Appendix 2.3 - BELGIUM – Brussels – Belliard Tunnel

1. INTRODUCTION

The Belliard tunnel is located in the city of Brussels and the city of Schaarbeek (170,000 & 130,000 inhabitants), in the centre of a metropolitan area of about 1,100,000 inhabitants. It is a one-way tunnel leading to the Brussels-Liege E40 motorway. It starts at the bottom of Rue Belliard, passes under the Schuman roundabout then in succession under Avenue Cortenbergh, Place Jamblinne de Meux and Avenue Roodebeek to emerge in the open at the Reyers portal.

The covered part of the Belliard tunnel runs for 2,026m **(Figure 1)**.

The tunnel has one curve and one reverse curve before becoming practically straight as far as the Reyers portal. Under the Schuman roundabout, the tunnel has a Y-shape branch leading to the Cinquantenaire tunnel.

The Belliard tunnel has one approach at the level of Avenue de la Joyeuse Entrée and one exit, via the Y branch, at the level of Avenue de la Renaissance and the Brussels Mosque.

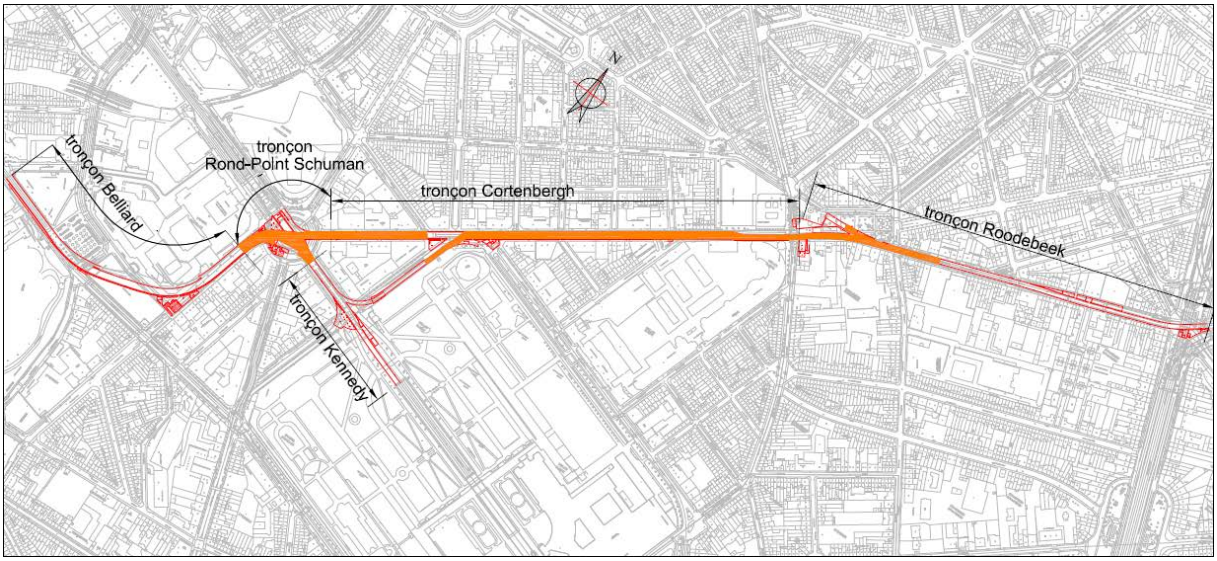

Figure 1 - Belliard tunnel location

The Belliard tunnel has been constructed in several stages:

- The Kennedy section from 1966 to1967,
- The Roodebeek section from 1970 to 1973,
- The Belliard-Schuman, Schuman roundabout and Cortenbergh sections from 1989 to 1993.

2. CHARACTERISTICS

2.1 GEOMETRY

The Belliard approach is oriented to the west, the exit for the E40 to the east-north-east, and the exit to the Cinquantenaire to the east-south-east.

The tunnel is comprised of a single passage. Hence it is a single tube one-way structure.

The global length of the tunnel is 2,026 m.Iit is divided into five sections:

- Belliard-Schuman section: 382 m,
- Schuman roundabout section: 156 m,
- Cortenbergh section: 784 m,
- Roodebeek section: 704 m,
- Kennedy section: 252 m.

2.2 GENERAL LAYOUT

The general layout and the functions of the diverse underground space are shown **Figure 2** below.

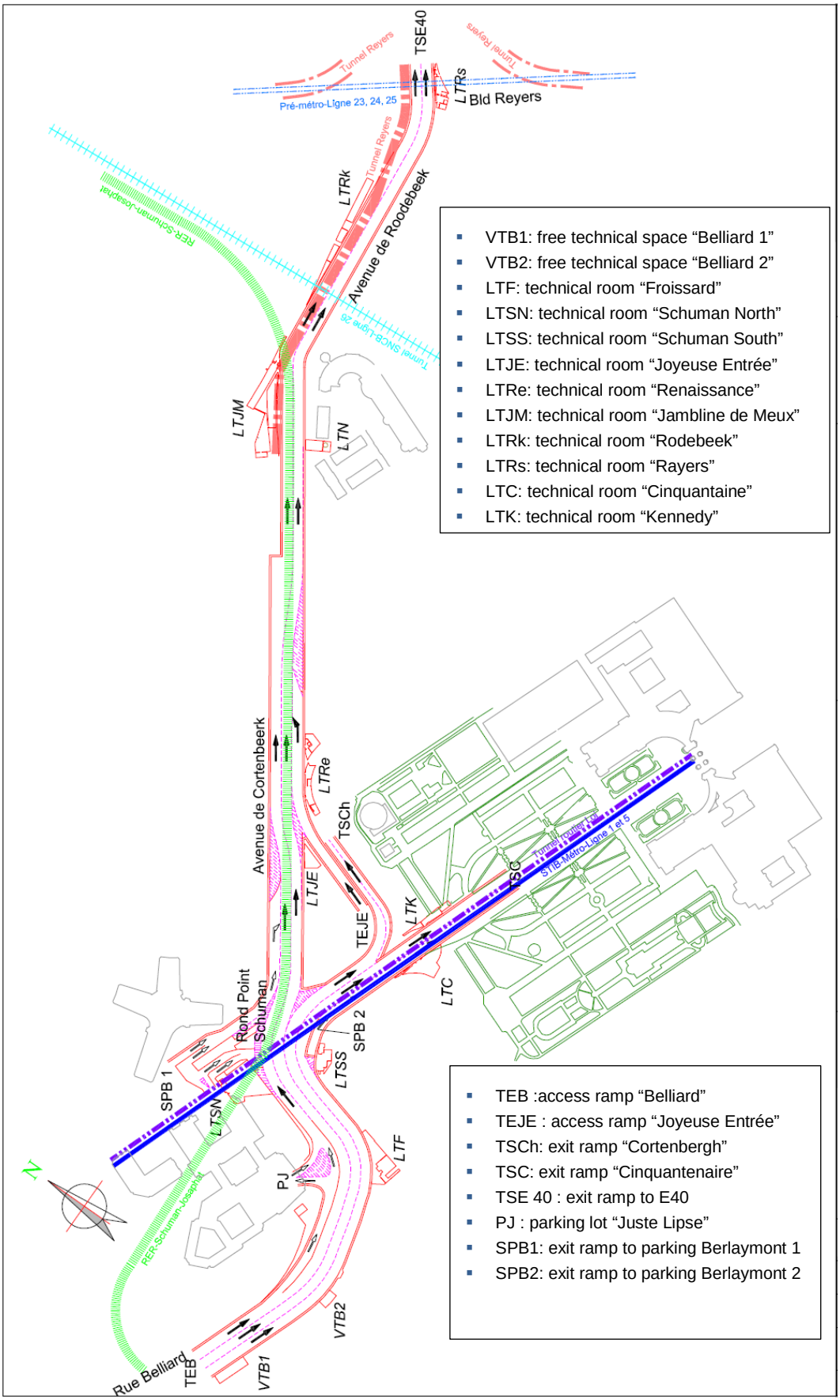

Figure 2 - Belliard tunnel general layout

2.3 DETAILED CONCEPT AND CROSS SECTION

The Belliard tunnel is made of several complex underground structures with numerous interfaces between them.

The detailed concept is shown **figure n°3**.

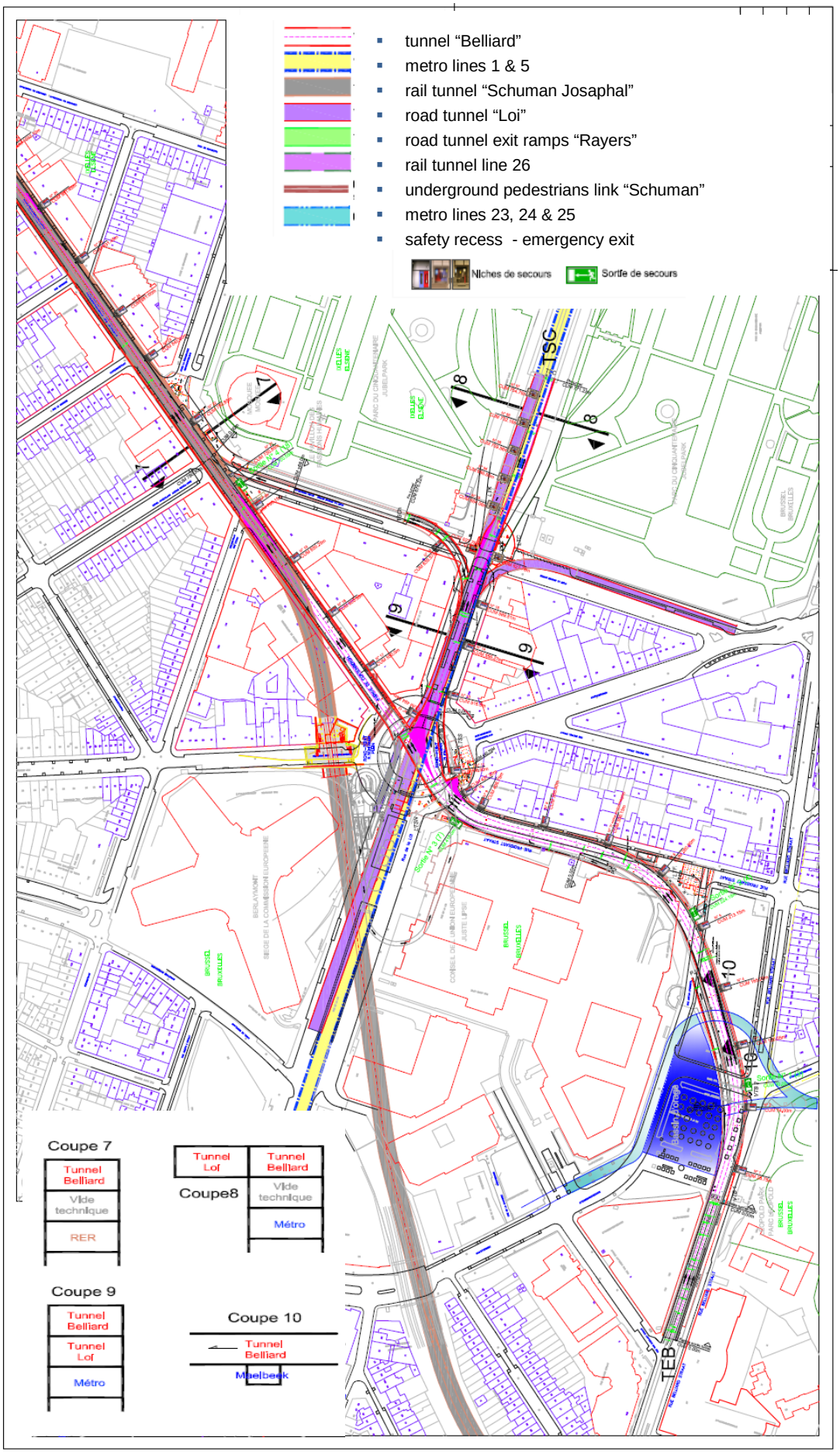

Figure 3 - Belliard tunnel – detailed concept

Figure 4 below shows some cross sectional profiles of the Belliard tunnel in particular in places with interfaces between the diverse structures:

- profile 1: Belliard tunnel and exit ramp,
- profile 2: on the upper part: tunnel Belliard, technical room and exit ramp – on the lower part railway tunnel,
- profile 6: same organization as for profile 2 without the technical room. Shifting of the upper part versus the lower part,
- profile 3: tunnel Belliard, merging ramp and free underground space.

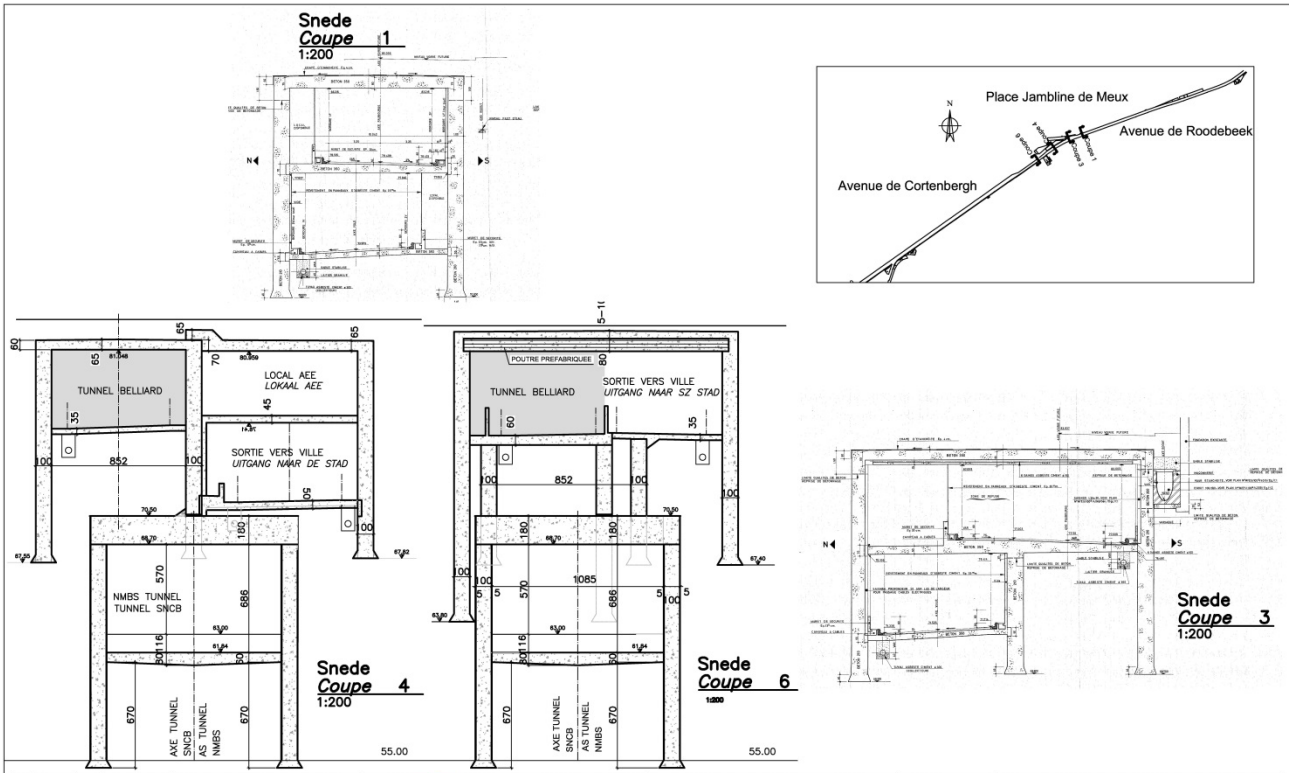

Figure 4 - Belliard tunnel – cross section and main structures

2.4 EMERGENCY EXITS

There are eight emergency exits along the tunnel, leading out to the surface. These emergency exits are not pressurized.

2.5 TRAFFIC CONDITION

2.5.1 Traffic

The AADT (Annual Average Daily Traffic) is estimated at 44,000 vehicles a day with a speed limit of 70 km/h.

2.5.2 Road tunnel

- Speed limit 70 km/h.
- Gauge 3.80m and < 3.5 t. The tunnel is prohibited to Heavy Goods Vehicles and to the Transport of Dangerous Goods.
- Bicyclists and pedestrians are prohibited.

2.5.3 Incident

- Fire: on average there is one fire every three years.
- Accidents: on average there are 18 accidents per year.
- Breakdowns: on average 41 breakdowns per year.

2.6 VENTILATION

2.6.1 Ventilation system in the road tunnel

The Belliard tunnel has 10 exhaust fans, 14 supply fans, and 44 Jet-fans.

The ventilation installation is longitudinal with massive extraction (air renewal) at six points in the direction of the traffic. The supply of fresh air and the exhaust of polluted air are achieved using variable flow supply or exhaust fans combined with jet-fans.

The incoming new air or outgoing polluted air passes through shafts emerging at the surface of the tunnel. The air intakes in these shafts are equipped with sound traps and grilles. These shafts are equipped with grilles most of which are located on surface roads. The plants are accessible from the tunnel.

Ventilation for pollution control is linked to the pollution monitoring and to the traffic in the tunnel (TRAFICON link).

2.6.2 Smoke extraction ventilation

The exhaust fans also perform the mechanical smoke extraction ventilation **(Figure 5)**.

Fire detection equipment operates on the smoke extraction ventilation by means of the PLC and SCADA systems.

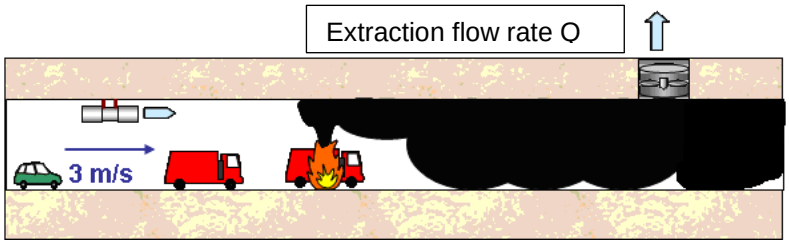

Figure 5 - Fire simulation

2.6.3 Ventilation of the emergency exits

The emergency exits are not fitted with ventilation systems. They all give access the outside. Some of them have however a very long and tortuous path.

2.7 ENVIRONMENT

2.7.1 Air quality

The carbon monoxide (CO) content is measured using electrochemical cells (ADOS 592 sensors, arranged in boxes in the refuges).

These different sensors are assembled in eight groups and interfaced by a central unit that transmits the measurements to the PLC and SCADA systems: four thresholds are defined for each group 50, 75, 150 and 200ppm of CO. All this information is sent to the Froissart room.

The PLC and SCADA systems ensure the automation of the ventilation according to the values read in the different tunnel sections.

2.7.2 Noise protection

The Jet-fans and axial fans are all fitted with silencers in order to reduce the sound nuisance.

2.7.3 Water

Water is collected by a drain system specific to the tunnel which discharges to a pumping station where there are submerged pumps and a mixer pump.

2.7.4 Equipment

The tunnel is equipped with the usual safety systems, i.e. fire detection, CCTV and emergency phones.

2.8 OPERATION

The Belliard tunnel is managed by the MOBIRIS control centre (open 24/7) which manages all the tunnels of the Brussels-Capital Region. This control centre is also responsible for the surface traffic of the main roads and motorways.