



New Line 4 of Athens Metro

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New Line 4 of Athens Metro

- After several years of careful planning, ATTIKO METRO S.A., the authority responsible for Athens and Thessaloniki Metro construction projects, has tendered the first section of a new metro line in Athens, namely Line 4.
- The current Athens Metro Development Plan includes the Metro Line 4, Alsos Veikou – Evangelismos – Faros – Maroussi, together with its extensions to Vyronas/Ano Ilioupoli and to Petroupoli and the National Road. The U-shaped Line 4 consists of two radial legs and one central part in the center of Athens and it incorporates five discrete individual sections.



New Line 4 of Athens Metro

- The tendered section of Line 4 «Alsos Veikou - Goudi» has been planned to serve a number of densely populated districts of the Greater Athens Area, as well as of the city centre (4 new stations). It will also lead to the decongestion of the existing central stations from the increasing passenger demand, and it will serve many important public facilities such as hospitals, universities etc.
- The Project Scope includes the design and construction of civil works, E/M and trackwork installations, testing & commissioning of 20 driverless fully automatic trains.



New Line 4 of Athens Metro

- The Project has an estimated budget of approx. 1.5 billion euros and an anticipated construction duration of 8 years and it is co-financed by the Hellenic state and the European Union.
- Environmental Impact Design was prepared in advance of the tendering phase. Approval was granted and Tender process begun in 2018 and is currently at its final stage.



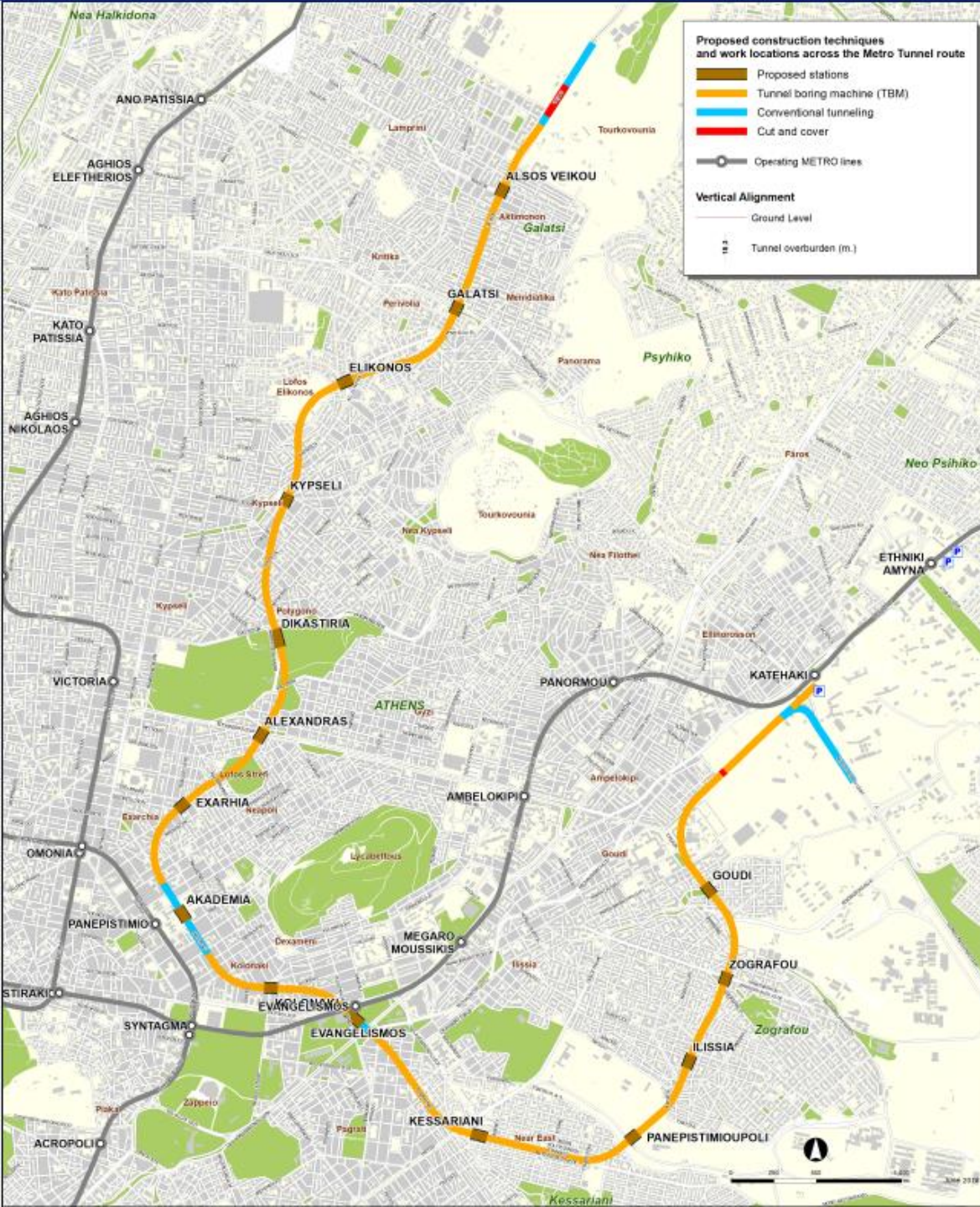
Athens Metro

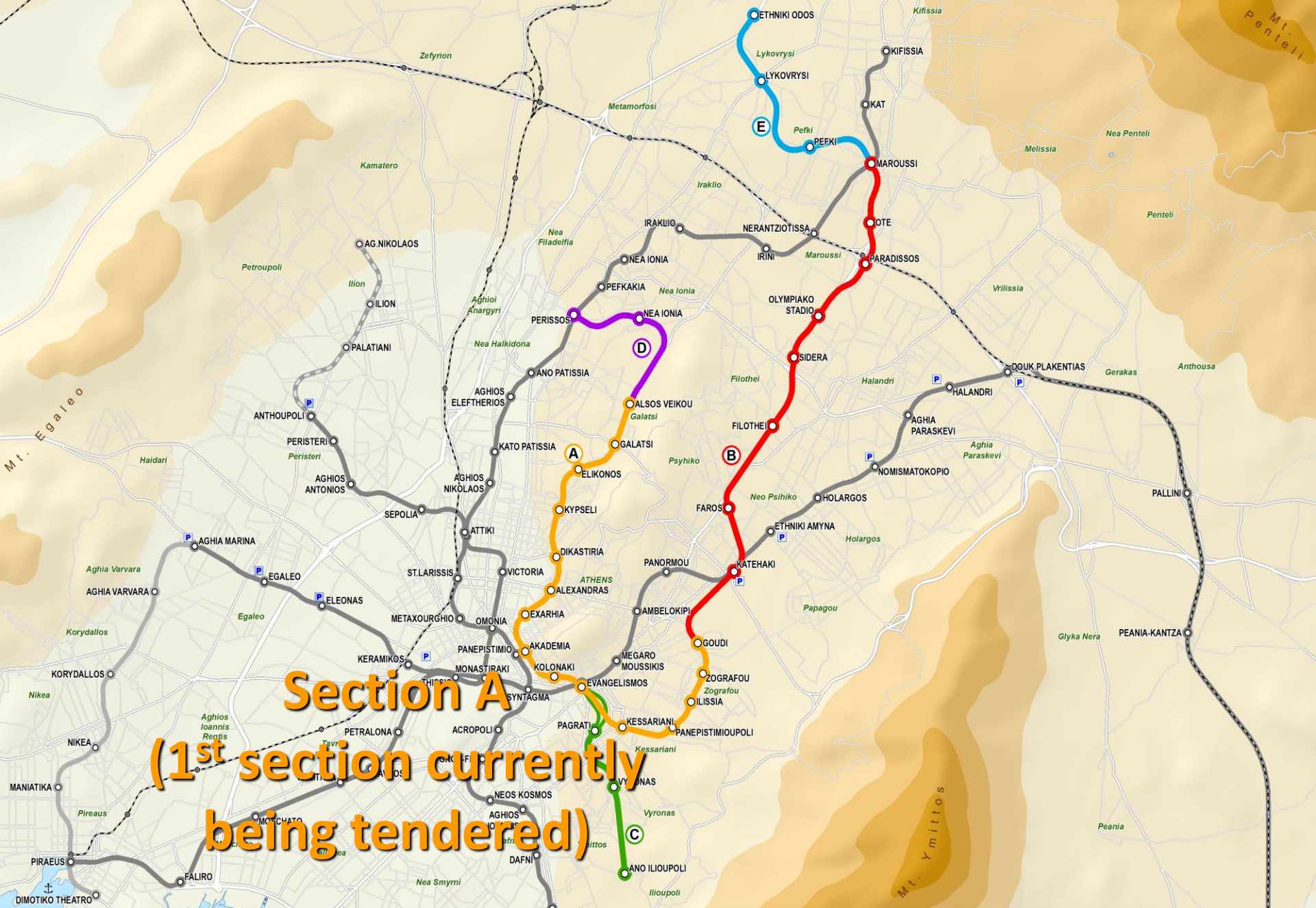
Line 4

Overall Project

budget:

3.5 bn €





Section A
(1st section currently
being tendered)



Athens city center photos



The line extends under the historic city center, as well as several highly congested areas, with sensitive buildings, monuments of significant heritage and high rise buildings.

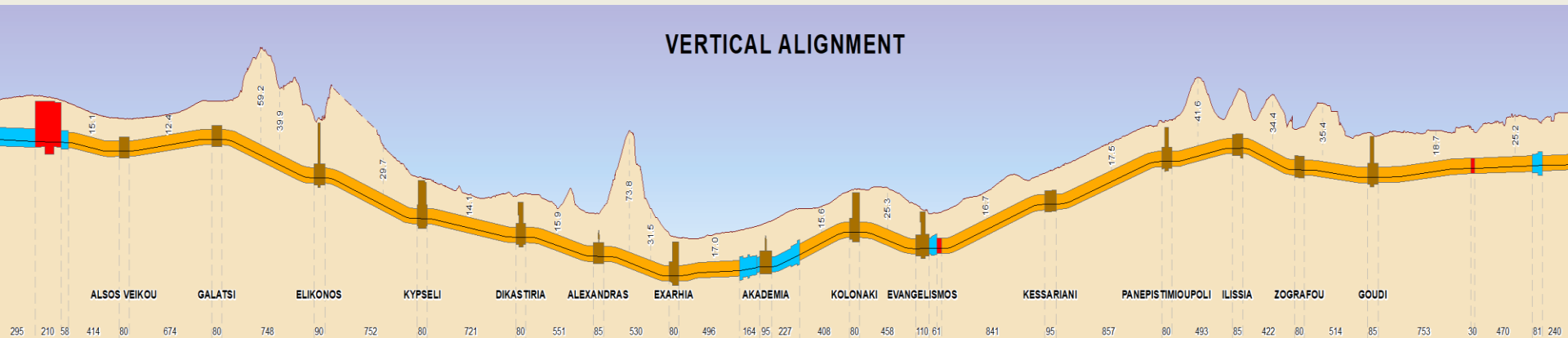
Ridership

- The estimated ridership for 2030 is expected to reach 8,000 passengers per direction at peak hours in the section with the highest passenger load, whilst the future ridership is anticipated to reach 13,000 passengers at peak hours per direction.
- A total of 508,000 passengers are to be transported daily, offering a significant CO₂ emission saving and significant relief on the heavy traffic of Athens City and the suburbs.
- To cover the foreseen ridership, the train headway will be 90 seconds in peak hours.



Project Overview

- 15 new underground stations & 19 ventilation shafts
- 12.8 km long underground line
- 9.5m diameter double track tunnel
- Approx. 2 km underground forestations, underground trumpet structures and underground connecting tunnels
- Construction of a new Depot for maintenance, repair & stabling facilities
- New Operations Control Centre.



Project Overview

Prior to open excavations at all Project locations within a city with long and great historical background, an extensive Archaeological Survey is to be performed in association with the Ministry of Culture.

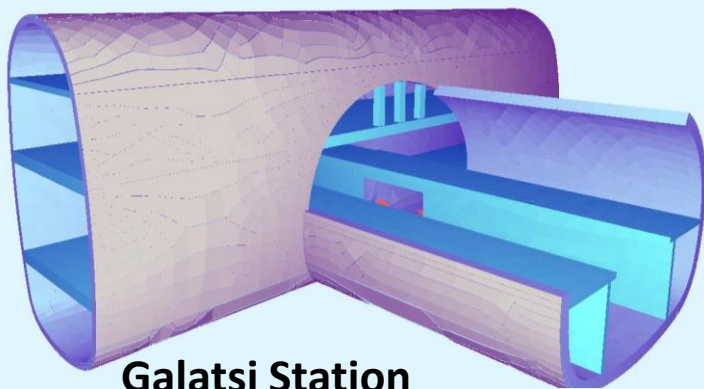
To mitigate the various hazards that are inherently encountered in underground projects, Risk Engineering Management will be applied (Project risk management, risk assessment, risk analysis, value engineering, risk mitigation).

For sufficient follow-up of the Project activities, modern software tools will be used such as Building Information Modeling – BIM (first time implementation of BIM in the Athens Metro).

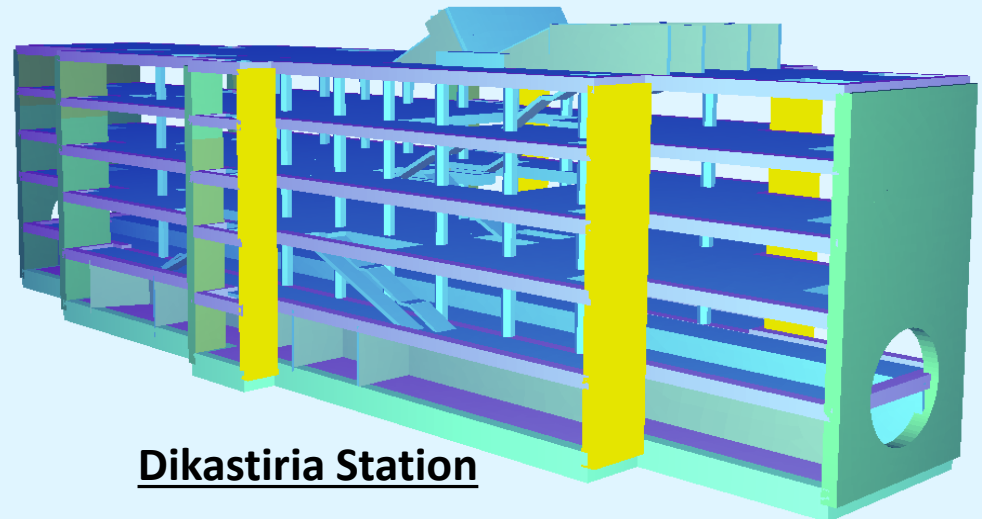


Stations Design

- Underground structures of various configurations
Construction methods: conventional excavation means (“NATM”) and partly cut & cover method
- 28m average depth and 85m average station length
- Side platforms equipped with PSD (fully automated Platform Screen Doors)



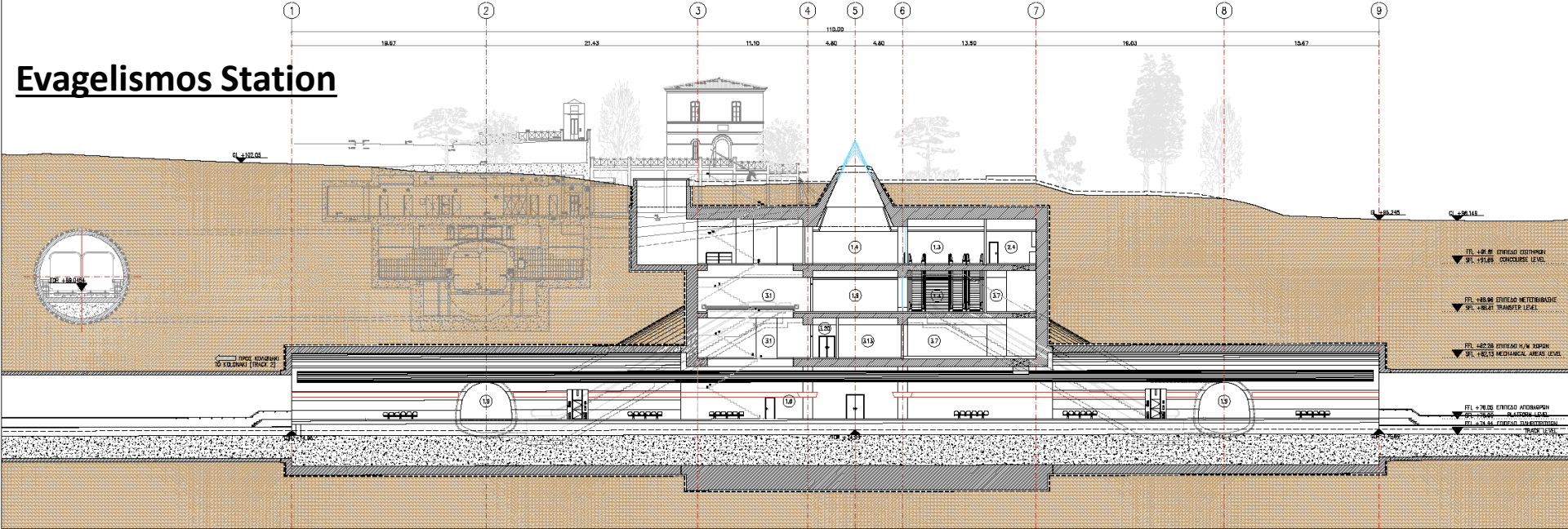
Galatsi Station



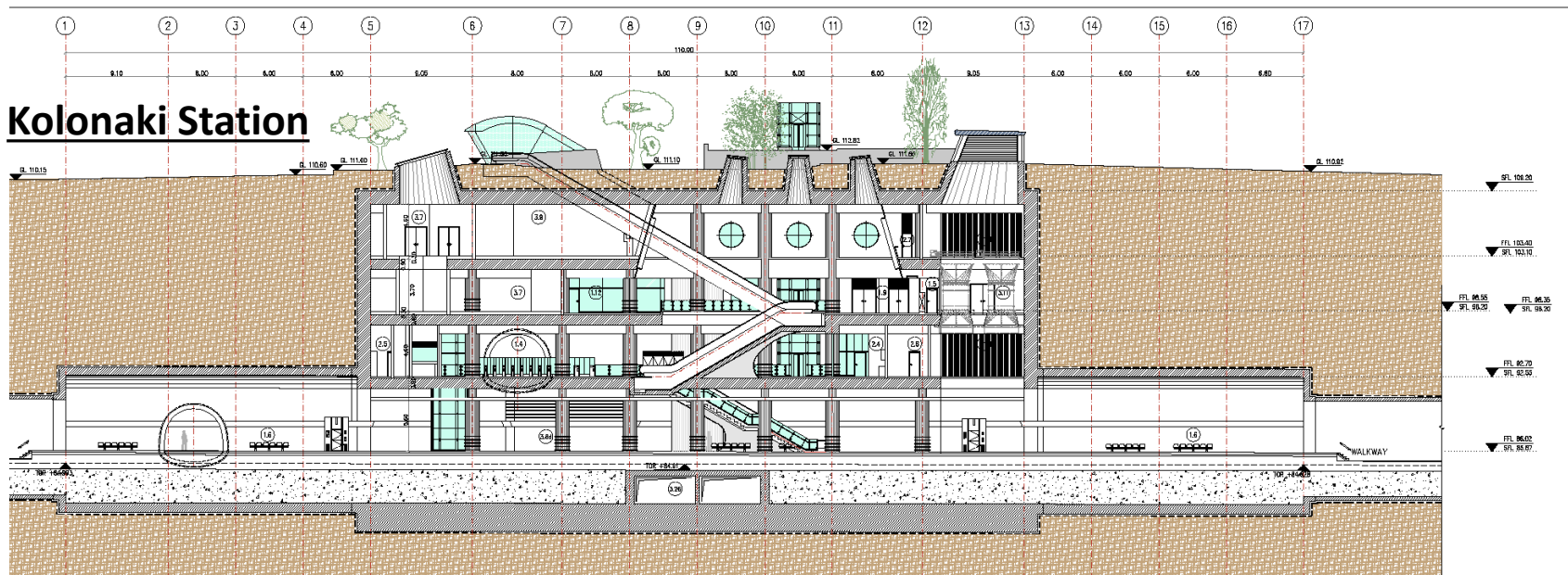
Dikastiria Station



Evangelismos Station



Kolonaki Station



Tunnelling

- Tunnels will be constructed using underground boring methods, mainly by Tunnel Boring Machines (TBM) and partly by conventional excavation means (“NATM”) within diversified geological strata.
- The running trains tunnel of the entire Project shall be a double-track tunnel, with minimum inner diameter of 8.48m, and total length of 10.144m.
- Tunnel parts with special cross-sections (e.g. trumpets) shall be constructed by conventional construction methods.
- The Final Design shall specify the excavation categories, the construction phases and the immediate supporting measures.

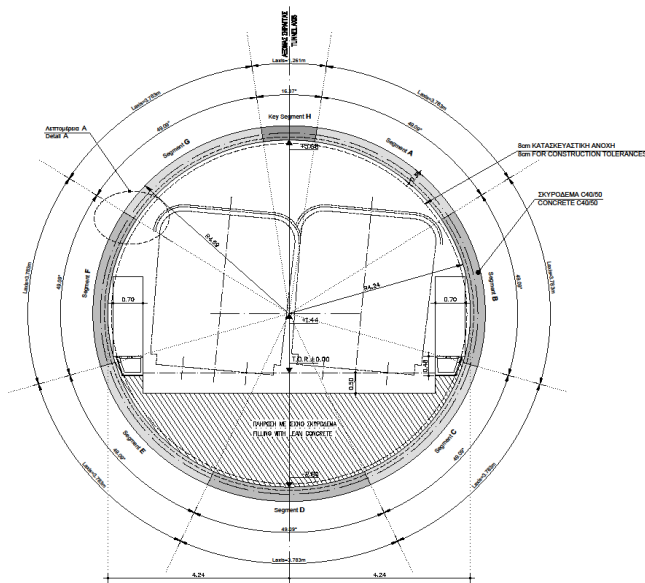


Mechanised Tunnel Construction

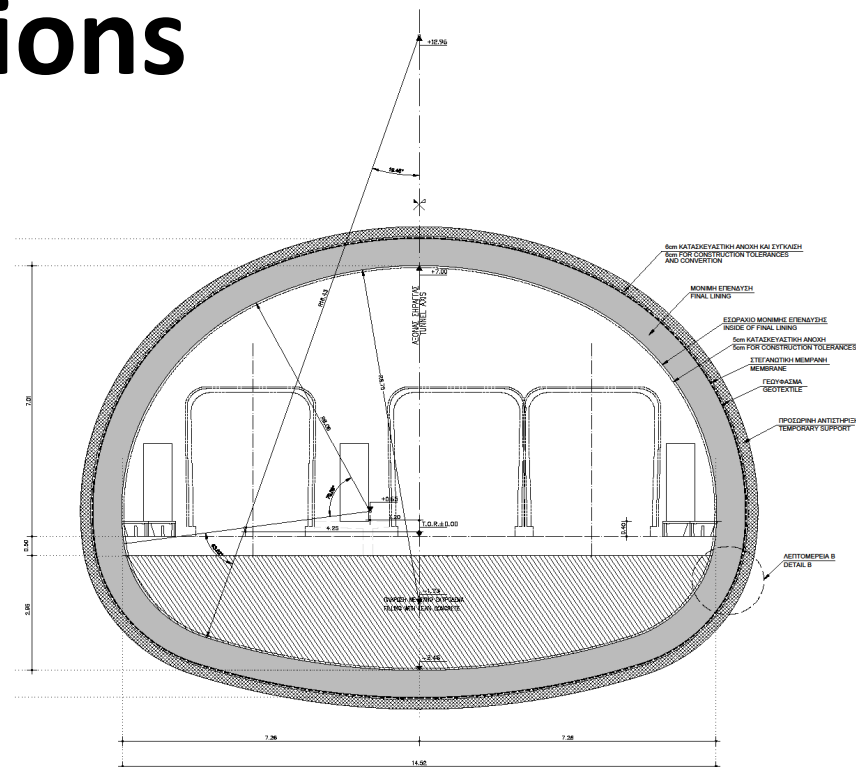
- A minimum of 2 brand new TBMs will be procured having a 9.5m diameter (double track tunnel)
- TBMs are properly designed and manufactured for the area's anticipated diverse hydrogeological conditions.
- “TBM first” to optimize construction progress by driving the running tunnels, prior to completion of the stations' excavation
- Each TBM shall be launched and retrieved at multiple sites with great consideration to the urban environment, whereas the support of the tunnelling activities shall be ensured to be unobstructed.
- Reinforced concrete precast segment tunnel lining rings (35cm minimum thickness).



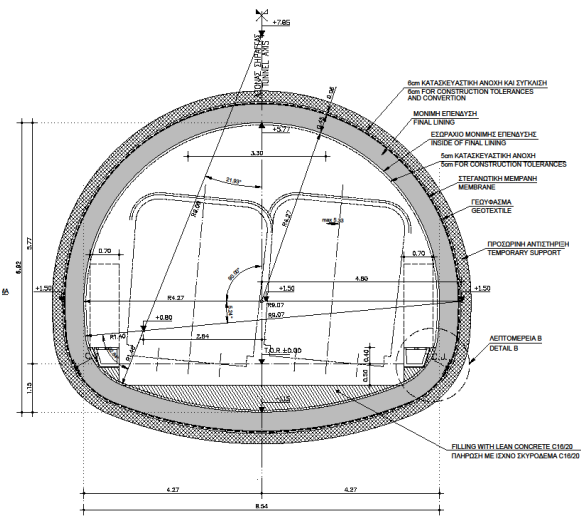
Typical Tunnel Sections



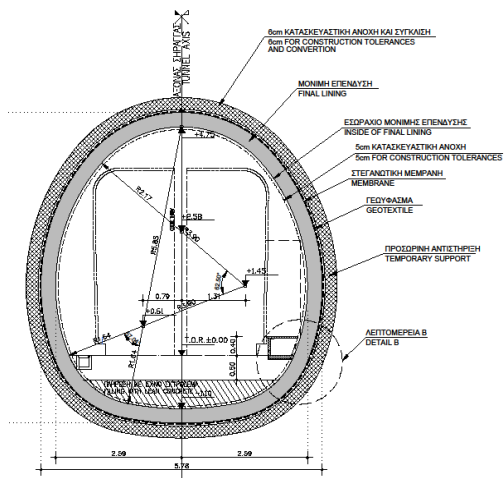
ΤΟΜΗ / SECTION 1-1
 ΤΥΠΙΚΗ ΔΙΑΤΟΜΗ ΔΙΠΛΗΣ ΤΡΟΧΙΑΣ/ΔΙΑΝΟΙΞΗ ΜΕ ΤΒΜ
 DOUBLE TRACK TYPICAL CROSS SECTION/TBM EXCAVATION



ΤΟΜΗ / SECTION 3-3
 ΤΥΠΙΚΗ ΔΙΑΤΟΜΗ ΣΗΡΑΓΓΑΣ ΤΡΙΠΛΗΣ ΤΡΟΧΙΑΣ/ΣΤΥΜΒΑΤΙΚΗ ΜΕΘΟΔΟΣ ΔΙΑΝΟΙΞΗΣ
 TRIPLE TRACK TUNNEL TYPICAL CROSS SECTION/CONVENTIONAL METHOD



ΤΟΜΗ / SECTION 2-2
 ΤΥΠΙΚΗ ΔΙΑΤΟΜΗ ΣΗΡΑΓΓΑΣ ΔΙΠΛΗΣ ΤΡΟΧΙΑΣ/ΣΤΥΜΒΑΤΙΚΗ ΜΕΘΟΔΟΣ ΔΙΑΝΟΙΞΗΣ
 DOUBLE TRACK TUNNEL TYPICAL CROSS SECTION/CONVENTIONAL METHOD

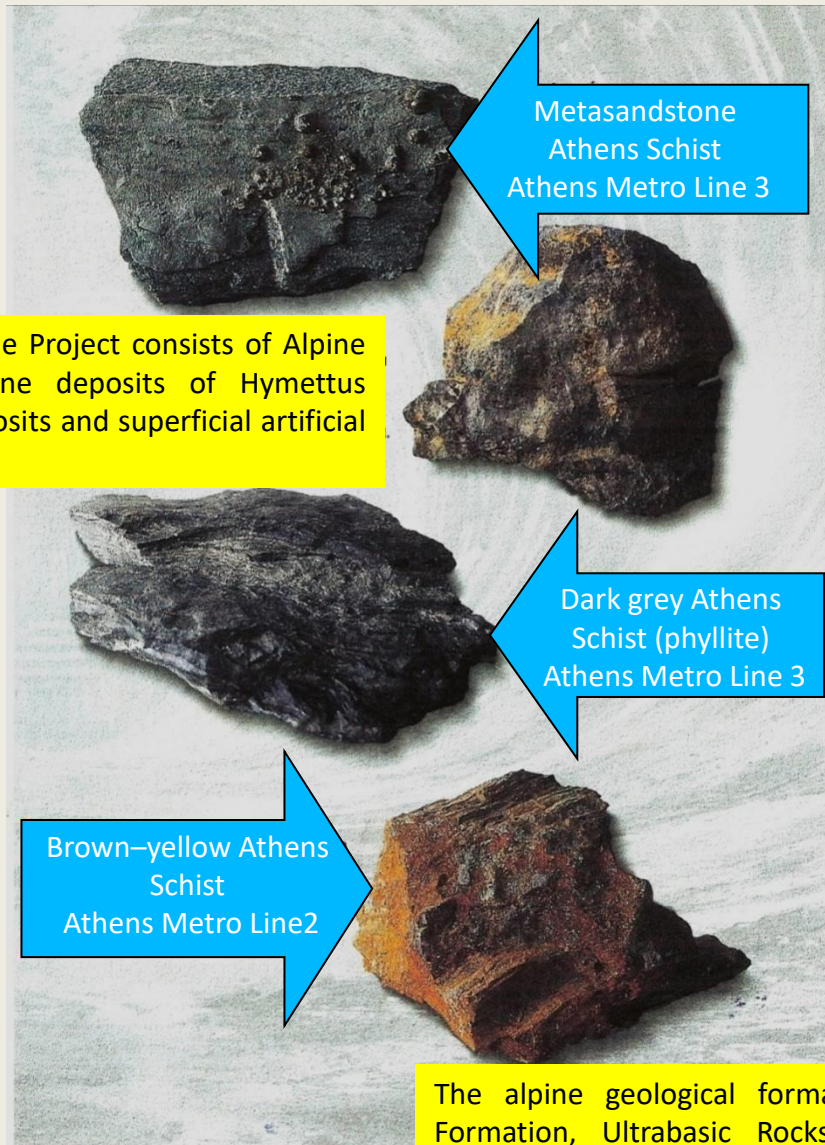


ΤΟΜΗ / SECTION 4-4
 ΔΙΑΤΟΜΗ ΣΗΡΑΓΓΑΣ ΜΟΝΗΣ ΤΡΟΧΙΑΣ/ΣΤΥΜΒΑΤΙΚΗ ΜΕΘΟΔΟΣ ΔΙΑΝΟΙΞΗΣ



Geological formations encountered in Athens area

The geological environment of the Project consists of Alpine geological formations, post-alpine deposits of Hymettus alluvial fans, fluvio-torrential deposits and superficial artificial deposits of a small thickness.



The alpine geological formations are the Alepovouni Formation, Ultrabasic Rocks, the Athens Schist, the Sandstone - Marl Sequence and the Crest Limestone

Electromechanical Installations

The Line will operate as a fully automated system with driverless trains. At the stations platform areas, screen doors will ensure safe and rapid circulation of the passengers.

The E/M systems include:

- Heating, Ventilation and Air Conditioning
- Lifts - Escalators – Travellators
- 20kV AC MV Power Supply
- Power Distribution of LV Power (400/230VAC)



Electromechanical Installations and Systems

- Fire protection installations
- 750V DC Traction Power Supply System
- Traction control and surveillance system in Depot/Maintenance Areas
- Traction system for feedback of non-used energy re-generated from the braking system
- Signaling and Automatic Train Control System



Operation Control Systems

- Building Automation Control System (BACS)
- Power Remote Control System (PRCS)
- Control and Surveillance System (SCADA) of E/M Systems
- Radio Communication System (RCS)
- Closed TV Circuit (CCTV)
- Passenger Information Display System (PIDS)
- Access Control / Intrusion Detection System





The authors would like to thank **ATTIKO METRO S.A.** for the kind provision of data and pictures.



Thank you for your attention



**Greek Tunnelling
Society**