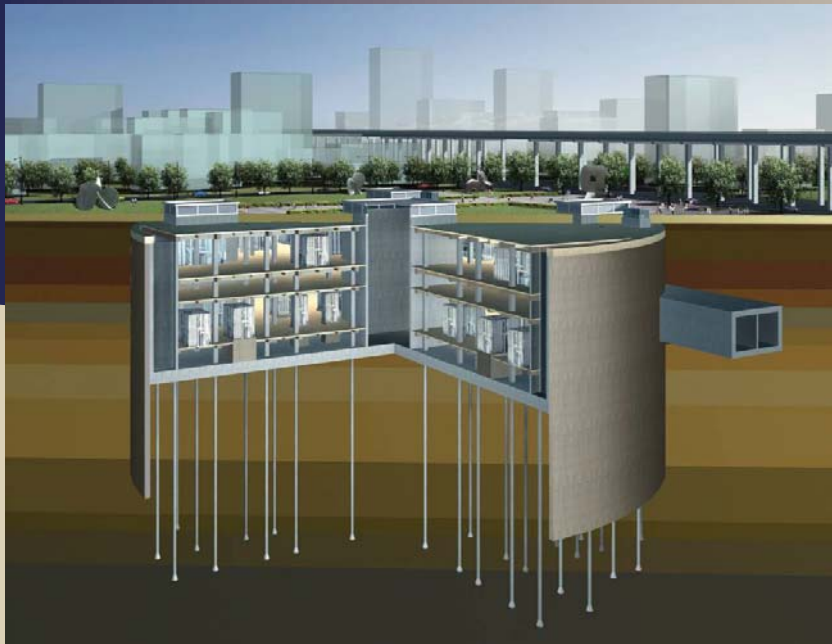
### CONSTRUCTION

DEC. '05 - JUN. '09

THE SHANGHAI WORLD EXPO UNDERGROUND TRANSMISSION AND SUBSTATION (SWEUTS) IS LOCATED NEAR THE HEART OF SHANGHAI, THEREFORE LAND IS AT A PREMIUM. THEREFORE, THE SUBSTATION WILL BE COMPLETELY UNDERGROUND WHILE ABOVE, A SCULPTURE PARK IS PLANNED. THE ALREADY STRAINED POWER GRIDE OF SHANGHAI WILL BE GREATLY ALLEVIATED BY THE STARTUP OF THE SWEUTS. THE STATION WILL ALSO SUPPLY RELIABLE POWER TO THE 2010 WORLD EXPO.

THE SHANGHAI AREA IS SEISMICALLY ACTIVE AND THEREFORE ANY MAJOR STRUCTURE MUST BE DESIGNED TO WITHSTAND SEISMIC LOADS. BY PLACING SWEUTS UNDERGROUND THE STATION IS PROTECTED AND SO IS THE PUBLIC





## SOLUTION

ENERGY

HOUSING

RAIL

ROAD

PEDESTRIAN

PARKING

VENUE

SHOPPING

MULTI-USE

STORAGE

PIPELINE

SEWER

TREATMENT

RECREATION

THE SHANGHAI WORLD EXPO UNDERGROUND POWER STATION WILL SUPPLY UP TO 500kV OF ELECTRICAL POWER TO THE DOWNTOWN SHANGHAI AREA AND HELP TO GUARANTEE THE STABILITY OF THE ALREADY STRAINED POWER GRID DURING THE 2010 SHANGHAI WORLD EXPO.

## BENEFITS

THE FIRST 500kV UNDERGROUND POWER STATION IN CHINA, UTILIZING MOST ADVANCED TECHNOLOGY AND TECHNIQUES AVAILABLE. THE STATION WILL GUARANTEE A CONTINUOUS POWER SUPPLY TO THE 2010 WORLD EXPO.

## KEYS TO SUCCESS

ECONOMIC USE OF SPACE IN A VERY DENSE AREA, CREATION OF PUBLIC SPACE WHILE ALLOWING THE SUBSTATION TO OPERATE SAFELY AND SECURELY.



## FURTHER INFORMATION

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0086 32 33134530  
[JIANGBIN\\_WU@ECADI.COM](mailto:JIANGBIN_WU@ECADI.COM)





# BUND TOURIST TUNNEL

OWNER: TBD

DESIGNER: TBD  
CONTRACTOR: TBD

BUND TOURIST TUNNEL IS LOCATED UNDER THE HUANGPU RIVER IN SHANGHAI DOWNTOWN. THE PUXI ENTRANCE IS LOCATED IN THE NORTH SIDE OF CHEN YI SQUARE AND BORDERING THE HUANGPU RIVER. THE PUDONG ENTRANCE IS LOCATED IN SOUTH SIDE OF THE ORIENTAL PEARL TV TOWER AND IN FRONT OF THE INTERNATIONAL CONFERENCE CENTER. NOT ONLY IS THE BUND TOURIST TUNNEL A TOURIST ATTRACTION BUT ALSO IT IS AN ARTERIAL CROSS-STRAIT TRAFFIC ROUTE FOR HUANGPU RIVER. THE TUNNEL IS 6.76 METERS IN DIAMETER, AND 646.7 METERS LONG. THE TUNNEL APPLIED A NUMBER OF NEW TECHNOLOGIES, AND BROKE SEVERAL RECORDS. EXCAVATION WAS ACCOMPLISHED THROUGH THE USE OF AN ARTICULATED EPB SHIELD MACHINE. THE 26.2 METERS DEPTH OF THE EXCAVATION PIT IS THE DEEPEST OF ITS TYPE IN SHANGHAI.



## URBAN ISSUES

- ARCHITECTURE
- SERVICE
- SAFETY
- PUBLIC TRANSIT
- TRAFFIC
- TRAVEL TIME
- NOISE LEVELS
- POLLUTION
- NATURAL HAZARDS
- LAND USE
- SERVICEABILITY
- CONSTRUCTION
- MULTI-USE
- INTRA-TRANSIT
- SEISMIC
- OTHER

TOTAL COST: 500 MILLION RMB

PLANNING  
TBD - TBD

CONSTRUCTION  
FEB. '98 - APR. '00

THE BUND TOURIST TUNNEL PROVIDES A CONDUIT TO ALLOW PEDESTRIANS TO QUICKLY CROSS THE HUANGPU RIVER. THE TOTAL TRANSIT TIME IS BETWEEN 2.5 AND 5 MINUTES AND THE TUNNEL CAN HANDLE UP TO FIVE THOUSAND PASSENGERS PER HOUR. EASING TRAFFIC IN DOWNTOWN SHANGHAI AND DECREASING TRAVEL TIME DURING TRAFFIC JAMS AND RUSH HOUR.





## SOLUTION

ENERGY

HOUSING

RAIL

ROAD

PEDESTRIAN

PARKING

VENUE

SHOPPING

MULTI-USE

STORAGE

PIPELINE

SEWER

TREATMENT

RECREATION

THE BUND TOURIST TUNNEL EMPLOYS SMALL AUTOMATED TRAIN CARS WHICH USE ADVANCED MONITORING TECHNOLOGIES TO ENSURE OPTIMAL SERVICE. THE TUNNEL HAS BECOME AN IMPORTANT TOURIST ATTRACTION WITH OVER 100,000 RIDERS IN THE FIRST WEEK OF OCTOBER, 2000.

## BENEFITS

QUICKLY TRANSPORTS PEDESTRIANS ACROSS THE HUANGPU RIVER.

USE OF IMAGES, MUSIC, AND LIGHTS CREATE AN ENTERTAINING SPACE WHILE MOVING PASSENGERS EFFICIENTLY.

## KEYS TO SUCCESS

USE OF AN ARTICULATED EPB MACHINE TO EXCAVATE THE TUNNEL ALLOWED FOR MINIMAL DISTURBANCE DURING CONSTRUCTION.



## FURTHER INFORMATION

WEIDONG WANG  
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