

Operaplein - Antwerpen

Wouter Van den Berghe

Operaplein - Antwerpen

Inhoud

- Presentation of the project
- Project in numbers
- Regulations in Belgium
- Construction
- Smoke and heat exhaust
- Automatic sprinkler system

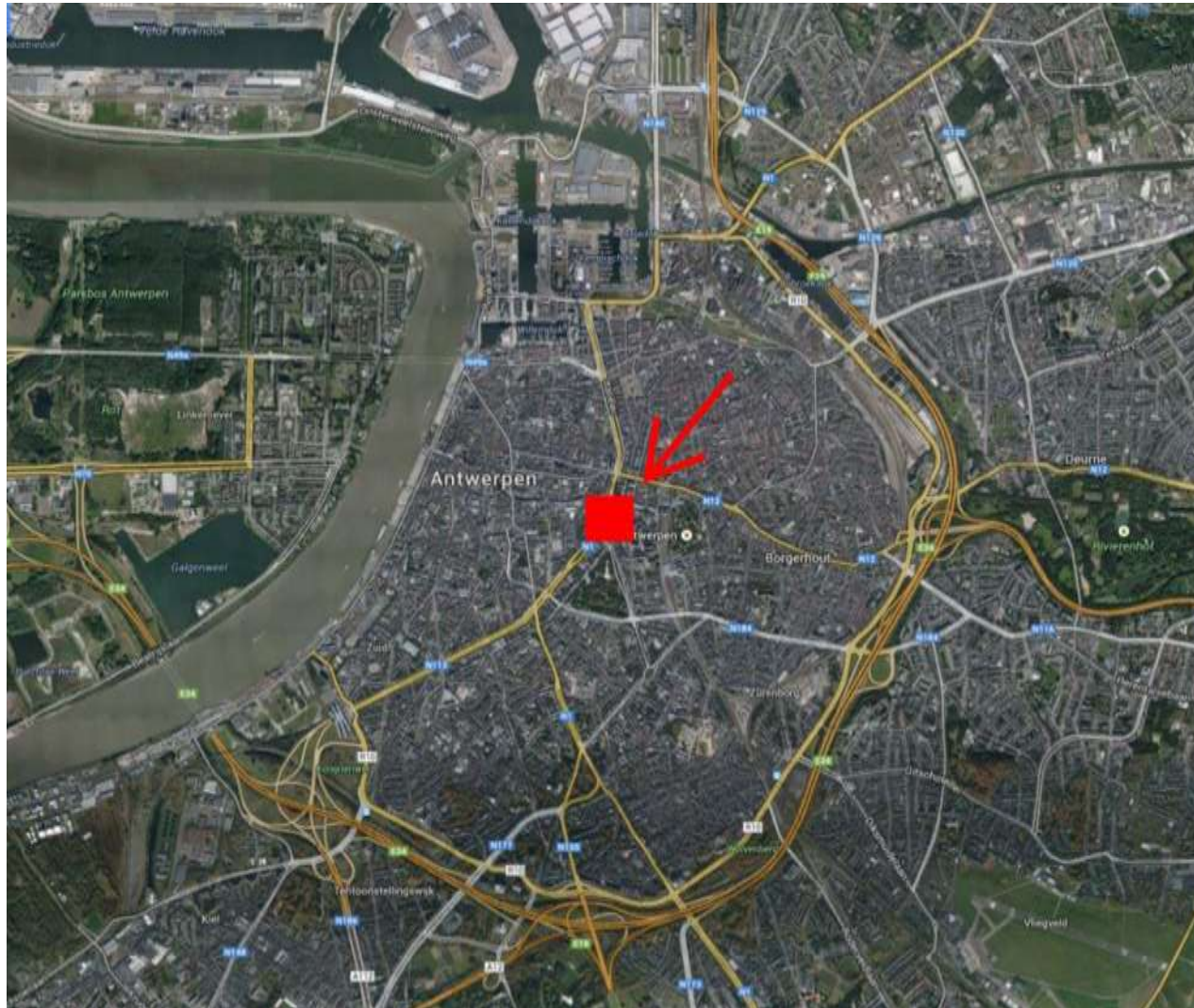
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Presentation of the project

4



Presentation of the project



Presentation of the project

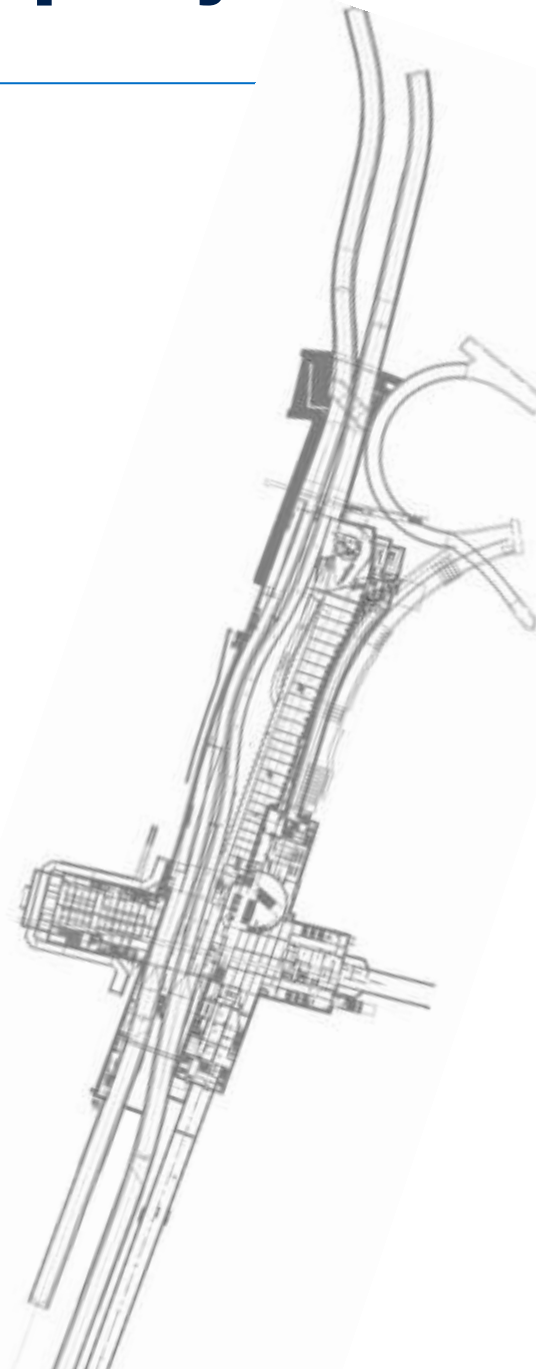
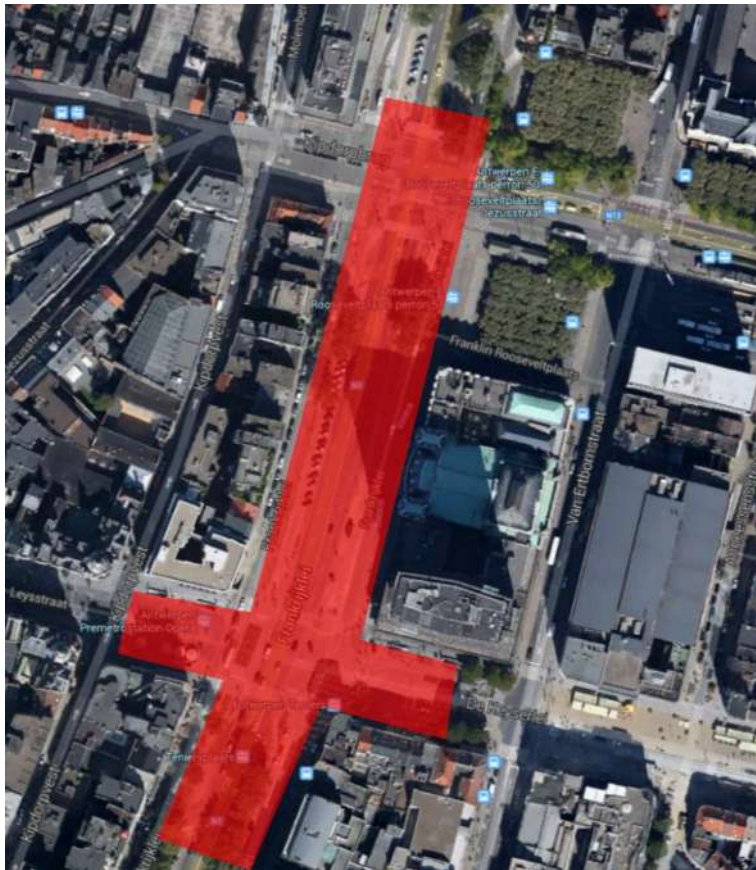


Presentation of the project

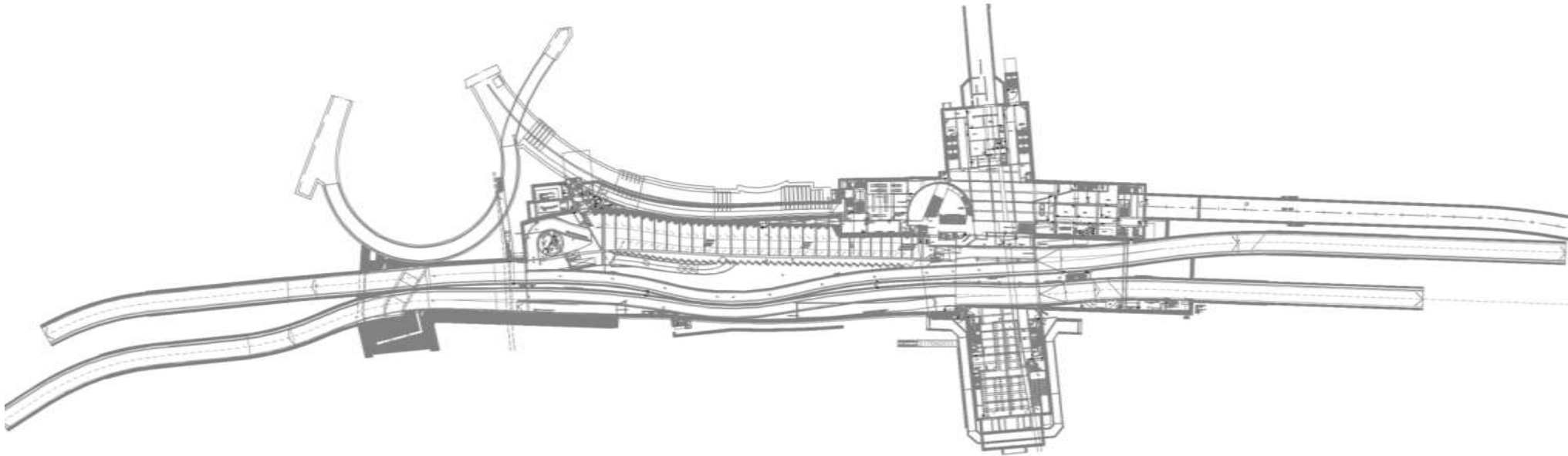
Composition of the building

- Roadtunnel 2 lanes
 - max. 50km/h
 - no heavy duty
- Parking 3 levels
- Premetro station north-south
- Tramstation east-west

Presentation of the project

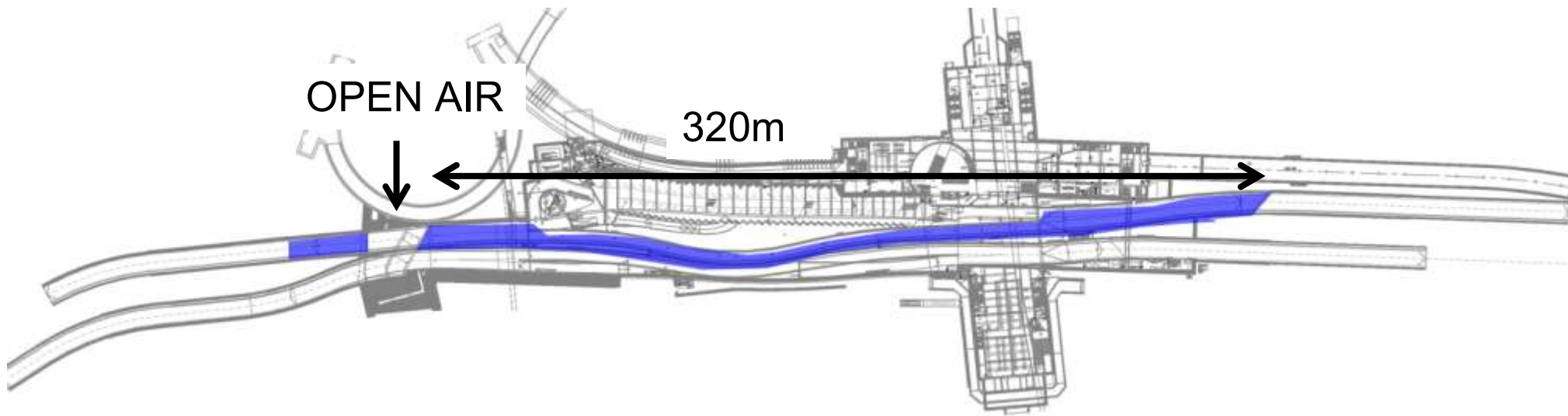


Presentation of the project



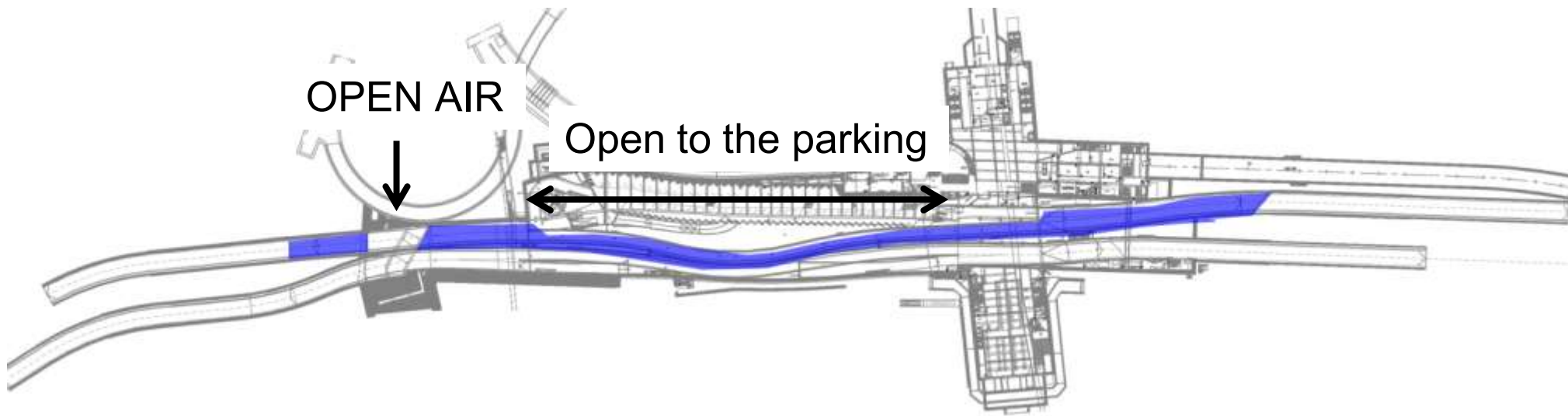
Presentation of the project

Tunnel at level -1 – south → north



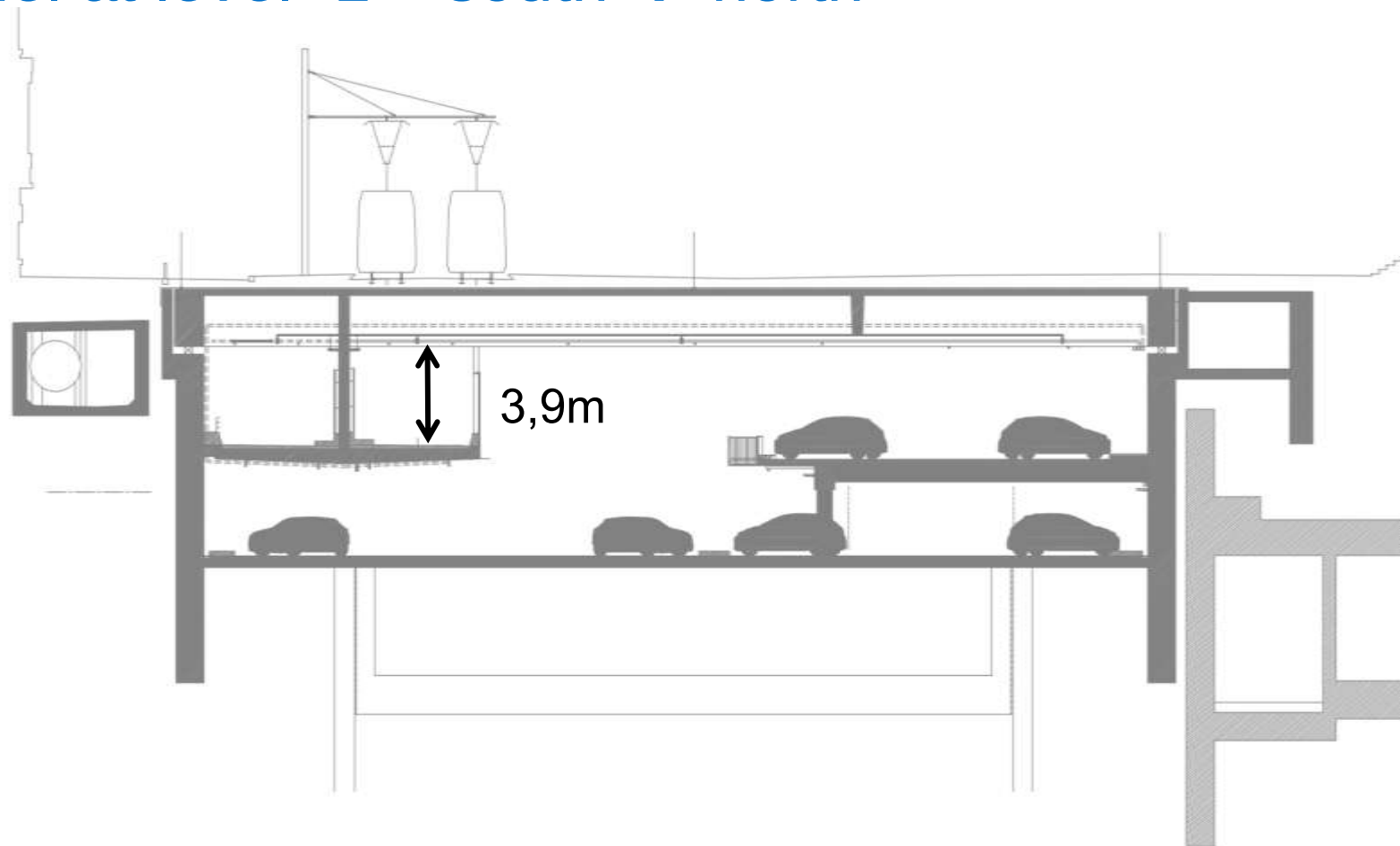
Presentation of the project

Tunnel at level -1 – south → north



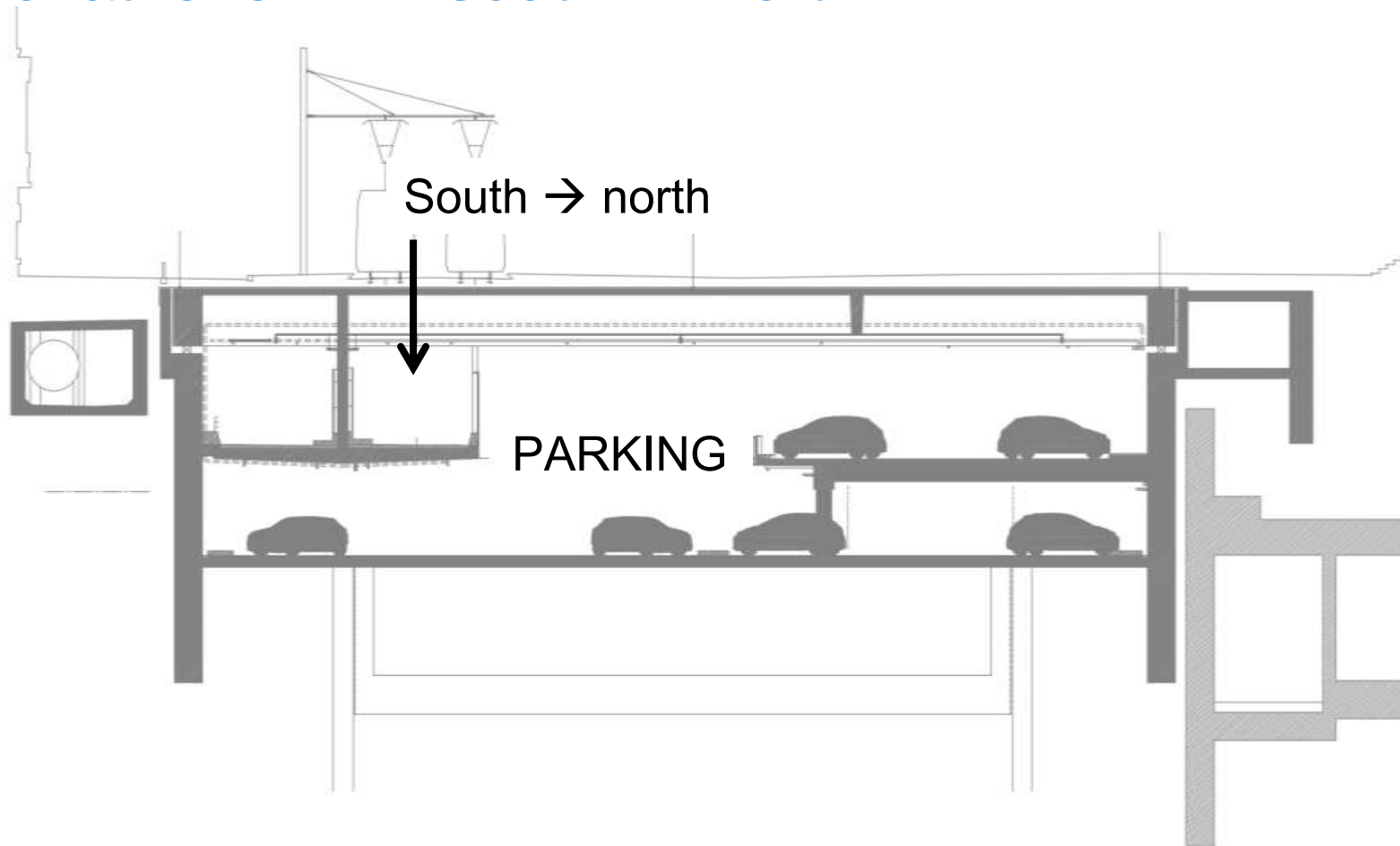
Presentation of the project

Tunnel at level -1 – south → north



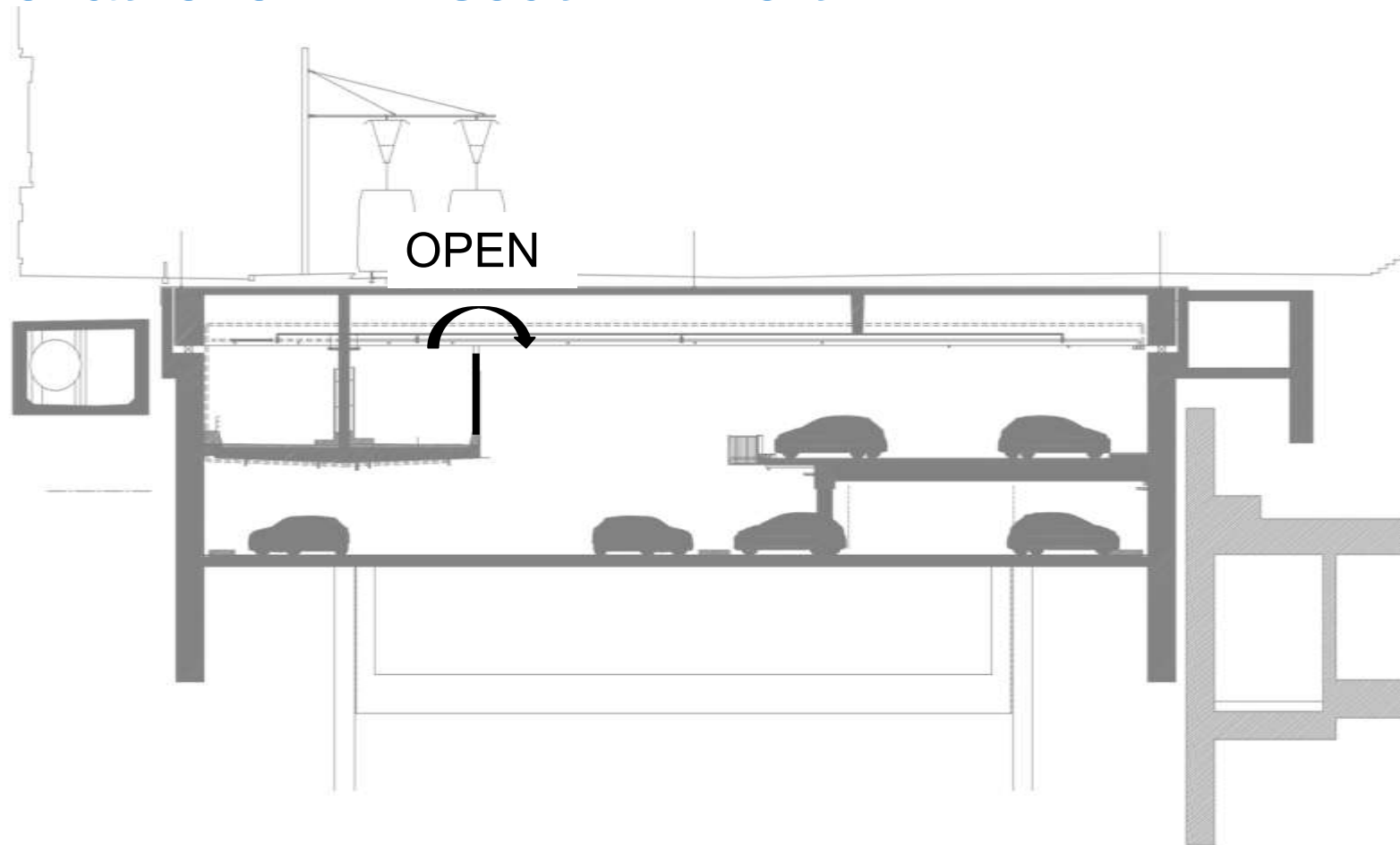
Presentation of the project

Tunnel at level -1 – south → north



Presentation of the project

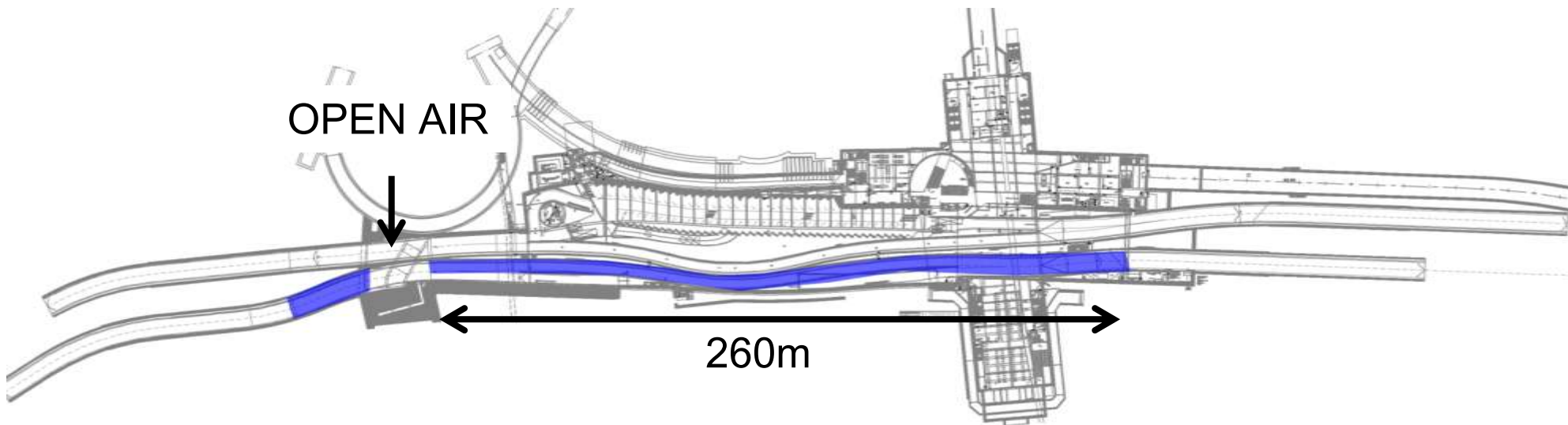
Tunnel at level -1 – south → north



Presentation of the project

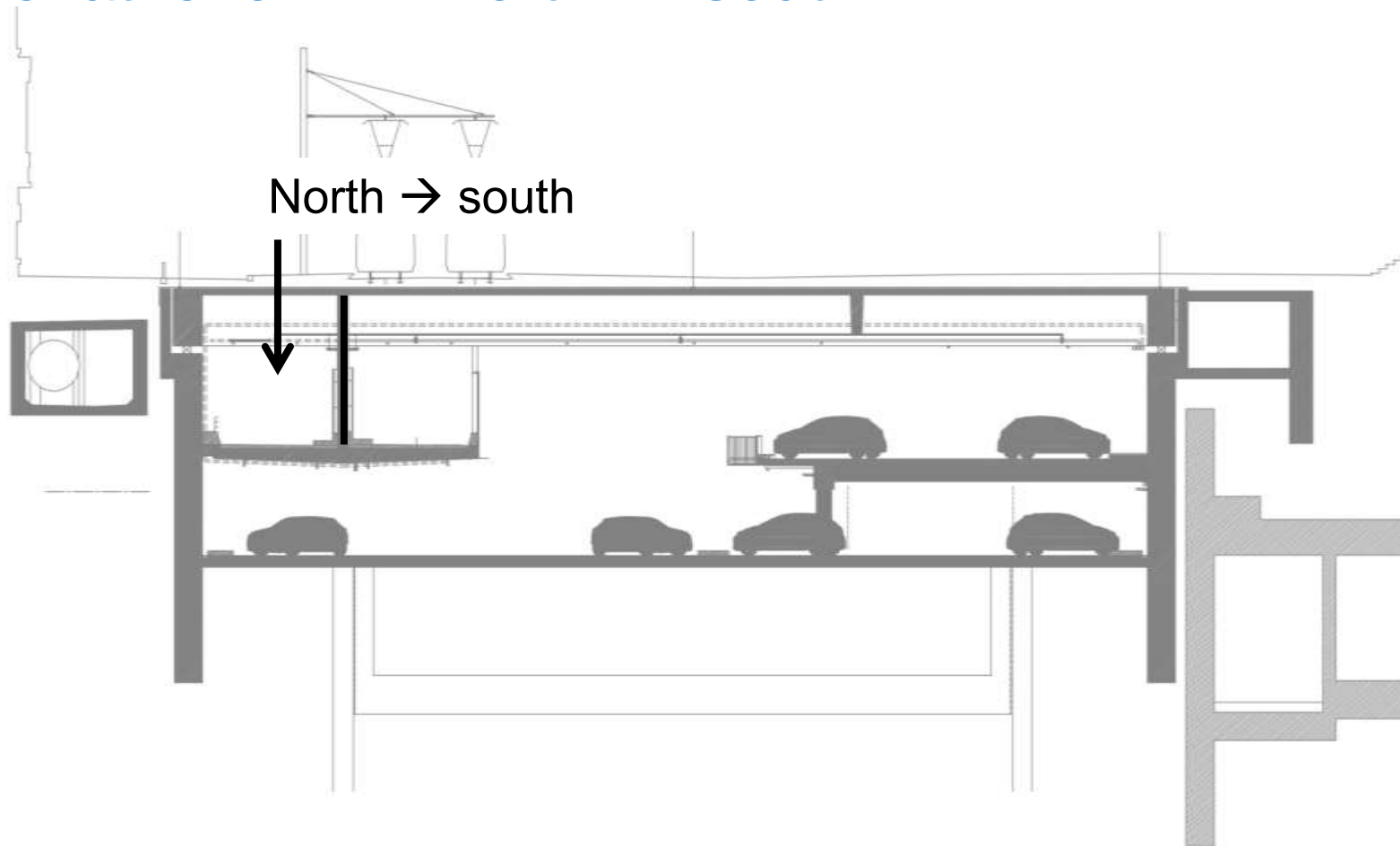
Tunnel at level -1 – north → south

- Separated from parking over full length



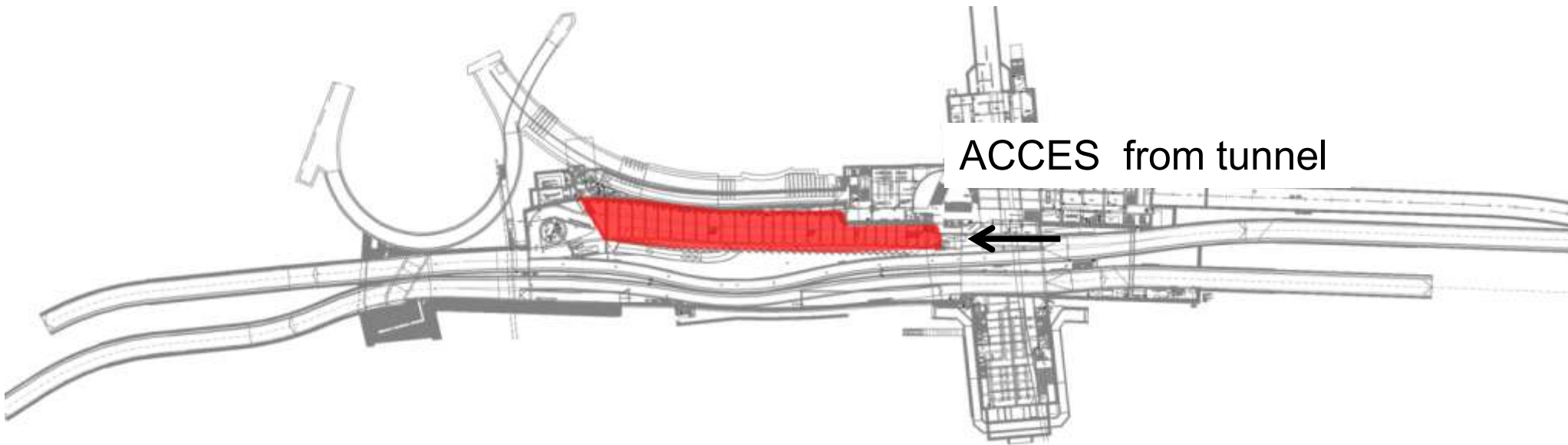
Presentation of the project

Tunnel at level -1 – north → south



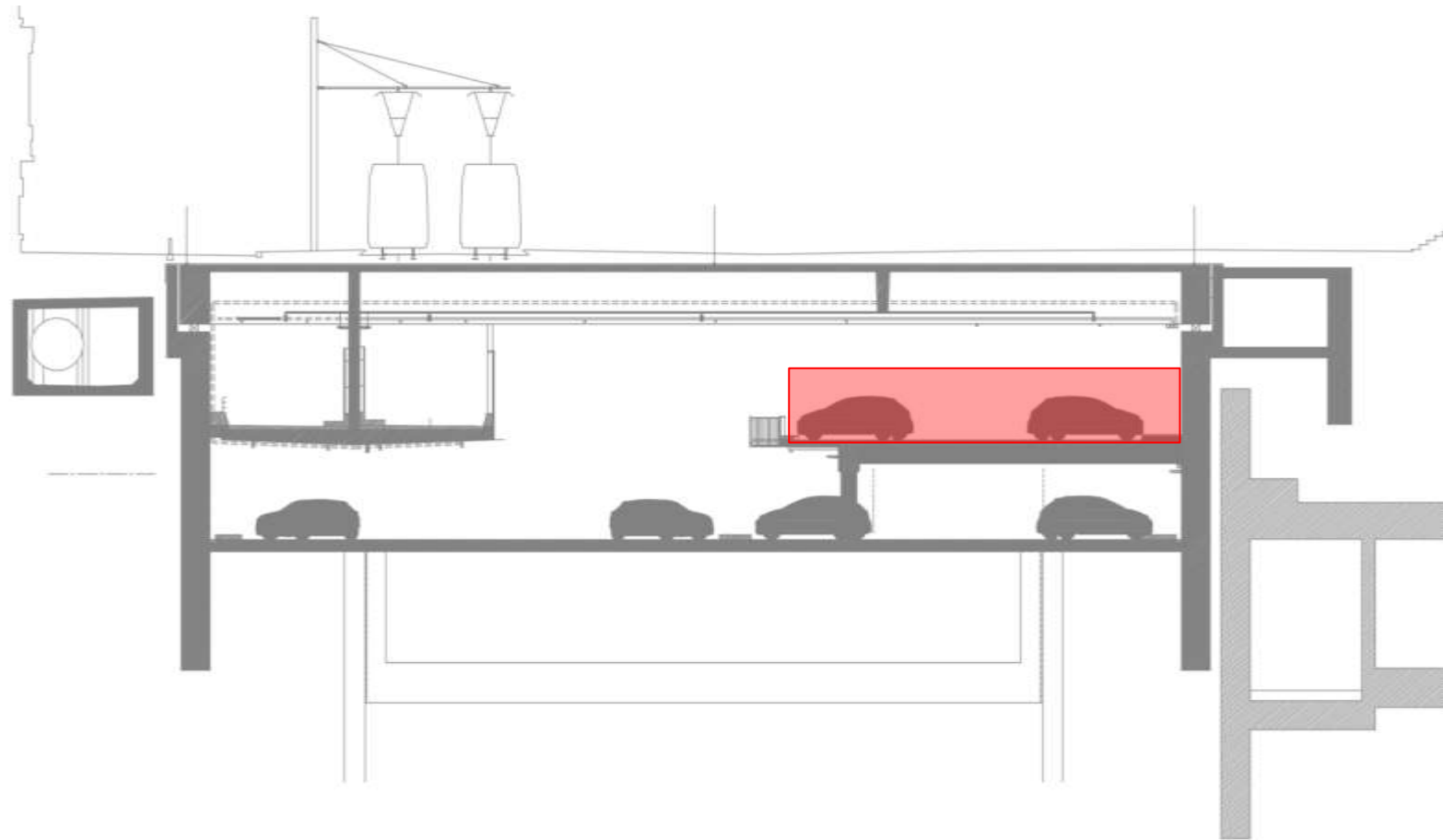
Presentation of the project

Parking -1



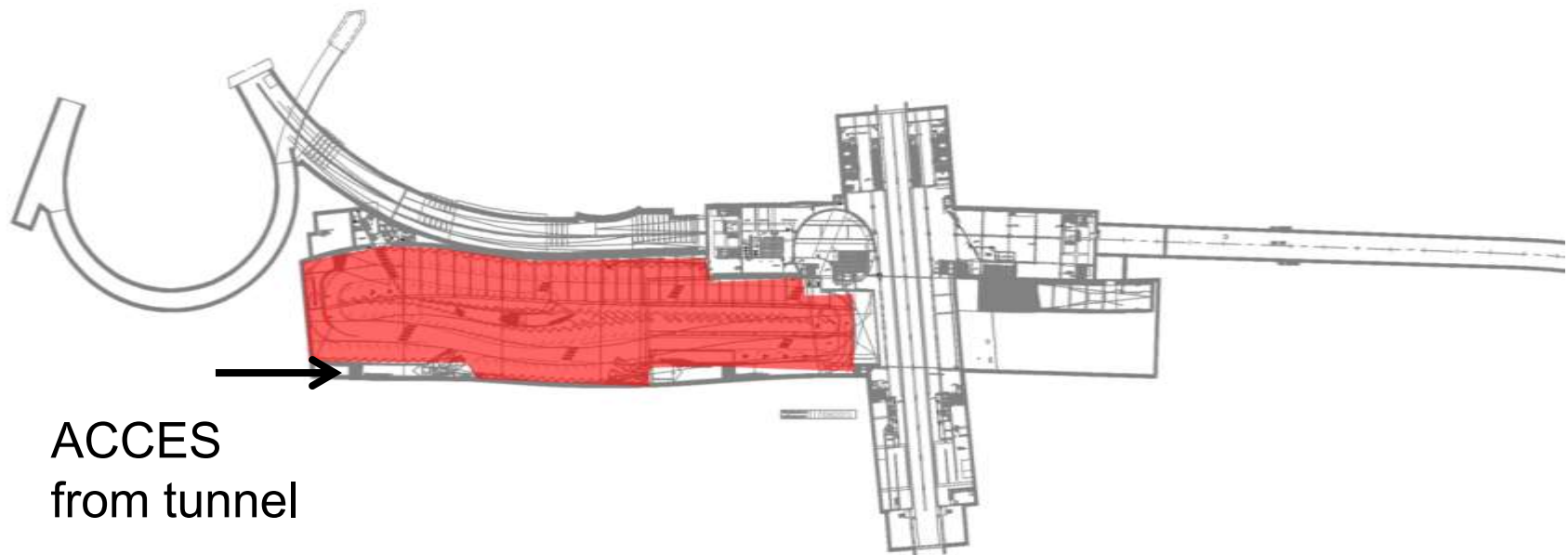
Presentation of the project

Parking -1



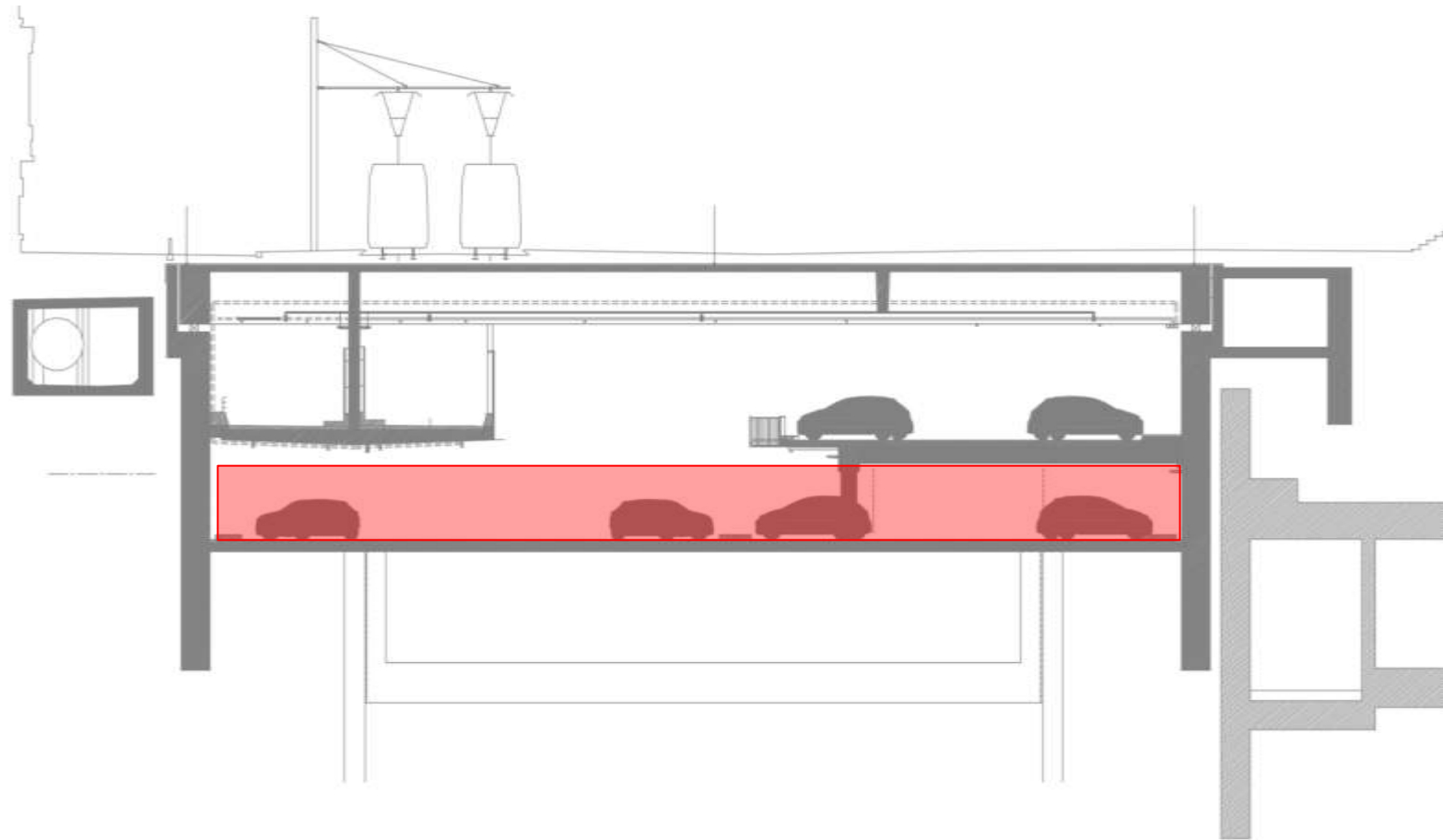
Presentation of the project

Parking -2



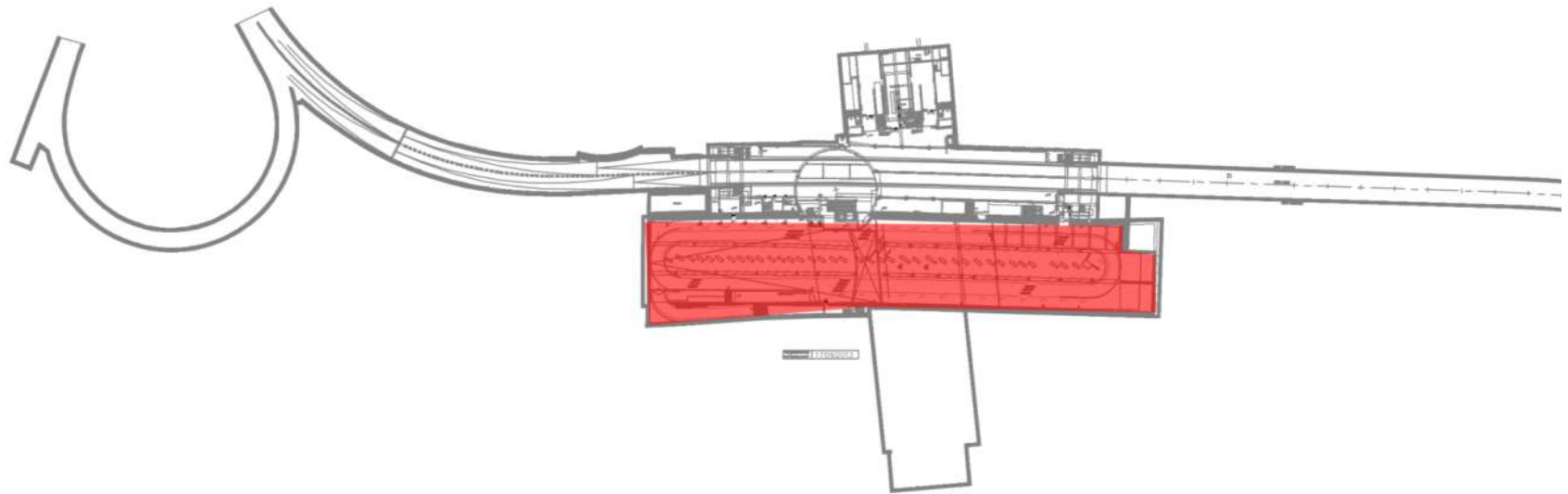
Presentation of the project

Parking -2



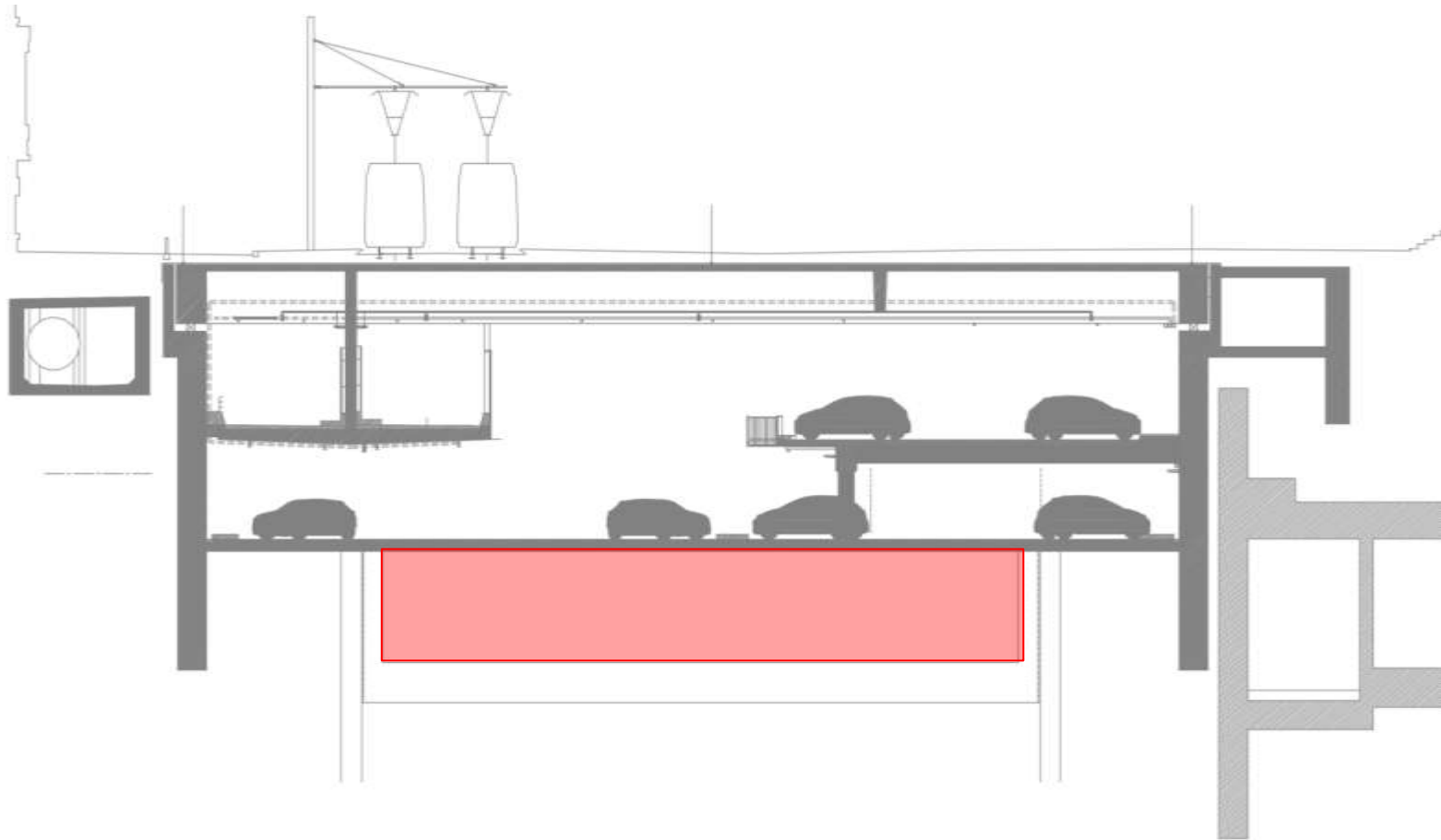
Presentation of the project

Parking -3



Presentation of the project

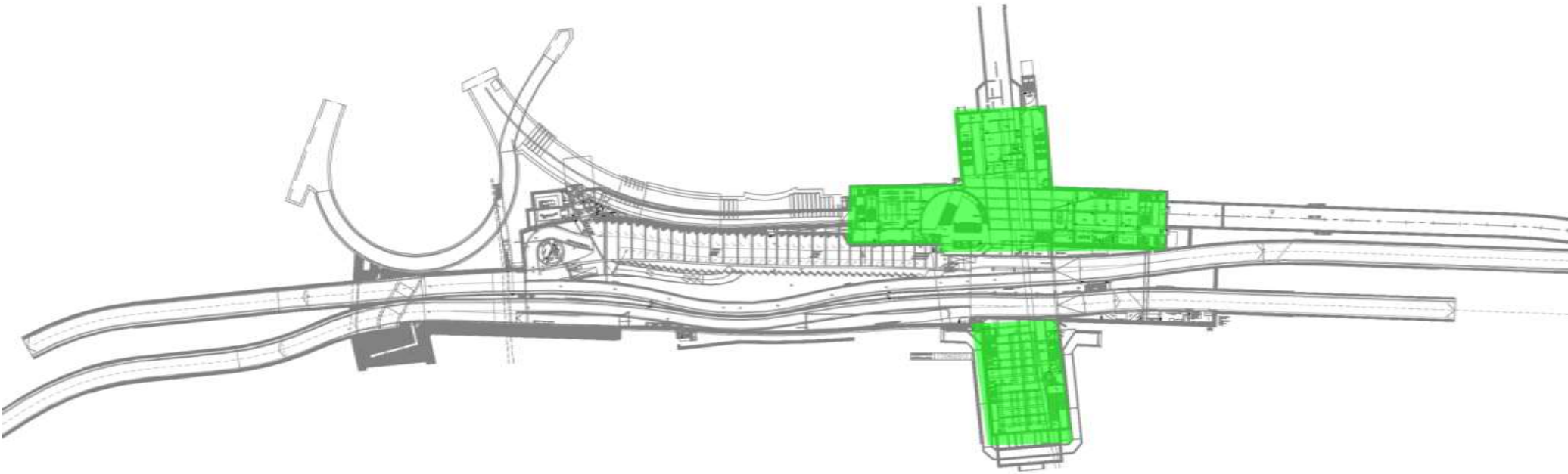
Parking -3



Presentation of the project

Tram/metro station

- Seperate compartment → no influence on tunnel/parking



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Project in numbers

- Investment
 - 75 miljoen euro
- Planning
 - Start building – mid 2015
 - Ready - 2019

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Regulations in Belgium

Tunnel

- Base: European Directive 2004/54/EG
 - Trans-European Road Network
 - Tunnellength > 500m
 - Evacuation – 250m
 - Smoke and heat exhaust ventilation
 - Water supply – 250m
- Flanders:
 - MOW/AWV/2008/24 → tunnels > 200m in accordance with European Directive
→ Operaplein
- Antwerp Fire Department:
 - Same compartment as parking → threat the same way as parking
 - Escape stairs in overpressure
 - Water supply
 - Smoke and heat exhaust ventilation

Regulations in Belgium

Parking

- Base: Royal Decree 7 july 1994
 - Underground parking > 2500m² → Smoke and heat exhaust
 - Escape route – 45m
 - Water supply – 60m
- Antwerp Fire Department:
 - Automatic sprinkler system
 - Overpressure escape stairs

Operaplein - Antwerpen

Inhoud

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- Regulations in Belgium
- **Construction**
- Smoke and heat exhaust
- Automatic sprinkler system

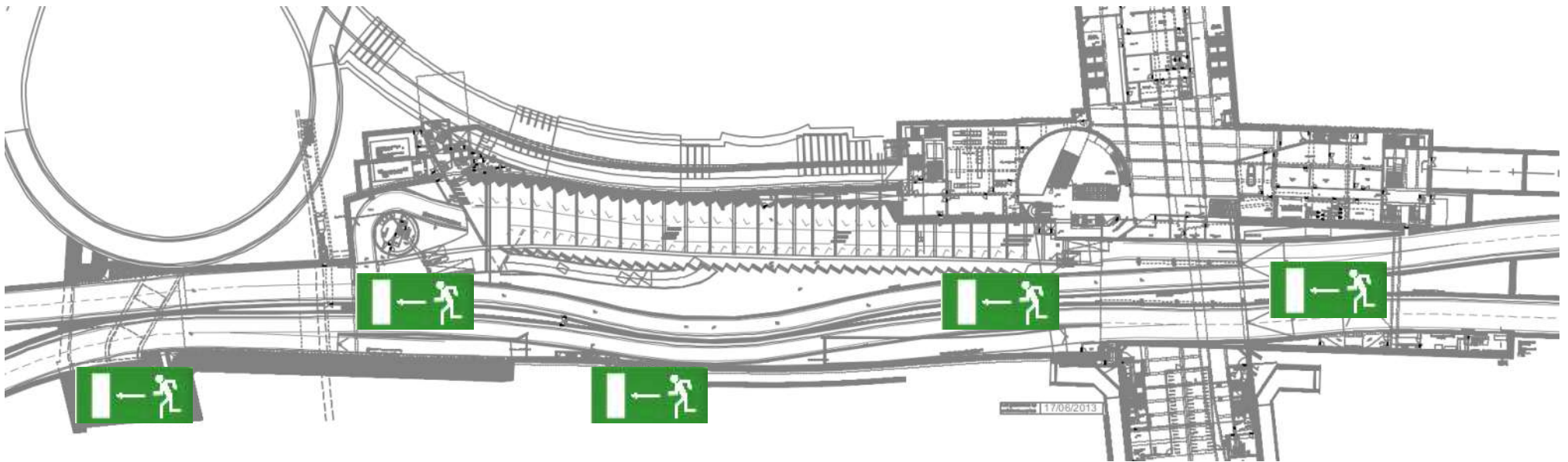
Construction

Escape route

- Parking: closest stairs at 45m
- Tunnel:
 - closest stairs at 45m (European Directive 2004/54/EG: 250m)
 - overpressure

Construction

Escape route - tunnel



Construction

Fire resistance

- 2 hours
 - Concrete suites Eurocode 1192-1-2

Operaplein - Antwerpen

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- **Smoke and heat exhaust**
- Automatic sprinkler system

Smoke and heat exhaust

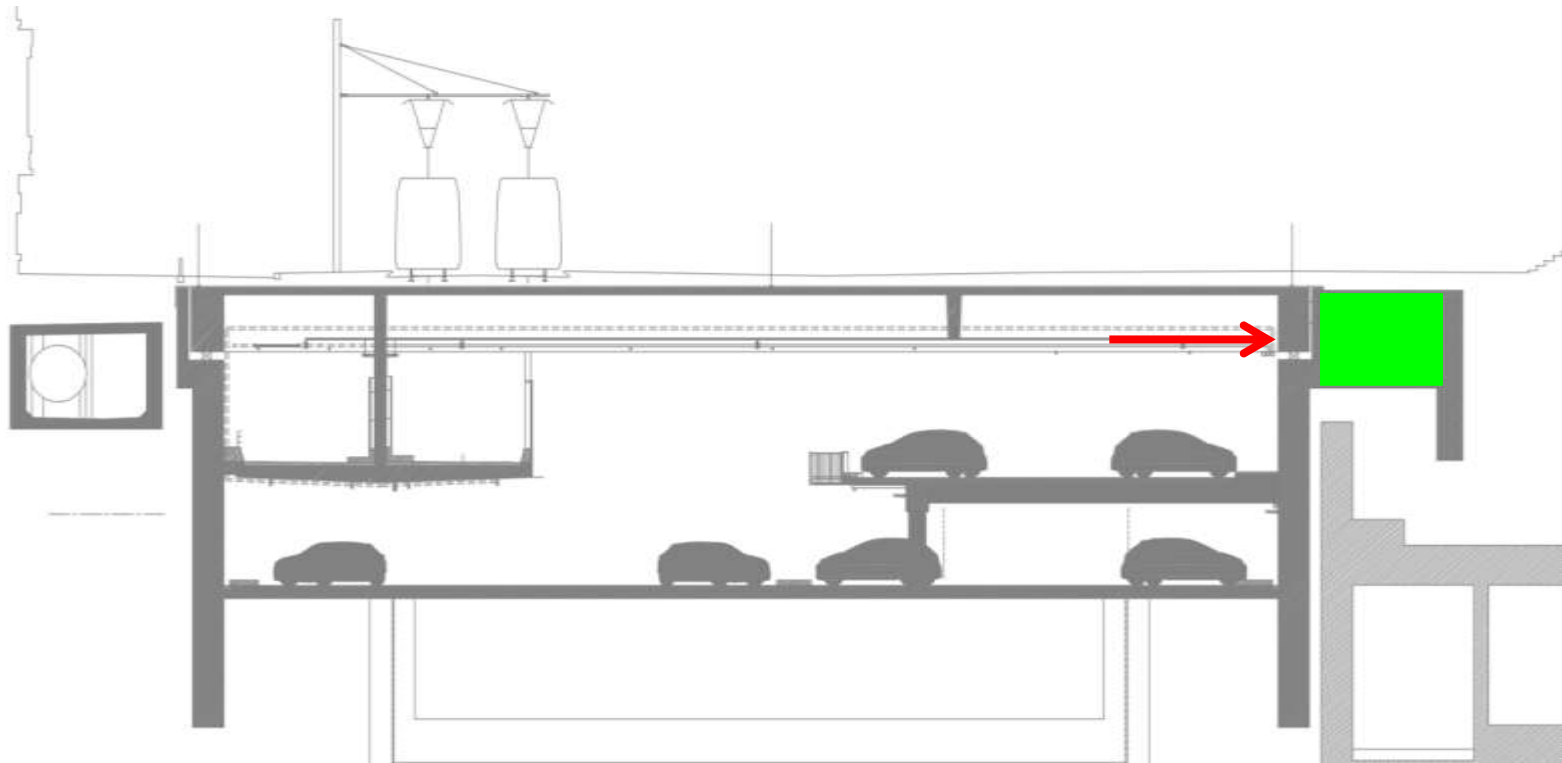
Parking

- Starting points
 - 6 MW – 2 cars (standard NBN S21-208-2)
 - Interference with tunnels
 - Strict architectural demands (no visible ducts)
- Calculations
 - Levels -1 and -2: Computational Fluid Dynamics (CFD)
 - 10 scenarios executed
 - Level -3: Standard NBN S21-208-2

Smoke and heat exhaust

Parking -1/-2 - Exhaust

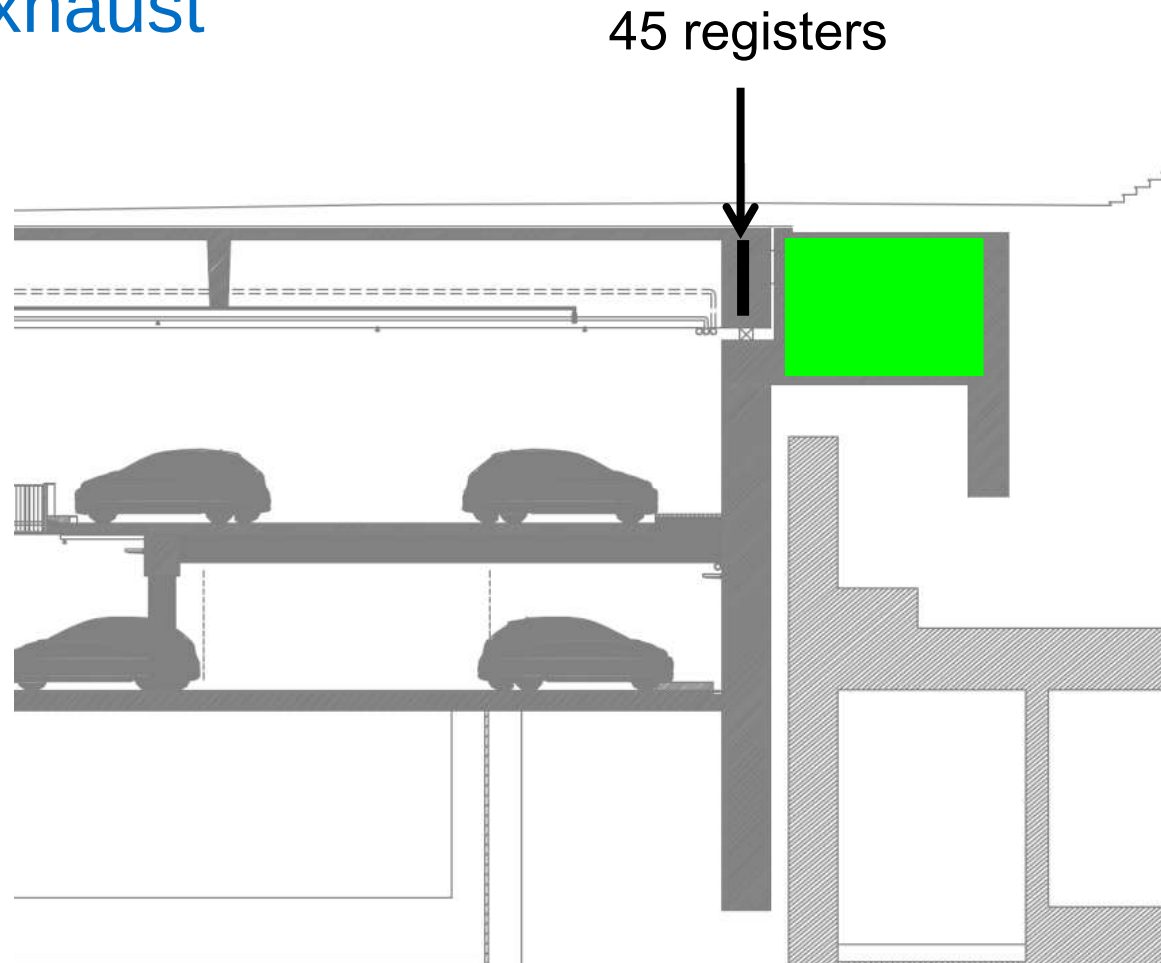
- Architectonic duct



Smoke and heat exhaust

Parking -1/-2 - Exhaust

- Architectonic duct

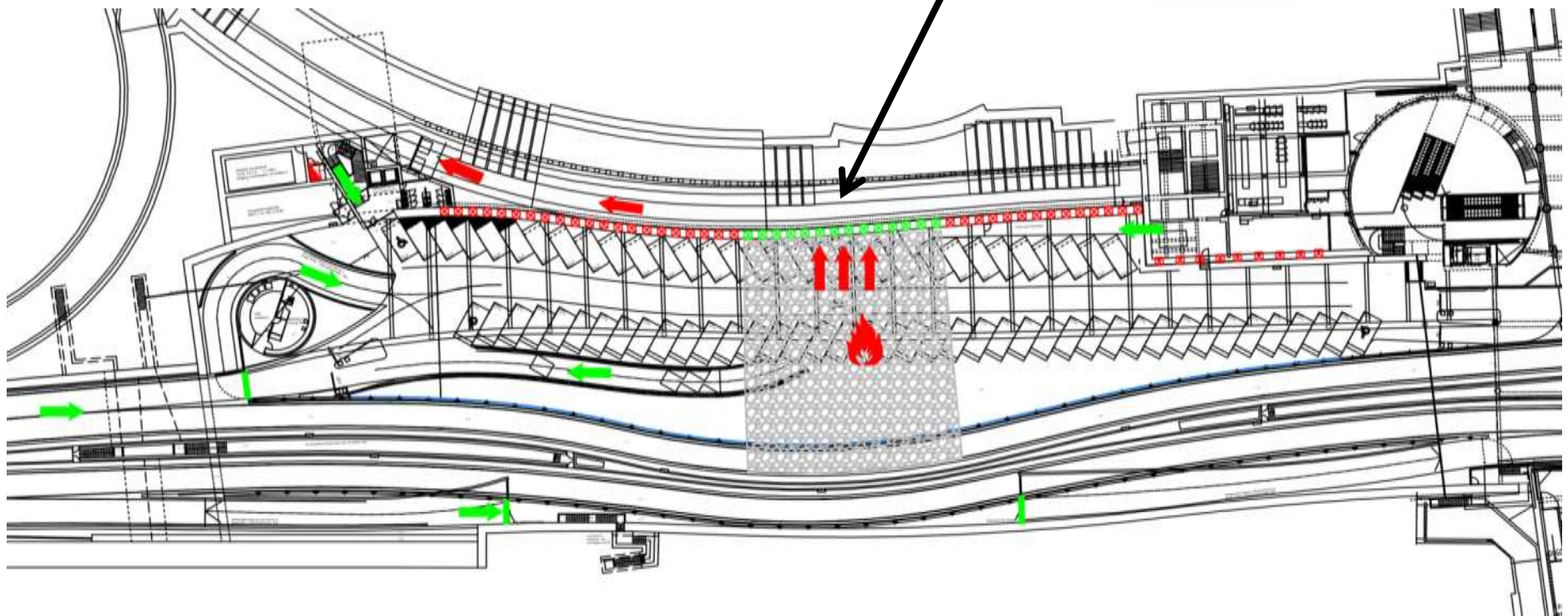


Smoke and heat exhaust

Parking -1/-2 - Exhaust

- Detection

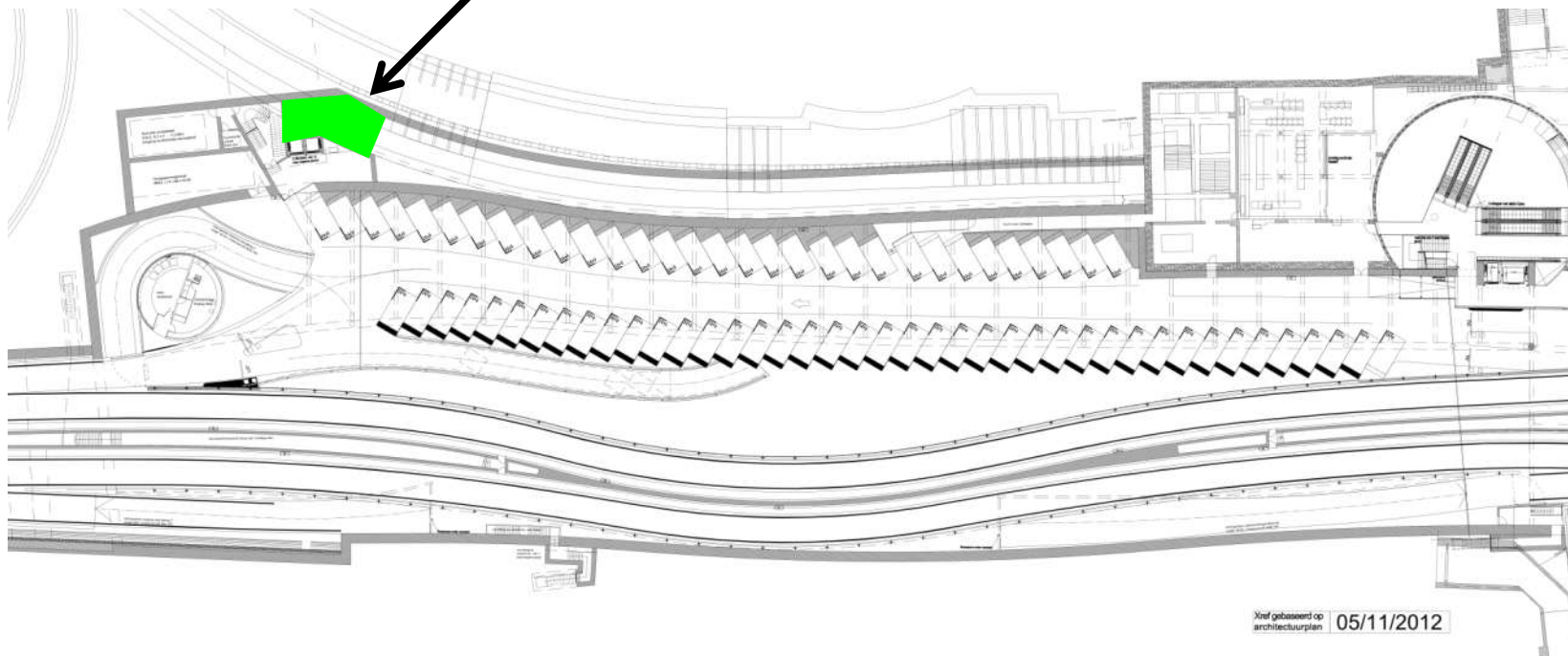
14 registers
open



Smoke and heat exhaust

Parking -1/-2 - Exhaust

- Central exhaust
- 3 fans of in total
400.000m³/h

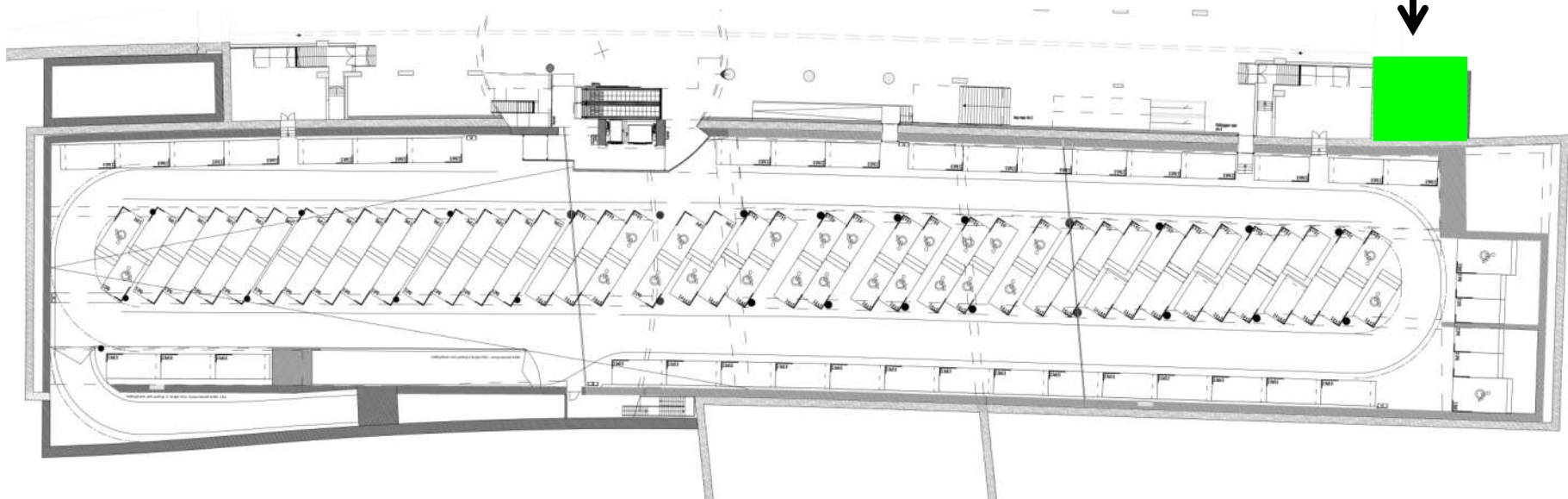


Smoke and heat exhaust

Parking -3 - Exhaust

- Vertical shaft with fans
- 550.000m³/h through calculations NBN S21-208-2

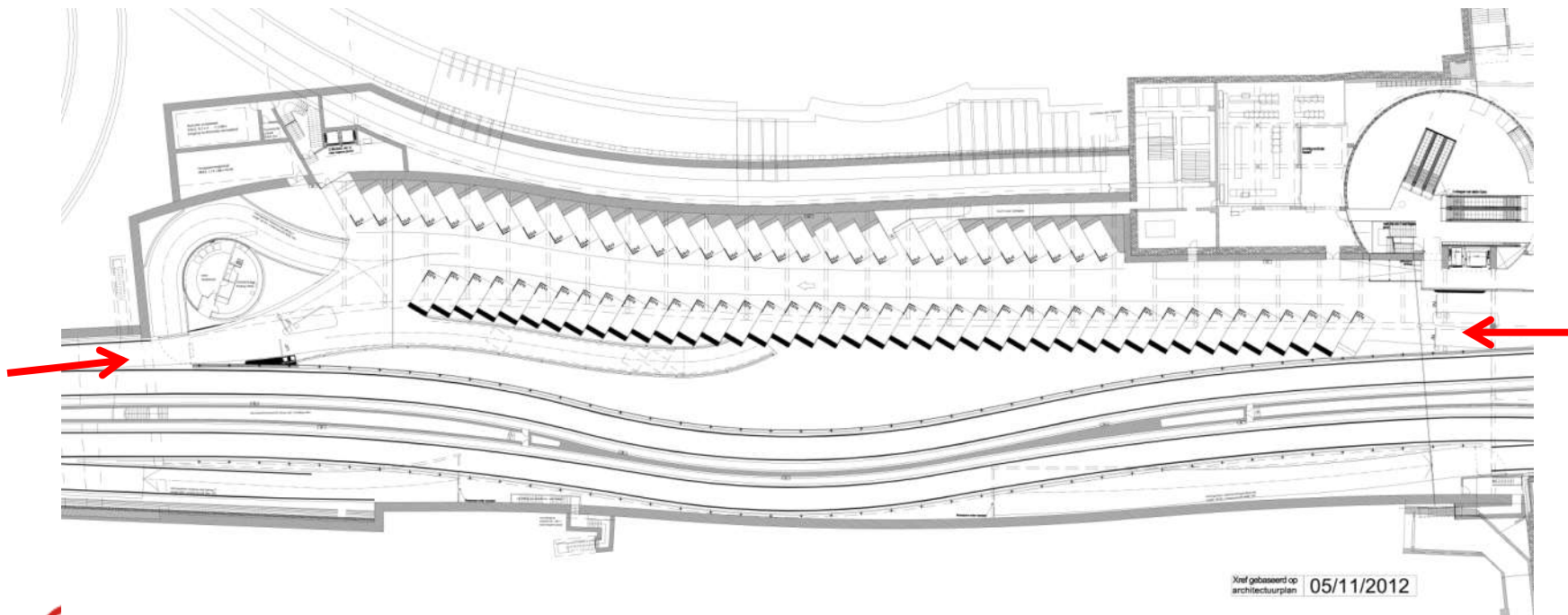
4 fans of in total
550.000m³/h



Smoke and heat exhaust

Parking -1/-2 – Replacement air

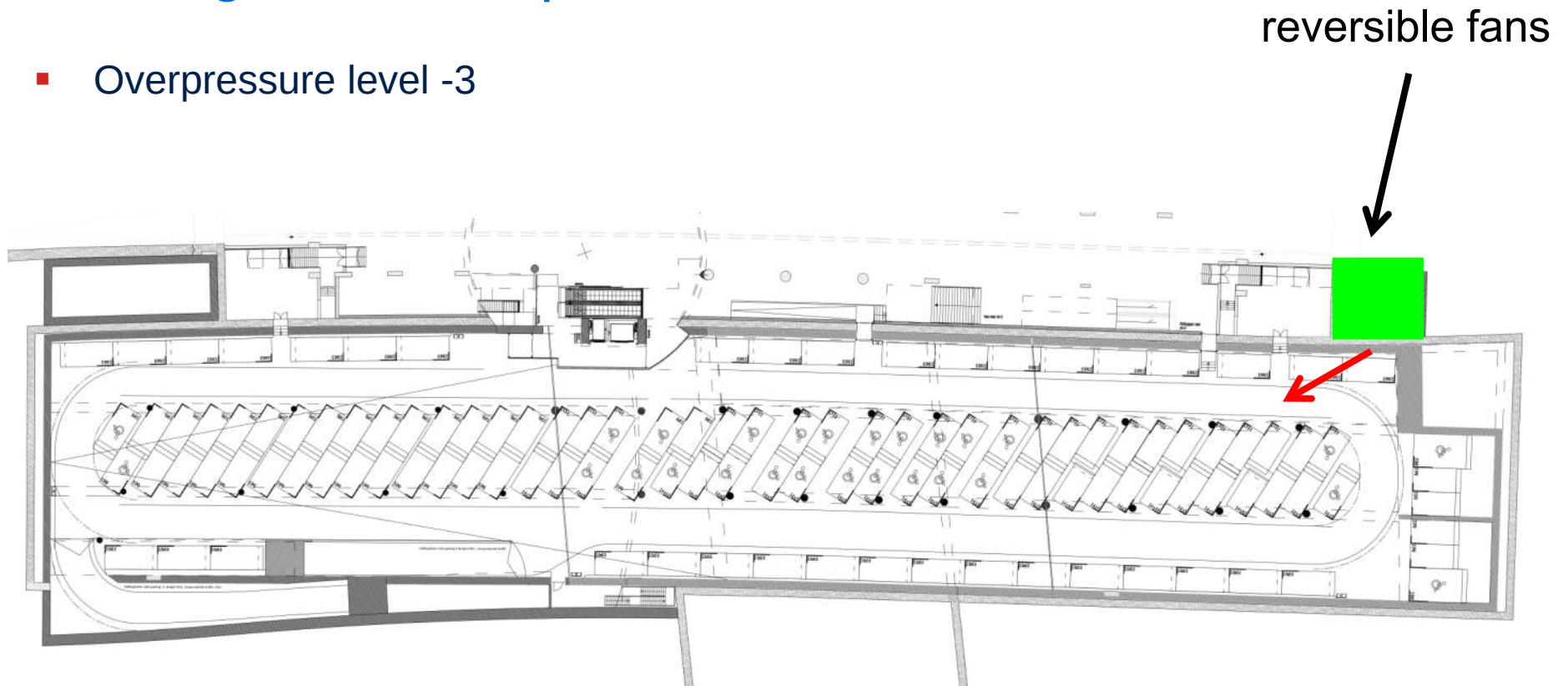
- Different scenario's – replacement air depends on scenario
 - mostly via tunnels
 - some scenario's: overpressure level -3



Smoke and heat exhaust

Parking -1/-2 – Replacement air

- Overpressure level -3



Smoke and heat exhaust

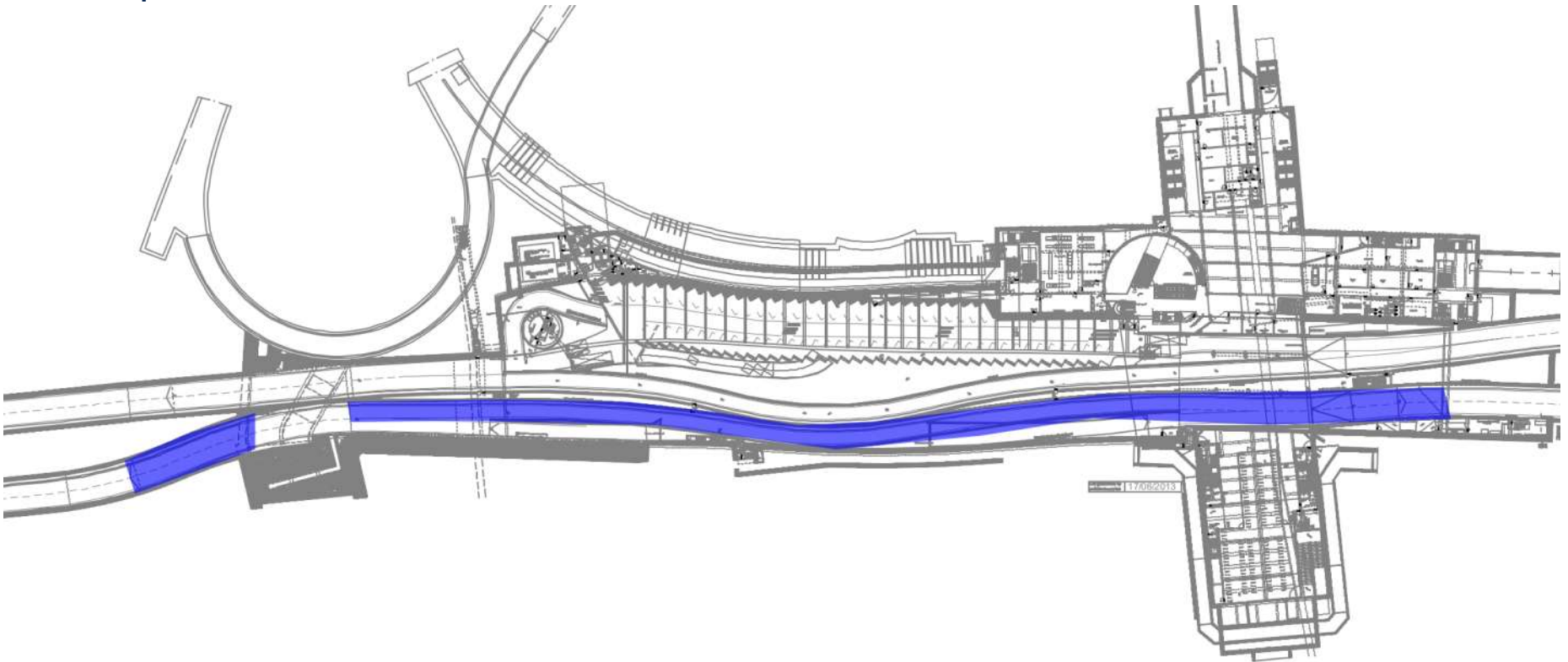
Tunnel

- Starting points
 - 15 MW (delivery van) – 17m, 15m²
 - Wind effect 5m/s
 - Smoke in driving direction
 - Access fire fighters
 - Interference with parking (open tunnel south-north)
- Calculations
 - Computational Fluid Dynamics (CFD)
 - Tunnel north-south – 1 scenario executed
 - Tunnel south-north – 5 scenarios executed
 - VRC Richtlijn part C

Smoke and heat exhaust

Tunnel – north → south

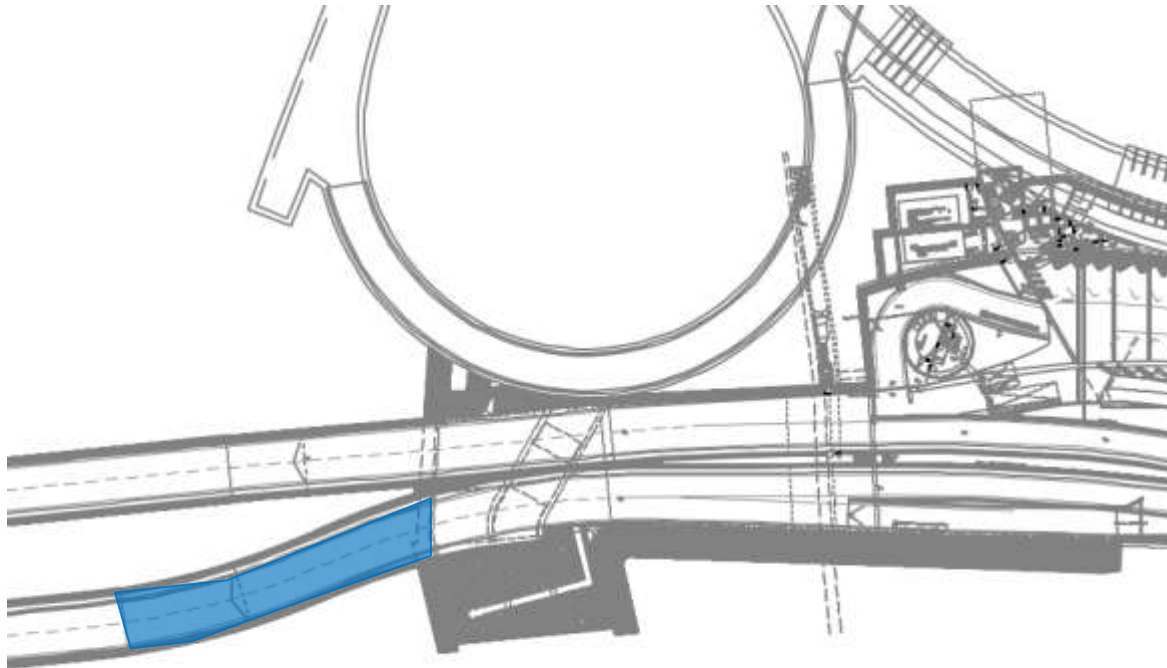
- Separated tunnel



Smoke and heat exhaust

Tunnel – north → south

- North side

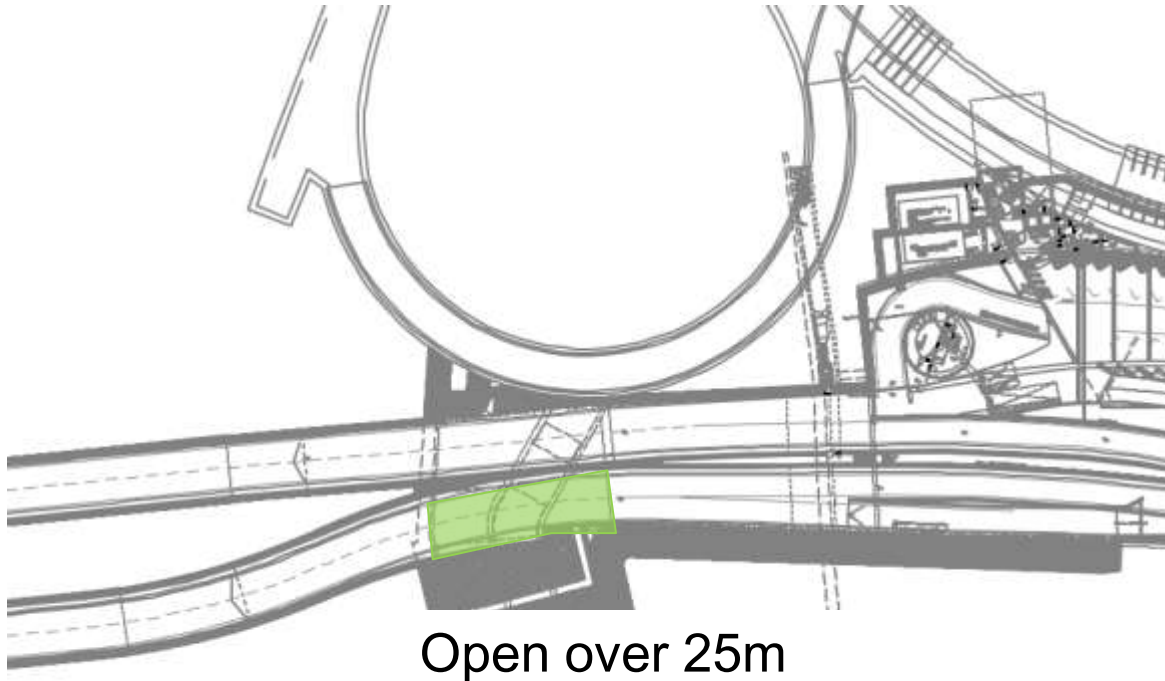


Covered over 46m

Smoke and heat exhaust

Tunnel – north → south

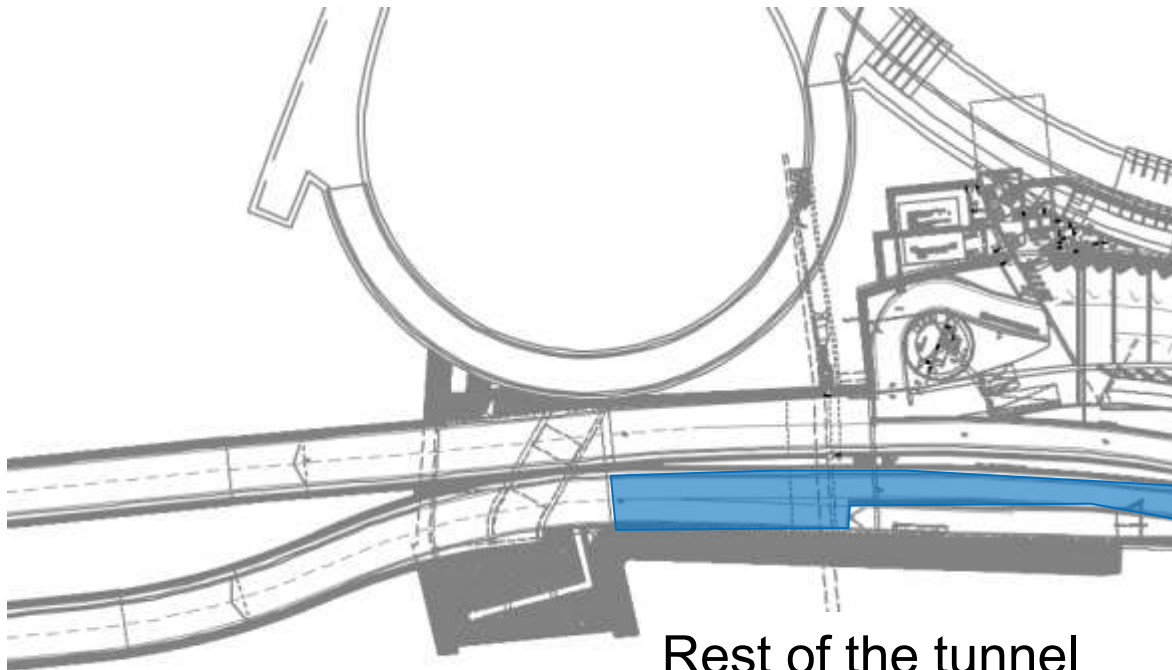
- North side



Smoke and heat exhaust

Tunnel – north → south

- North side

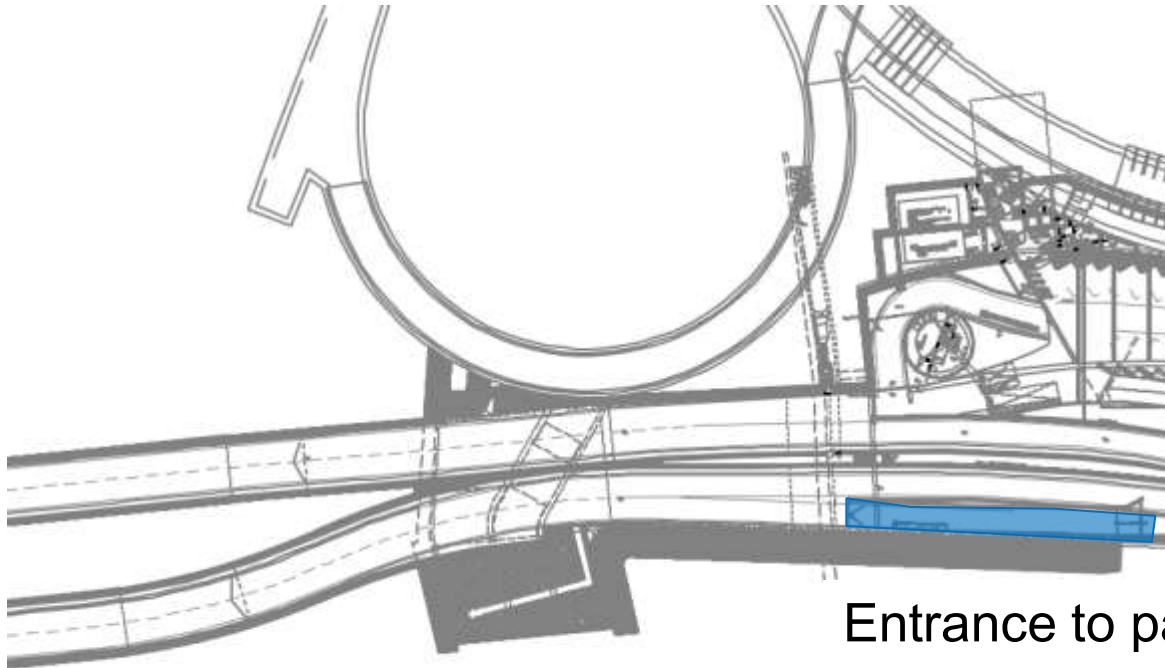


Rest of the tunnel
is covered

Smoke and heat exhaust

Tunnel – north → south

- North side

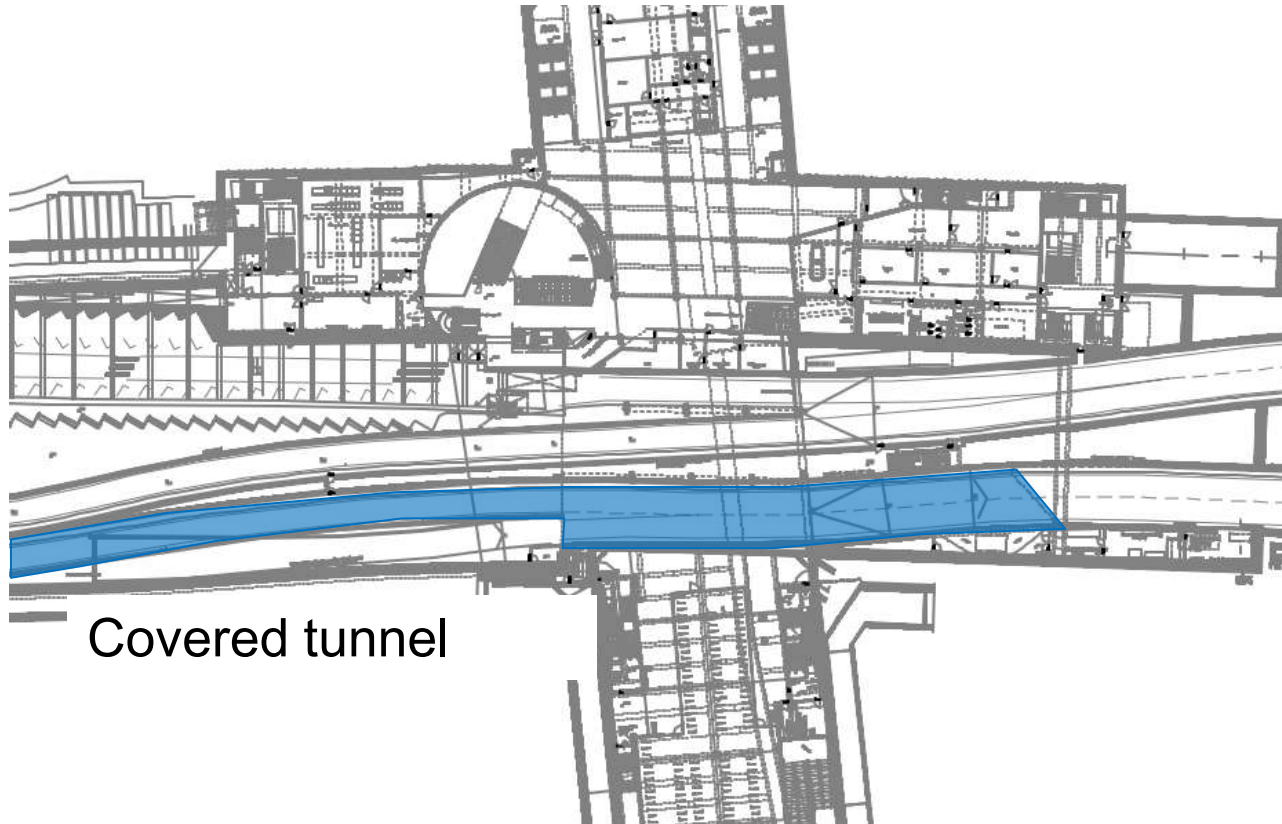


Entrance to parking

Smoke and heat exhaust

Tunnel – north → south

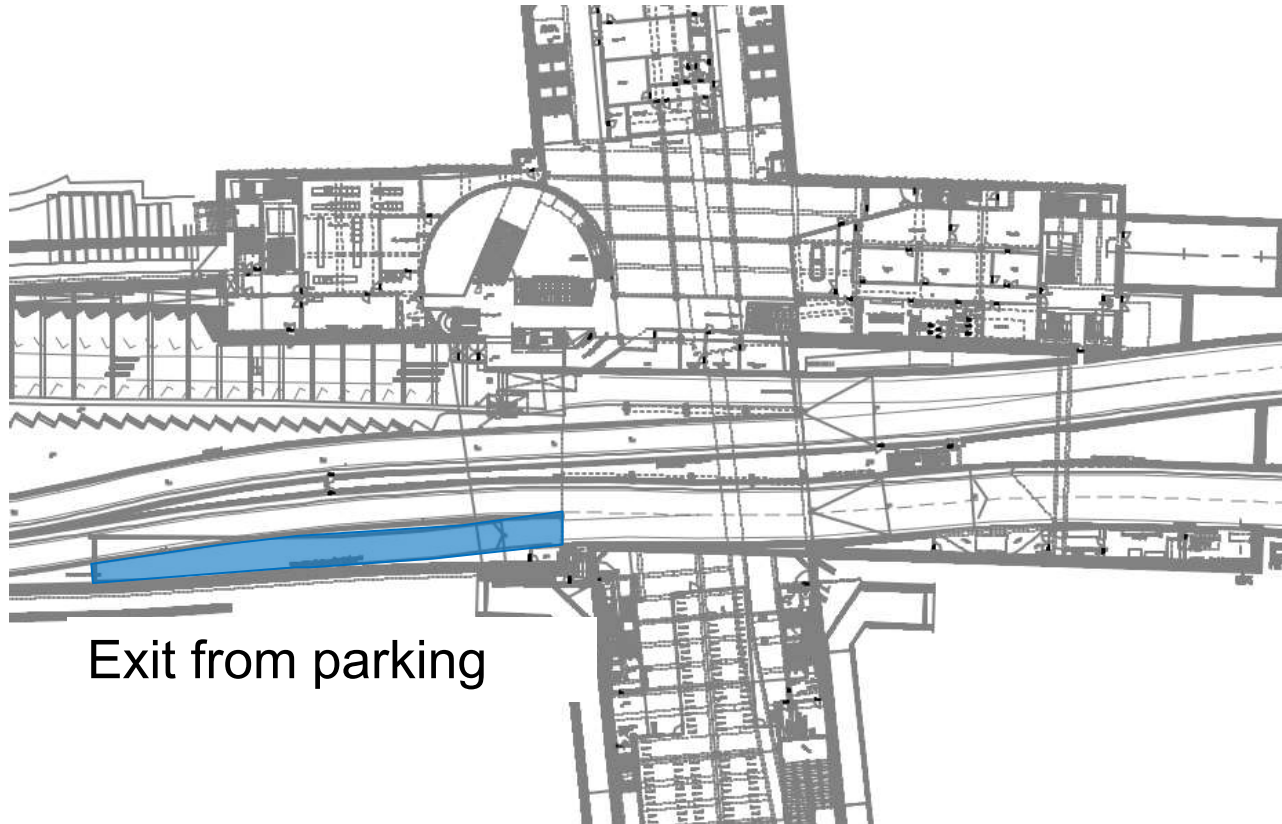
- South side



Smoke and heat exhaust

Tunnel – north → south

- South side



Smoke and heat exhaust

Tunnel – north → south

- Measures

No ventilation

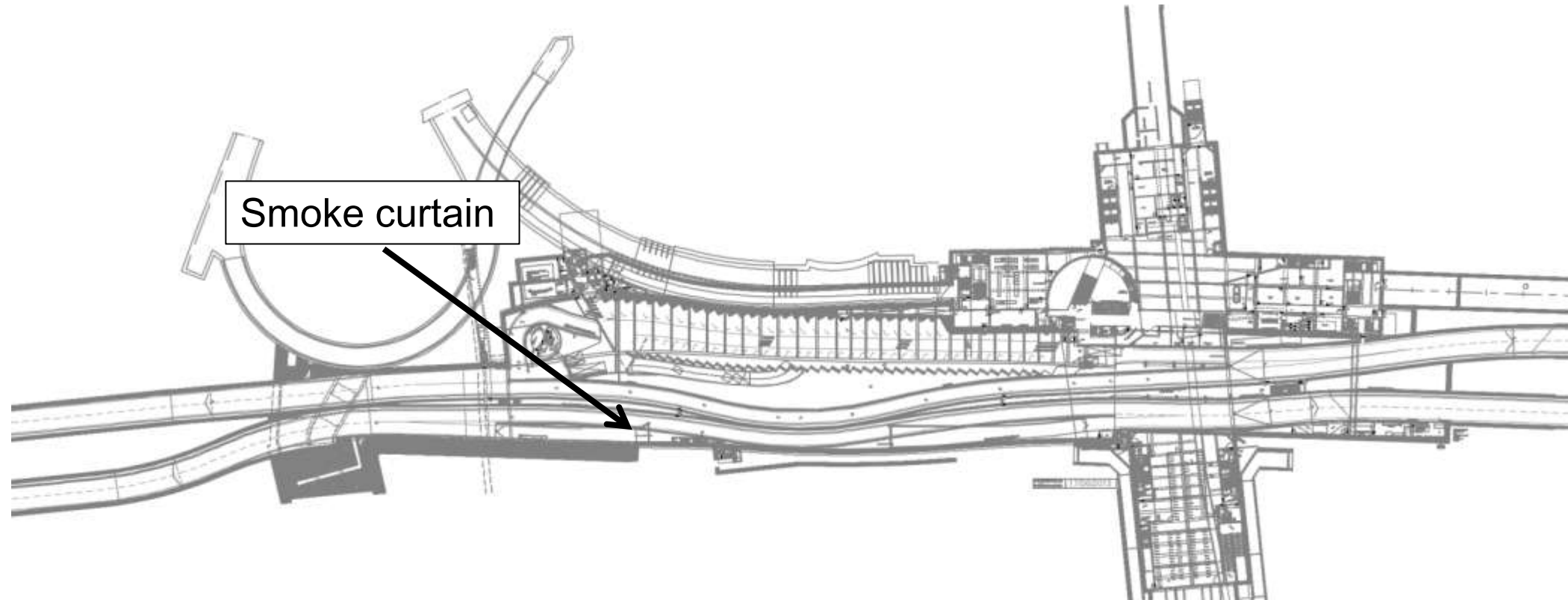


Smoke and heat exhaust

Tunnel – north → south

- Measures

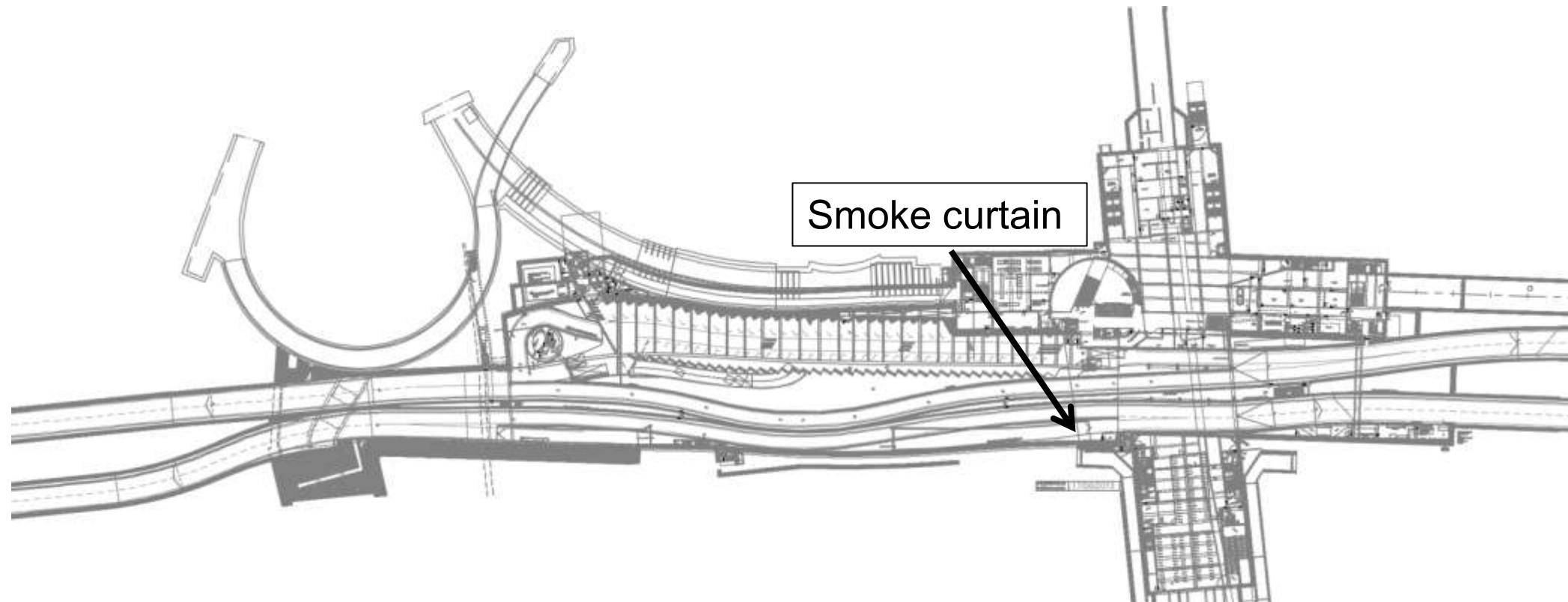
Smoke curtain



Smoke and heat exhaust

Tunnel – north → south

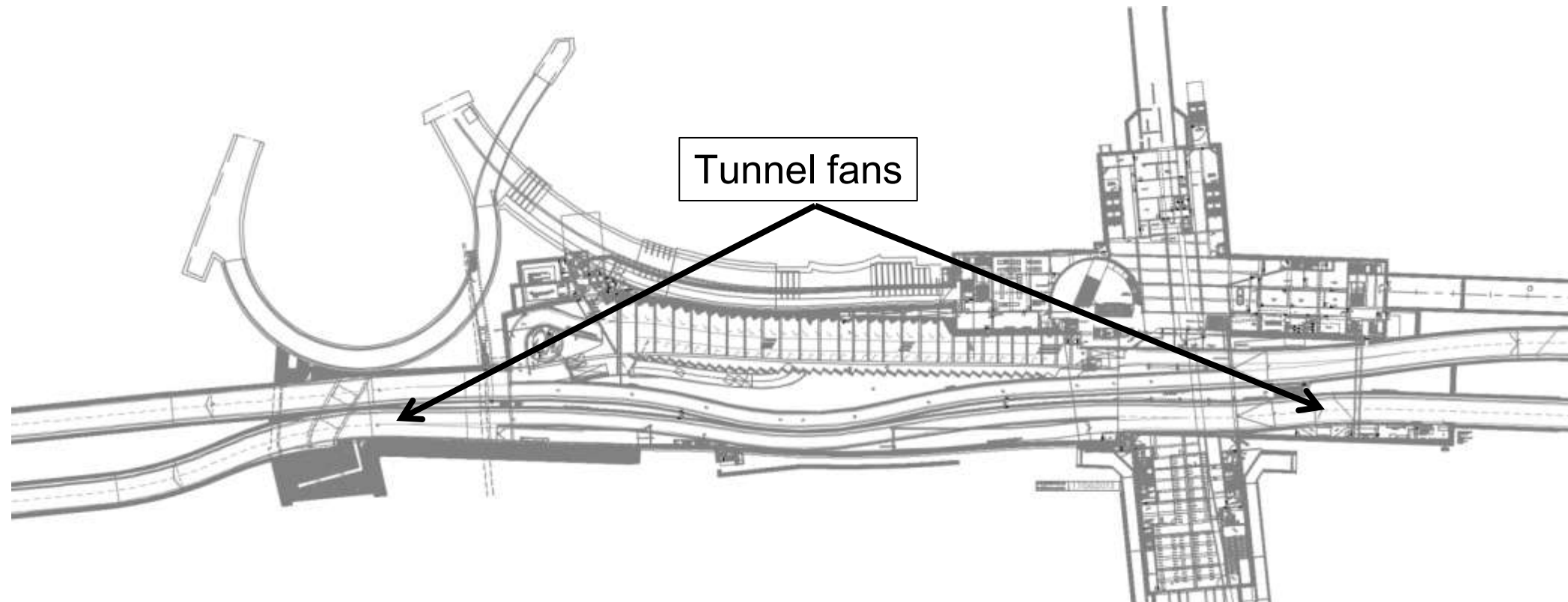
- Measures



Smoke and heat exhaust

Tunnel – north → south

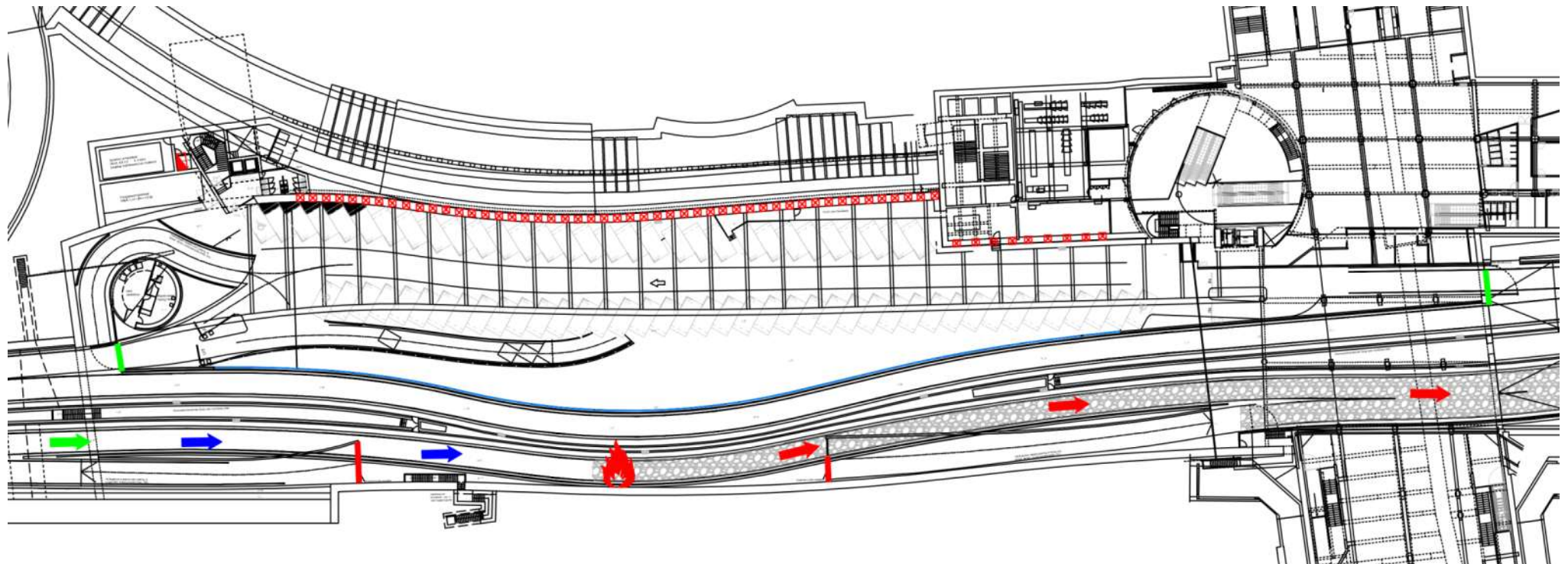
- Measures



Smoke and heat exhaust

Tunnel – north → south

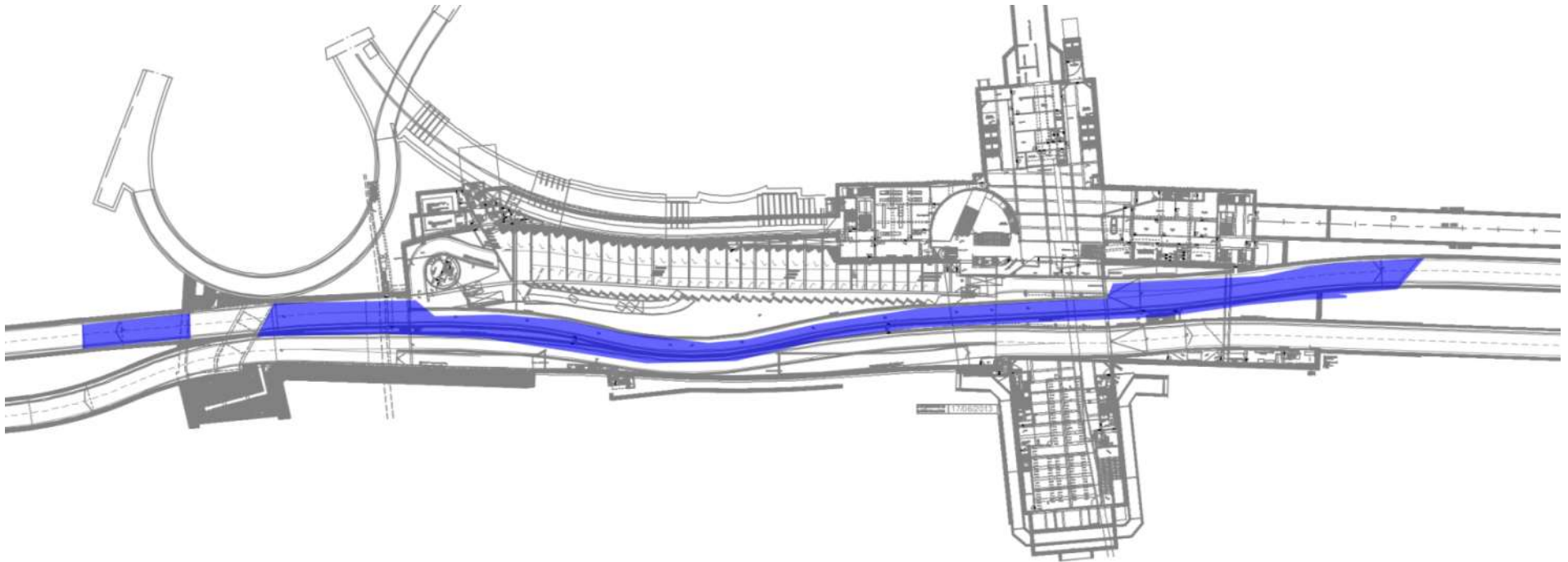
- Measures



Smoke and heat exhaust

Tunnel – south → north

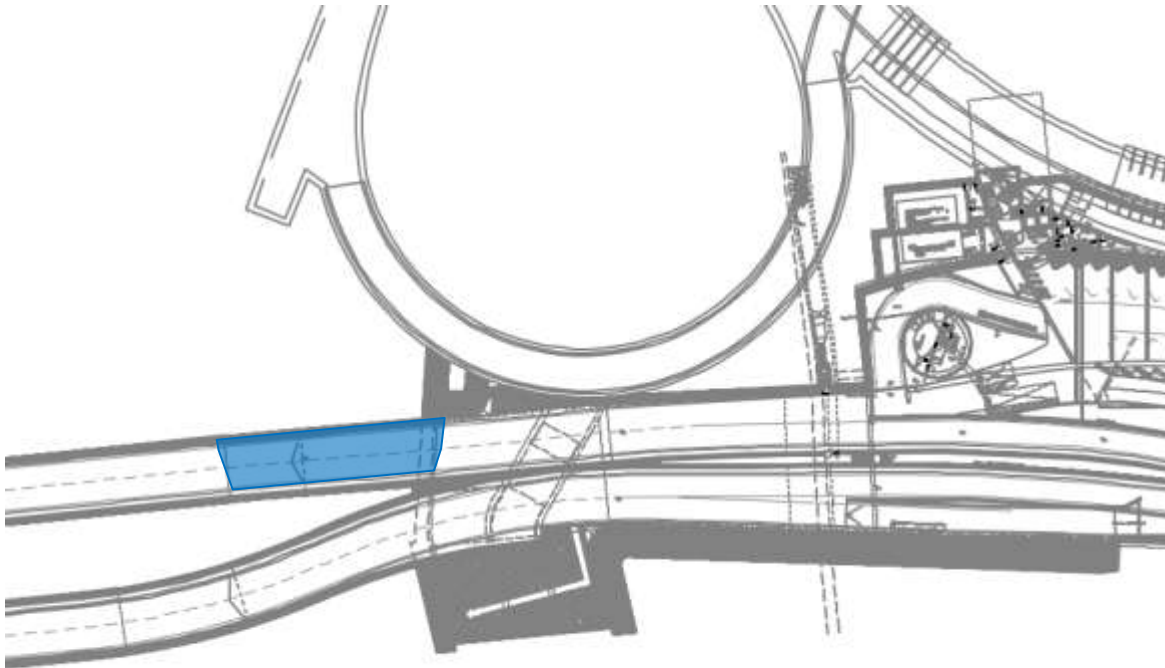
- Open tunnel



Smoke and heat exhaust

Tunnel – south → north

- North side

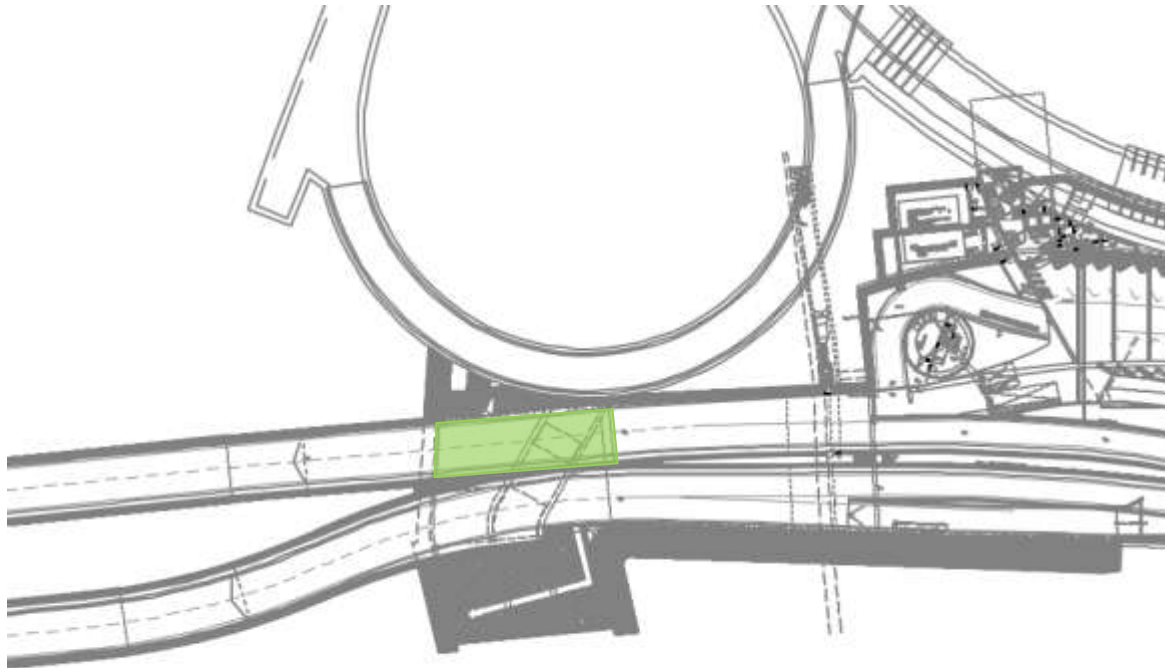


Covered over 30m

Smoke and heat exhaust

Tunnel – south → north

- North side

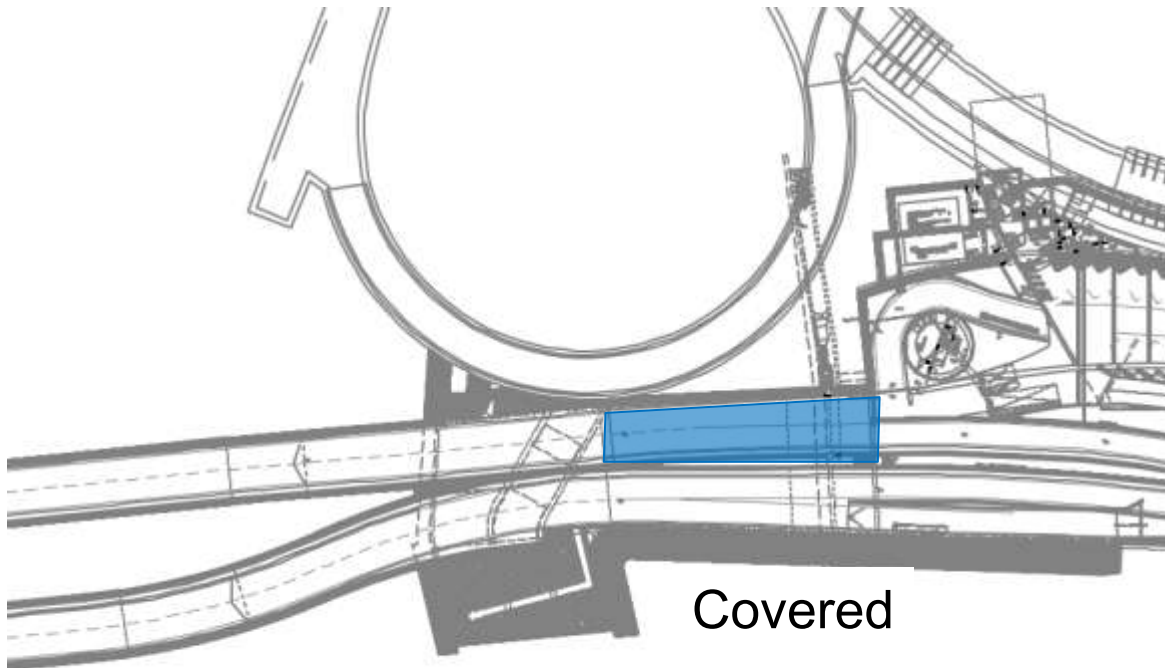


Open over 25m

Smoke and heat exhaust

Tunnel – south → north

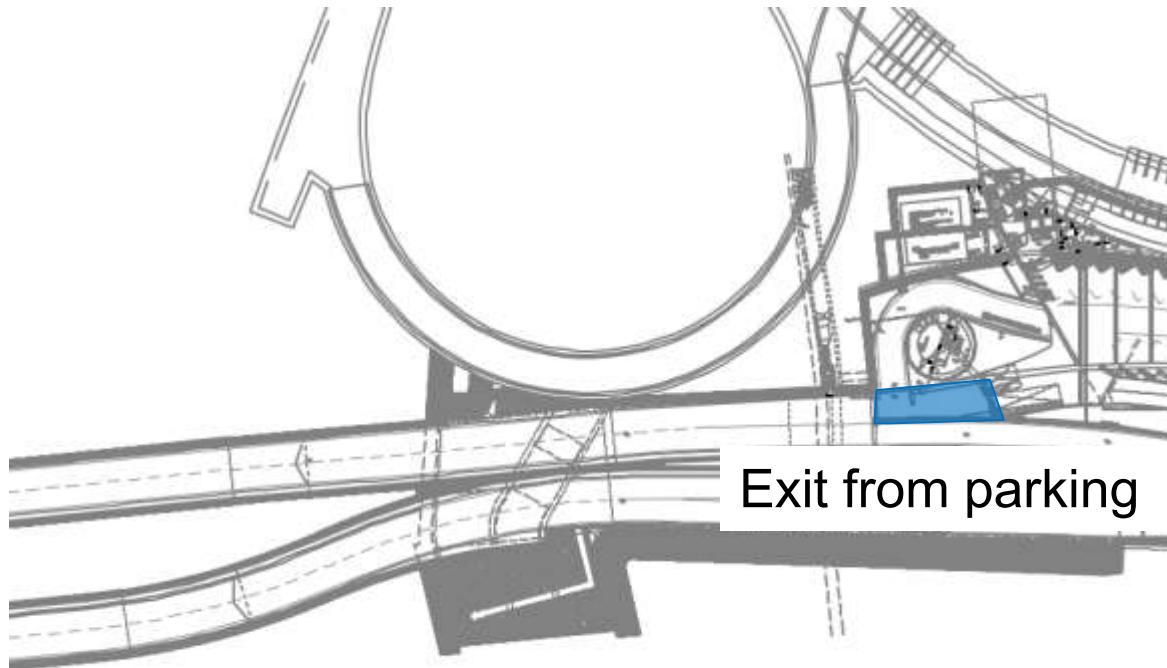
- North side



Smoke and heat exhaust

Tunnel – south → north

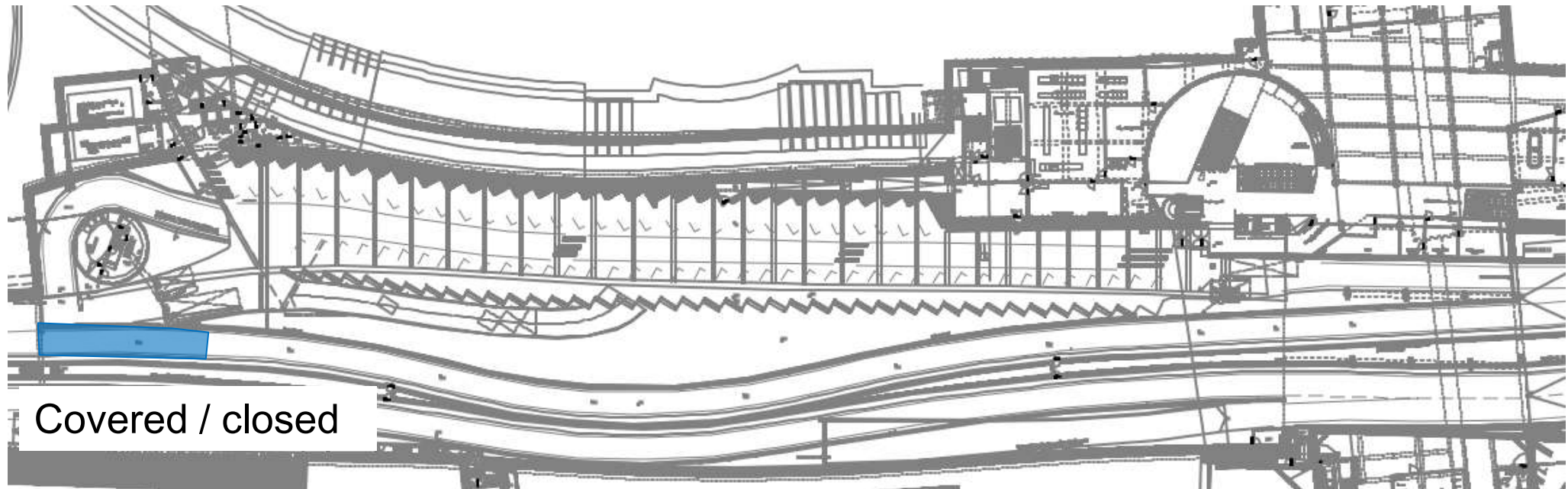
- North side



Smoke and heat exhaust

Tunnel – south → north

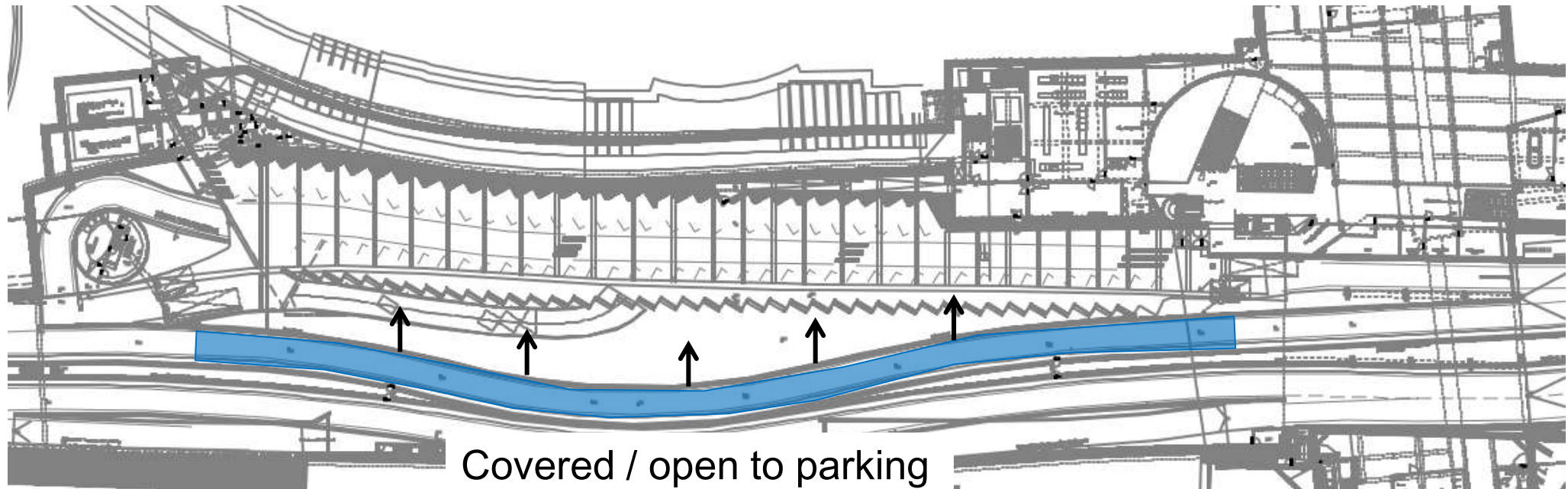
■ Mid-section



Smoke and heat exhaust

Tunnel – south → north

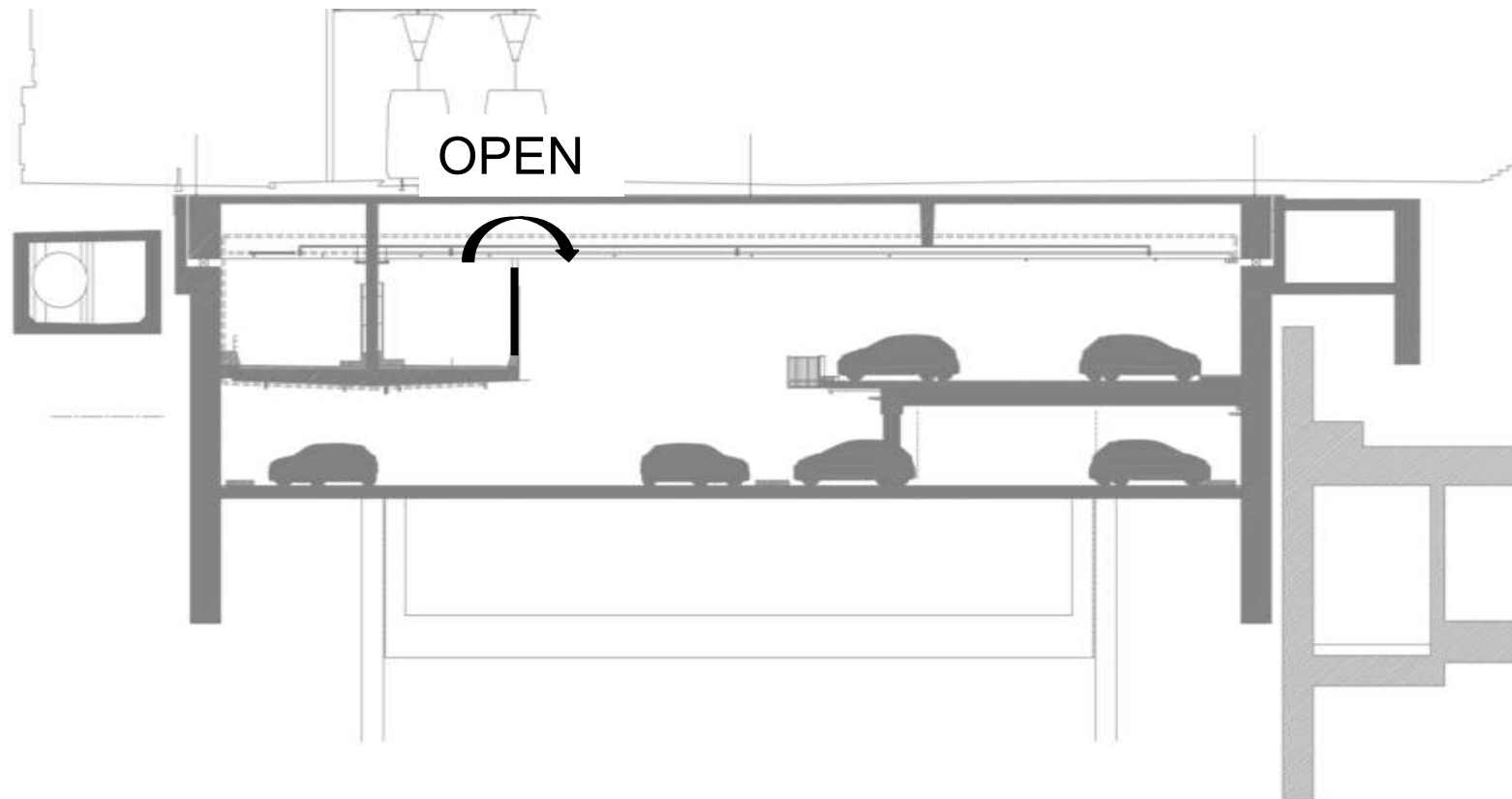
■ Mid-section



Smoke and heat exhaust

Tunnel – south → north

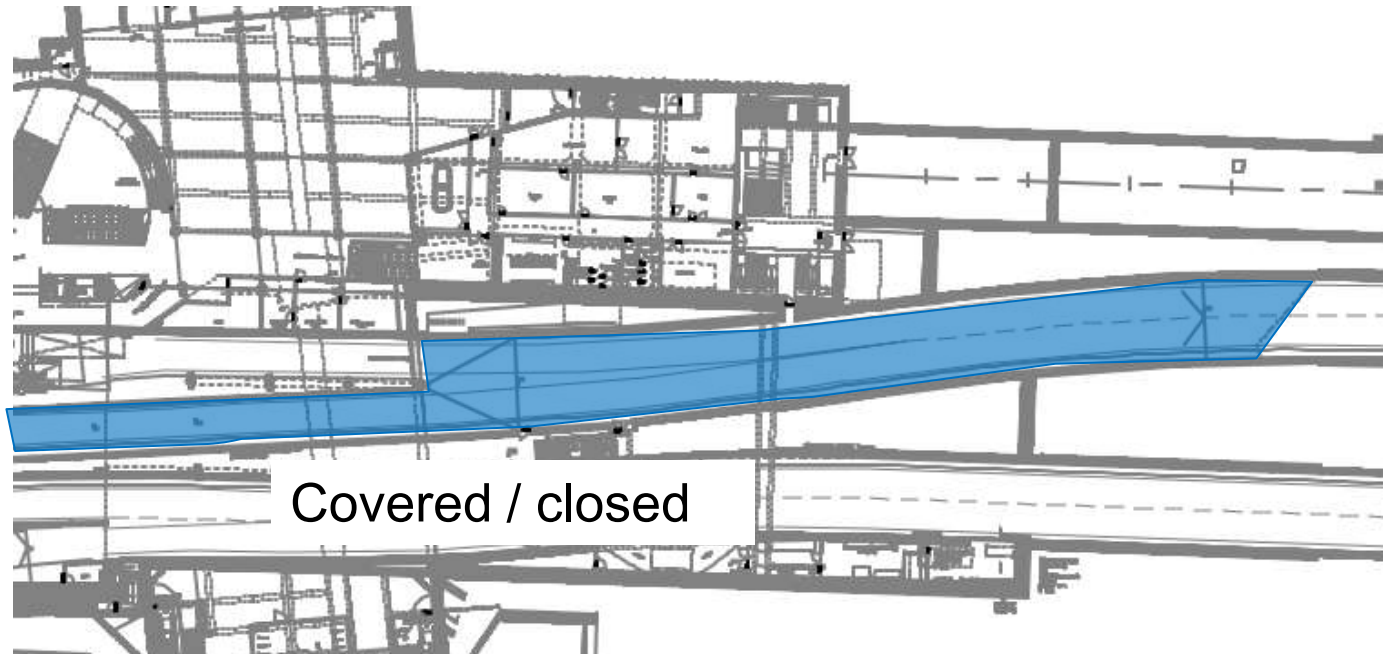
- Mid-section



Smoke and heat exhaust

Tunnel – south → north

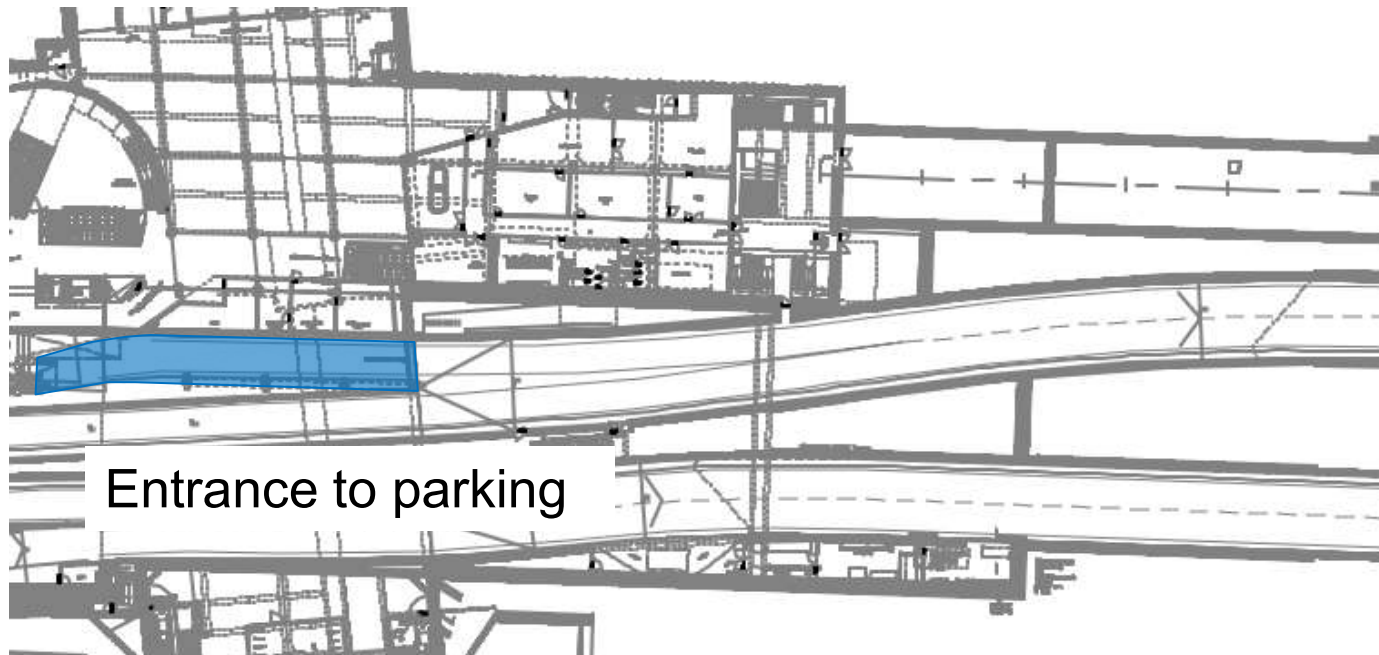
- South side



Smoke and heat exhaust

Tunnel – south → north

- South side

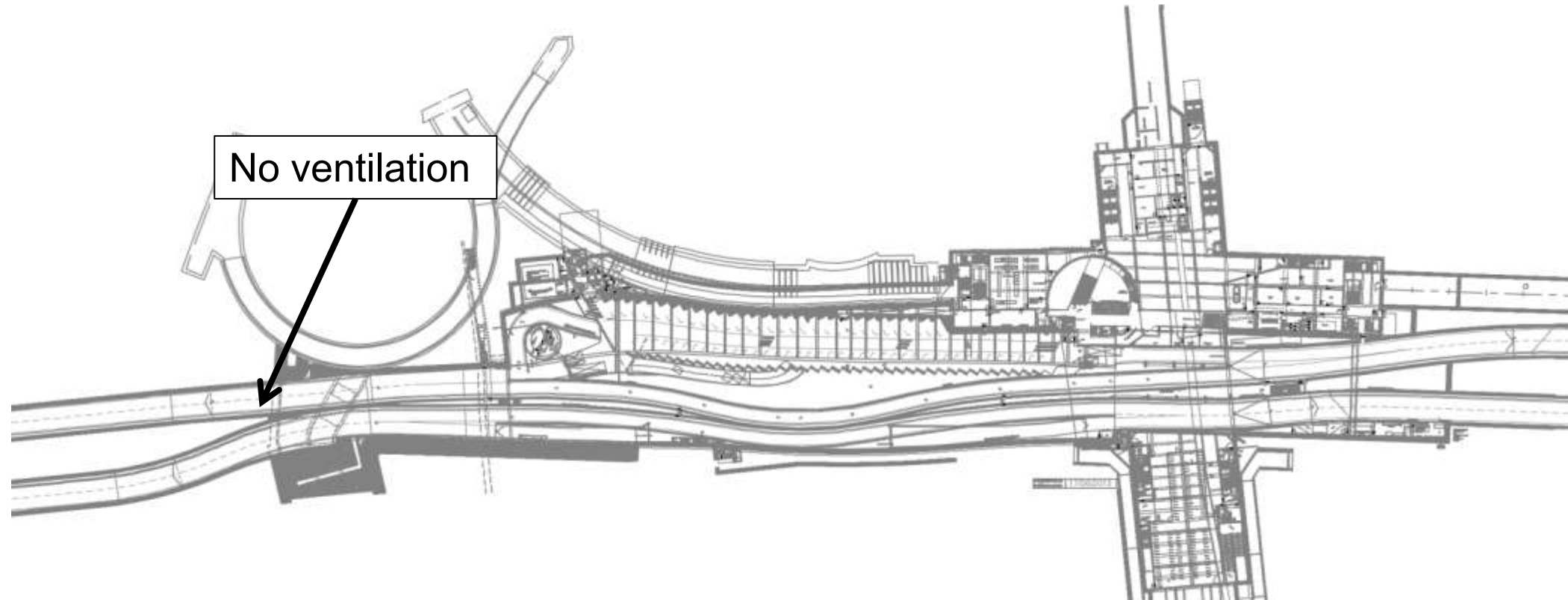


Smoke and heat exhaust

Tunnel – north → south

- Measures

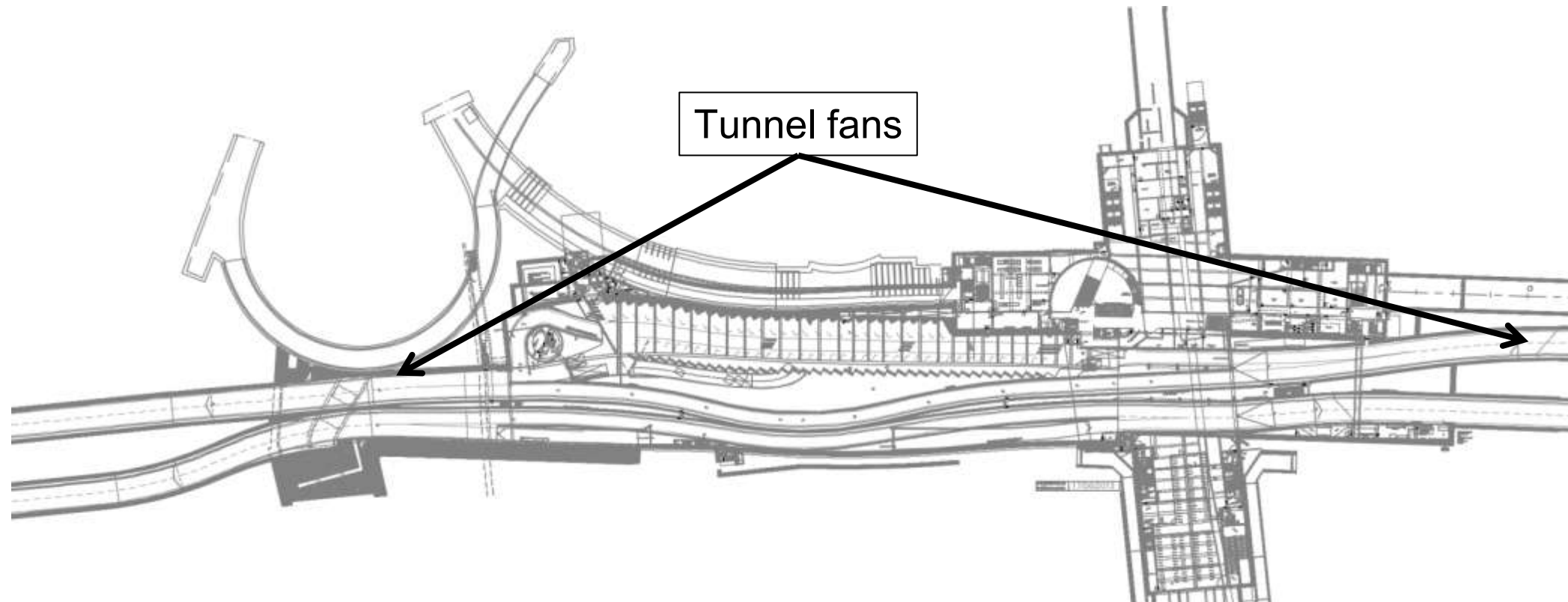
No ventilation



Smoke and heat exhaust

Tunnel – north → south

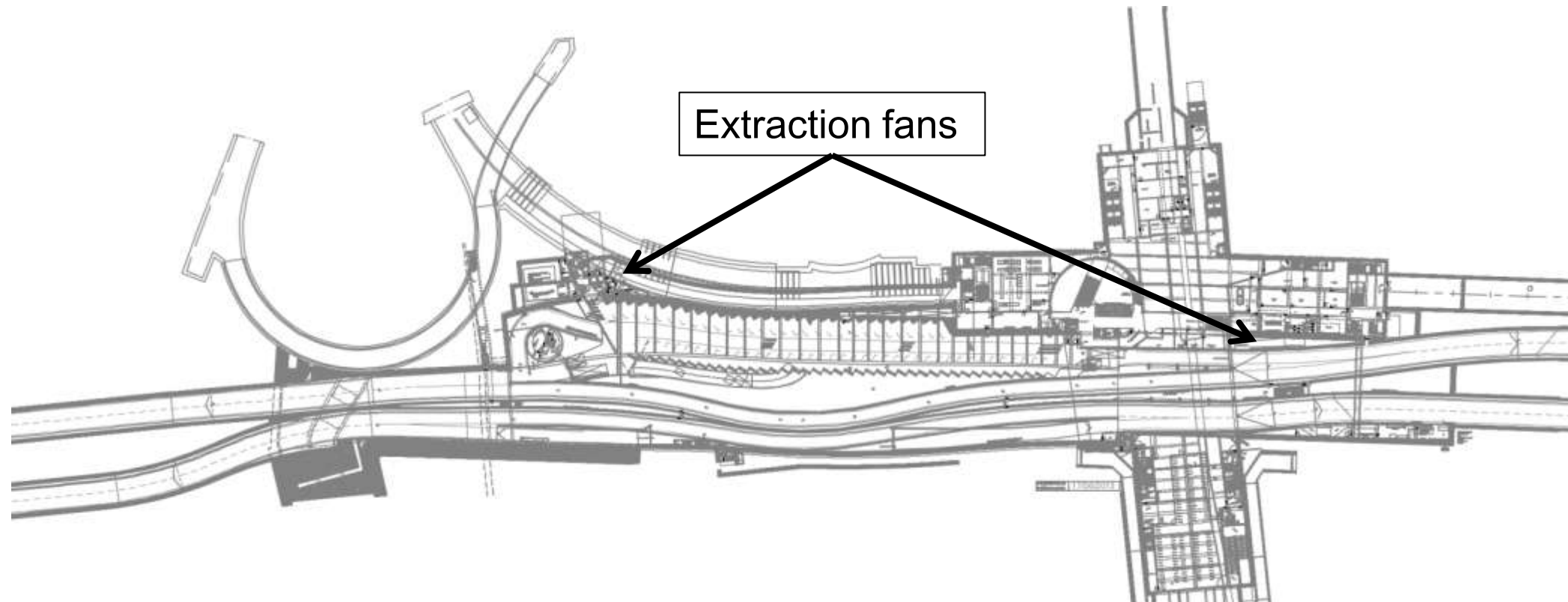
- Measures



Smoke and heat exhaust

Tunnel – north → south

- Measures

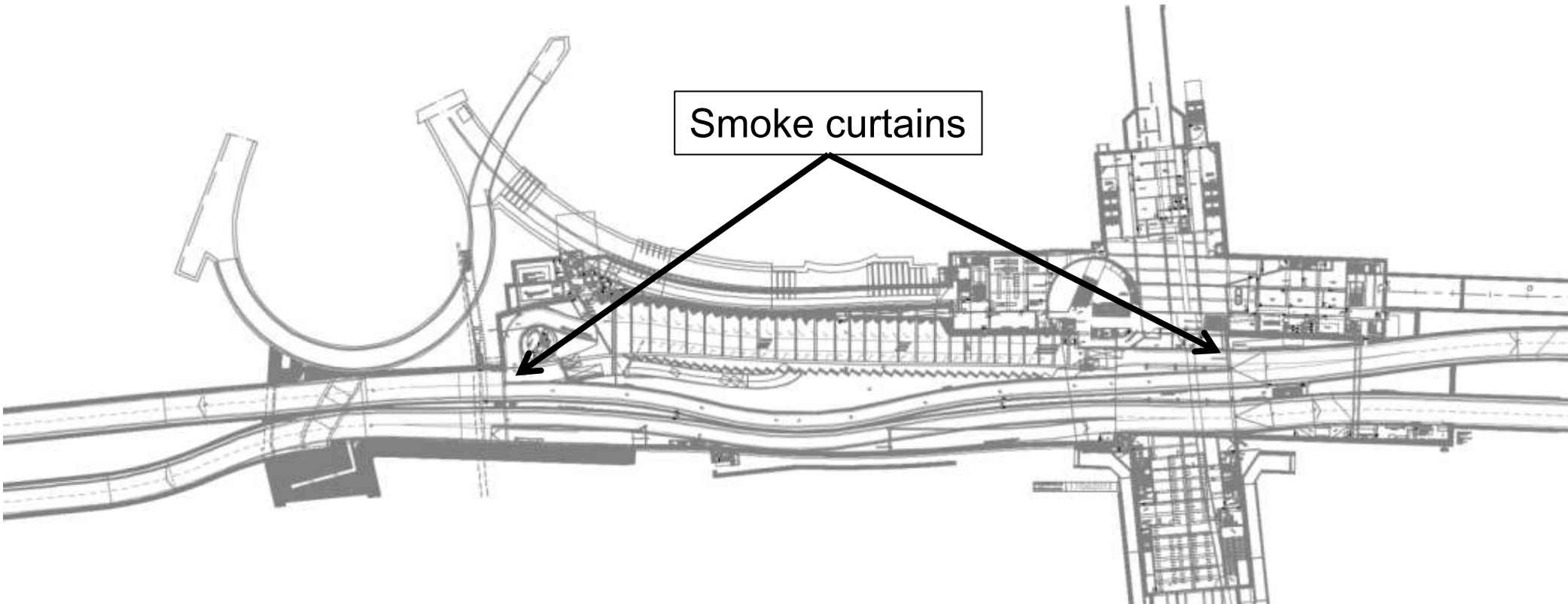


Smoke and heat exhaust

Tunnel – north → south

- Measures

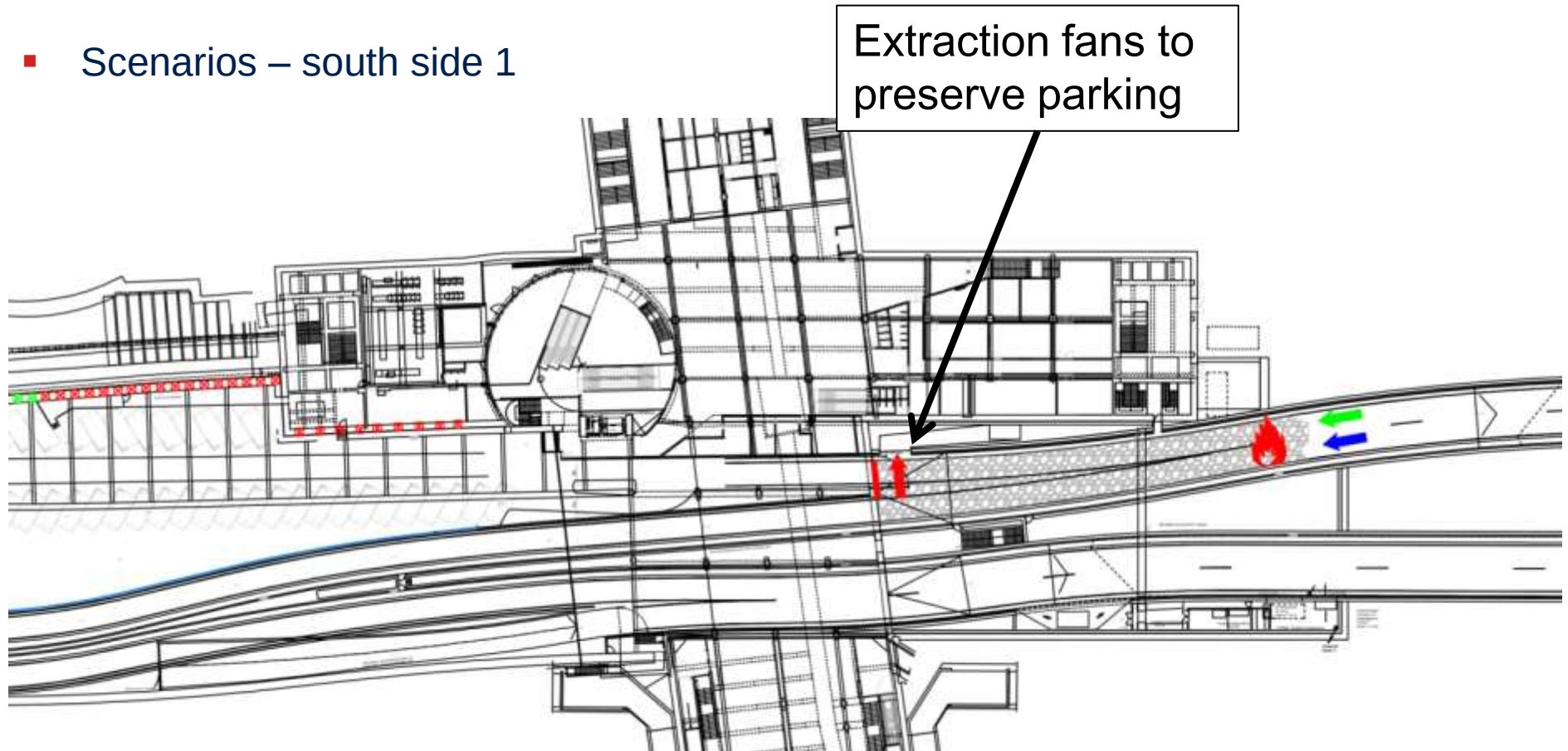
Smoke curtains



Smoke and heat exhaust

Tunnel – north → south

- Scenarios – south side 1



Smoke and heat exhaust

Tunnel – north → south

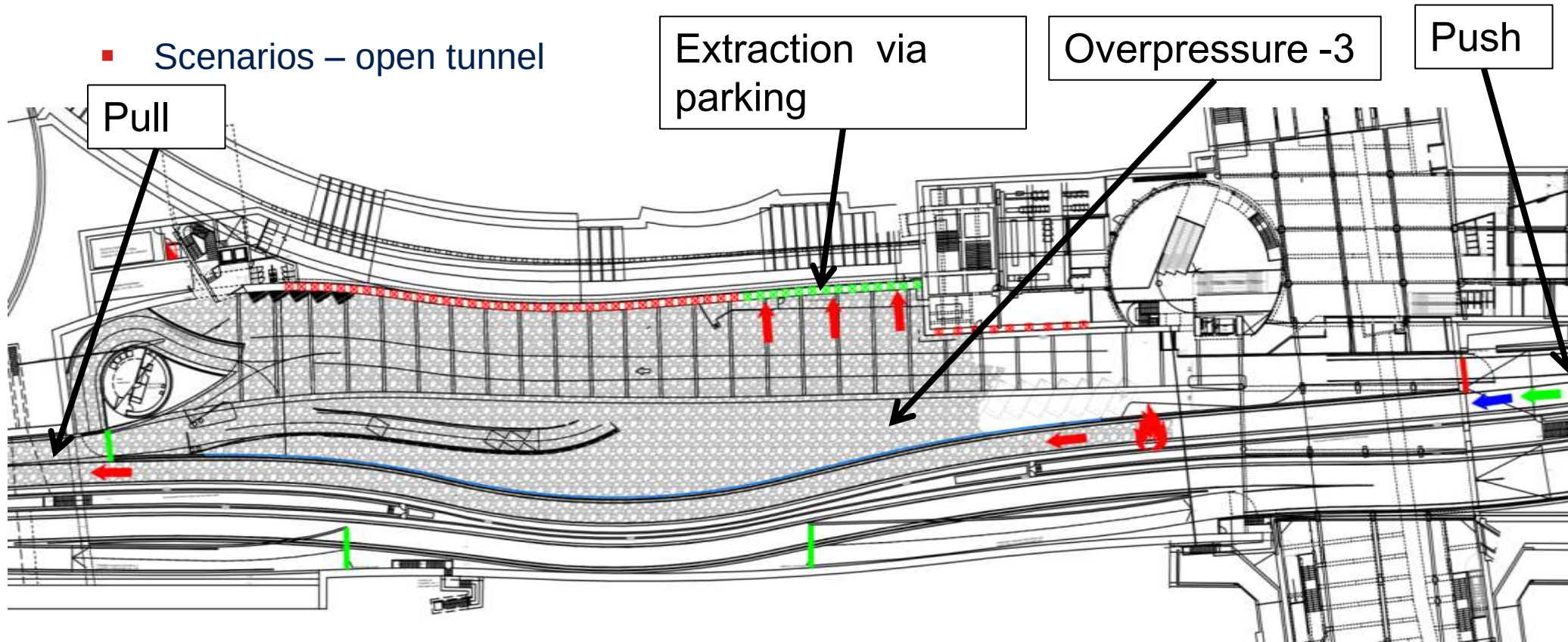
■ Scenarios – open tunnel

Pull

Extraction via parking

Overpressure -3

Push



Smoke and heat exhaust

Tunnel – north → south

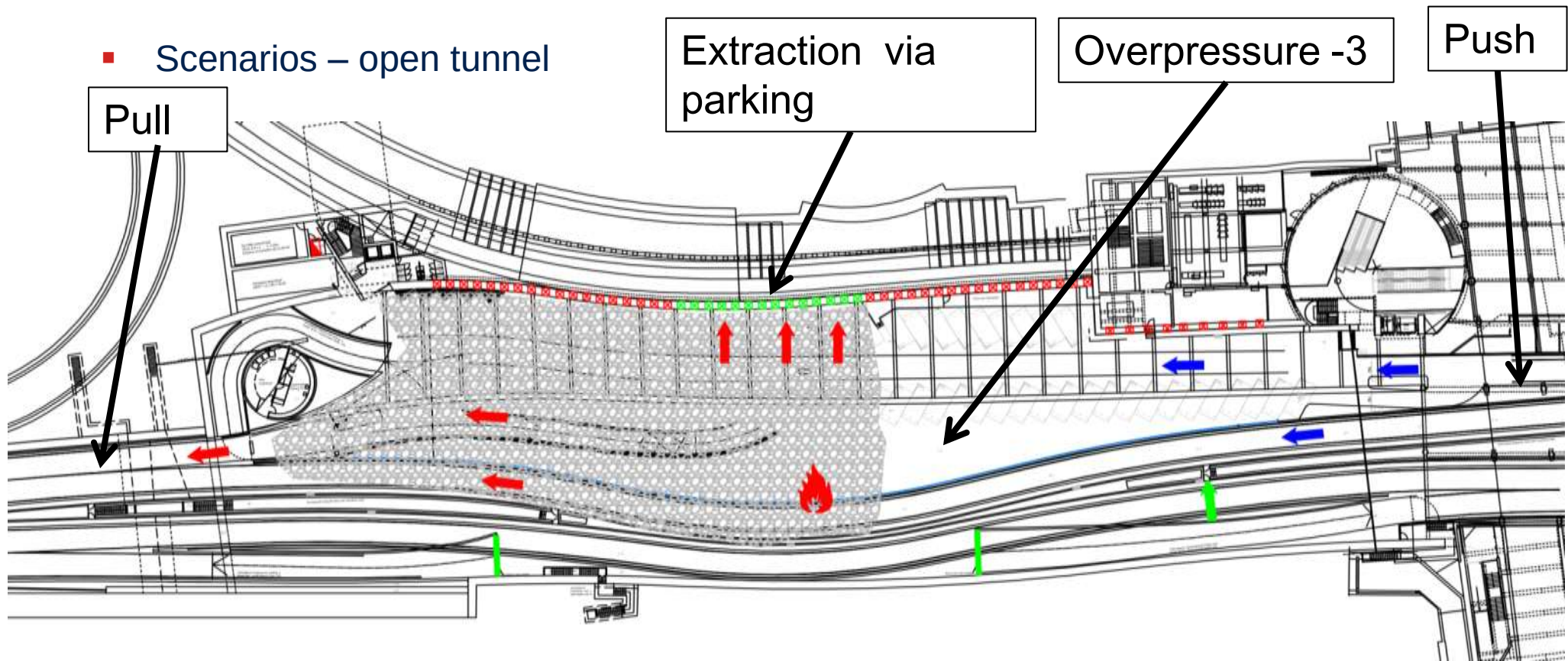
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Extraction via parking

Overpressure -3

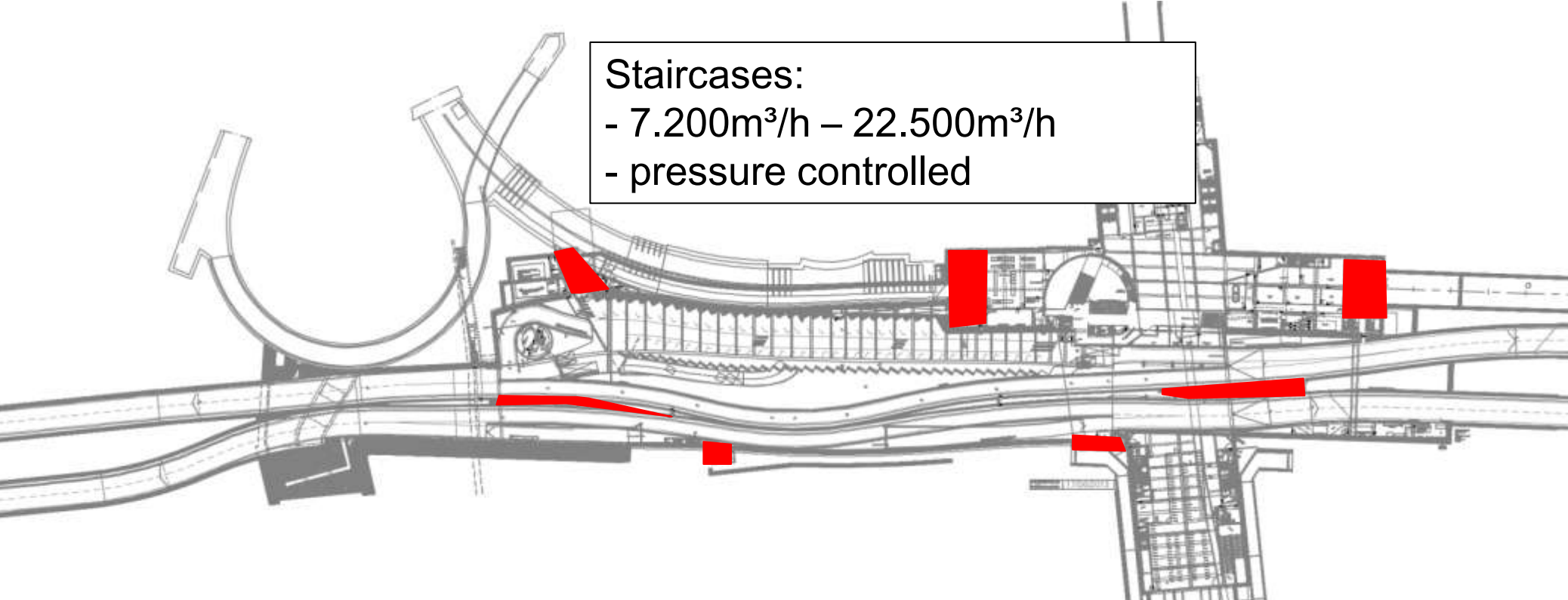
Push



Smoke and heat exhaust

Escape stairs - overpressure

- Calculations - standard EN 12101-6



The diagram is a detailed architectural cross-section of a building, likely a multi-story structure with a curved roofline. It shows the internal layout of escape stairs and the integration of a smoke and heat exhaust system. Red annotations highlight specific components: red rectangles mark the locations of mechanical exhaust units on different floors, and red lines indicate the ductwork and airflow paths for the exhaust system. The stairs are shown as a series of landings and flights, with the exhaust system designed to protect these critical escape routes from smoke and heat.

Staircases:
- 7.200m³/h – 22.500m³/h
- pressure controlled

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Automatic sprinkler system

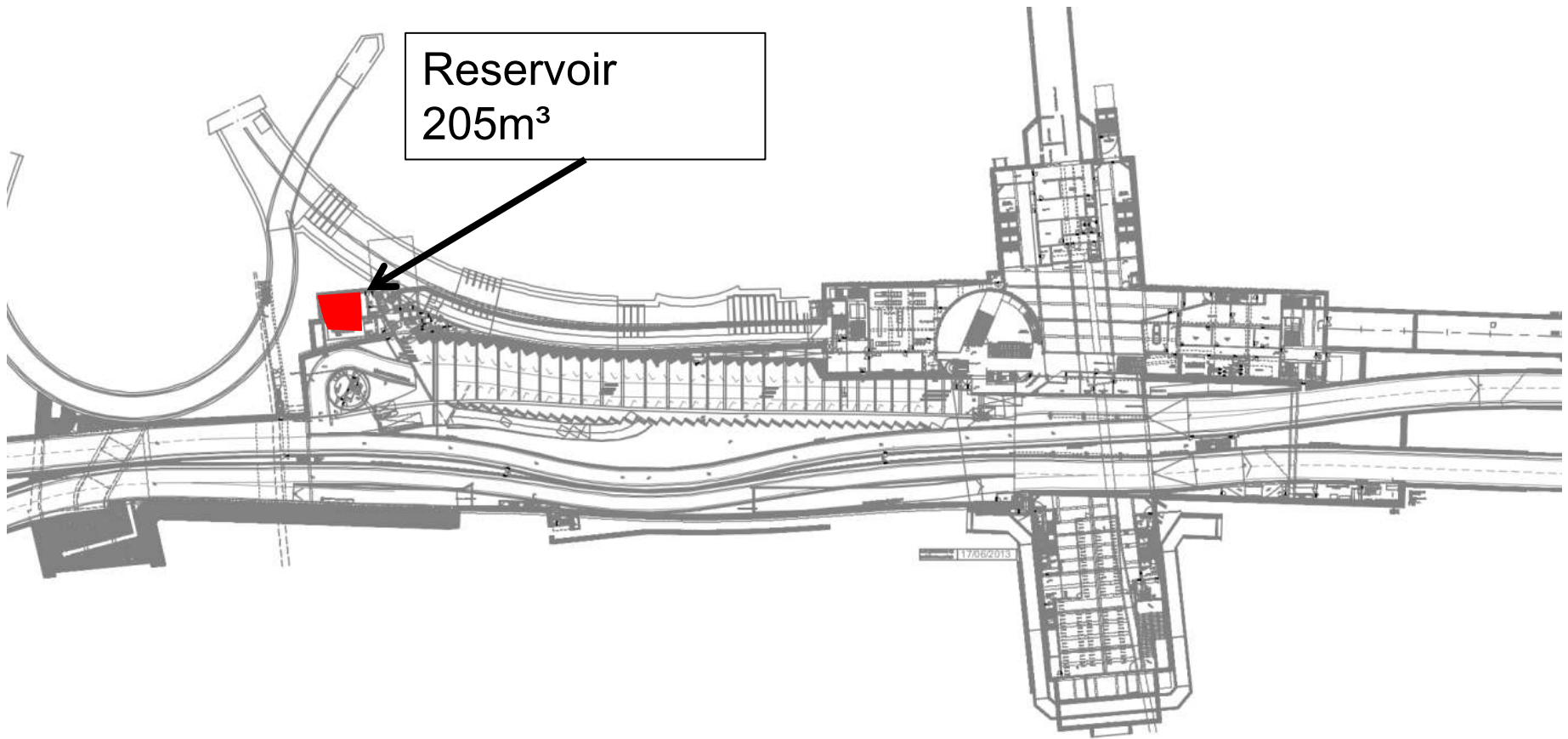
Tunnel

- Starting points
 - Europe: local road tunnels: no sprinklers
 - But: parking has to be sprinklered
 - Tunnel south - north is 'part of' the parking → same approach
 - Tunnel north - south → same logic

- Calculations
 - NFPA 13
 - Ordinary Hazard Group 1
 - 6,1 l/min/m²
 - 181m² (= ±40m in the tunnel)
 - 1 hour

Automatic sprinkler system

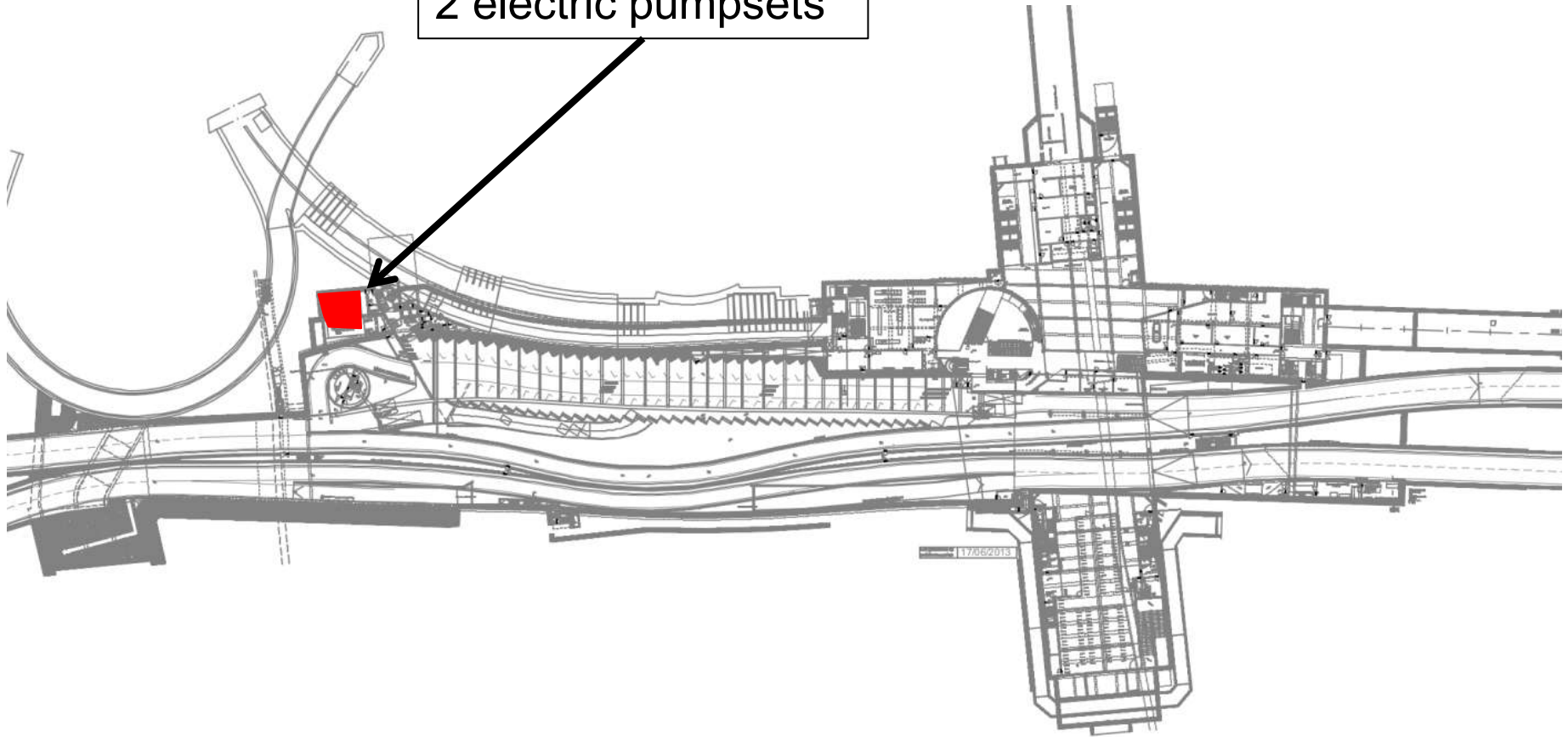
Water supply



Automatic sprinkler system

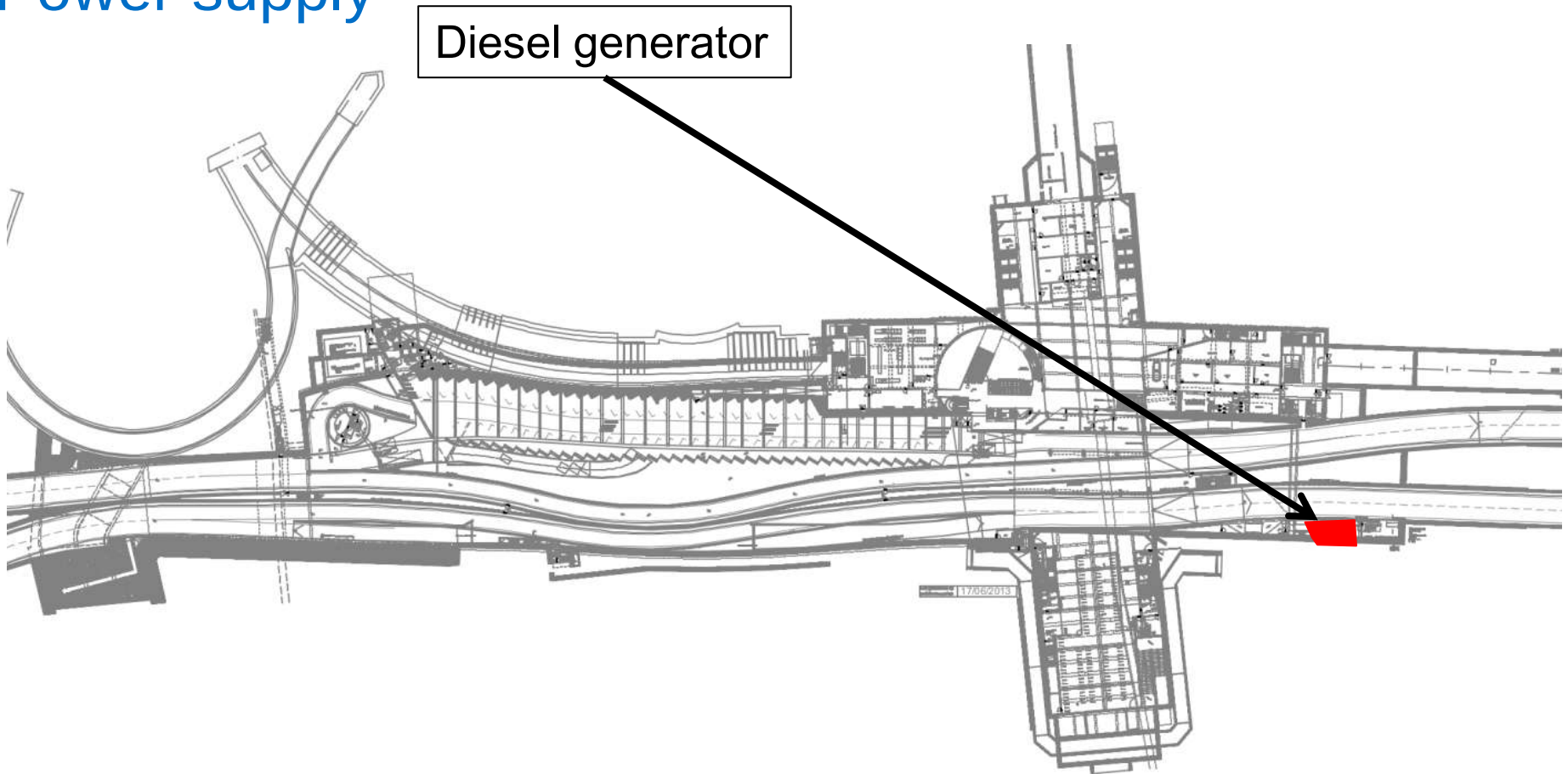
Water supply

2 electric pumpsets



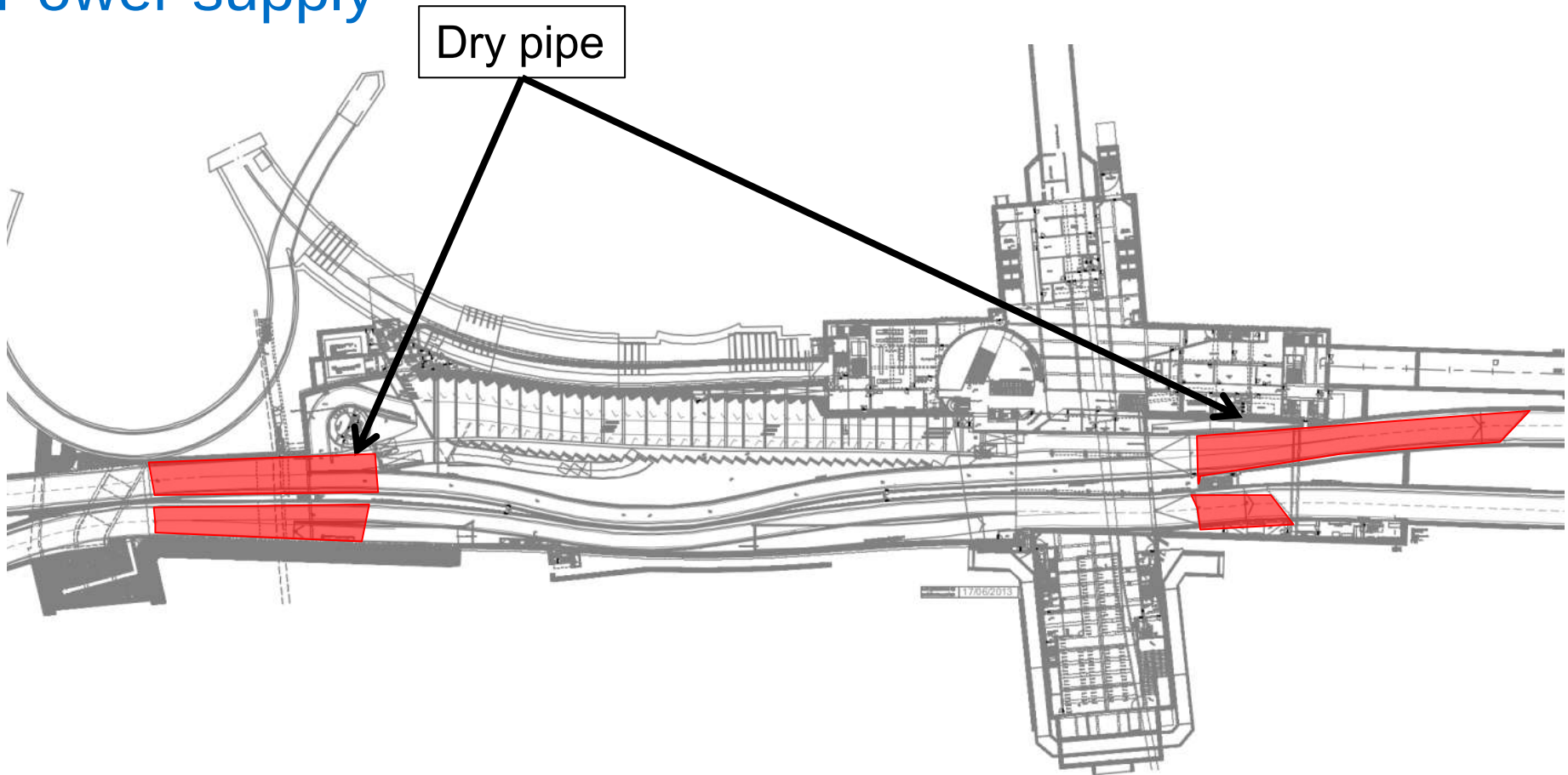
Automatic sprinkler system

Power supply



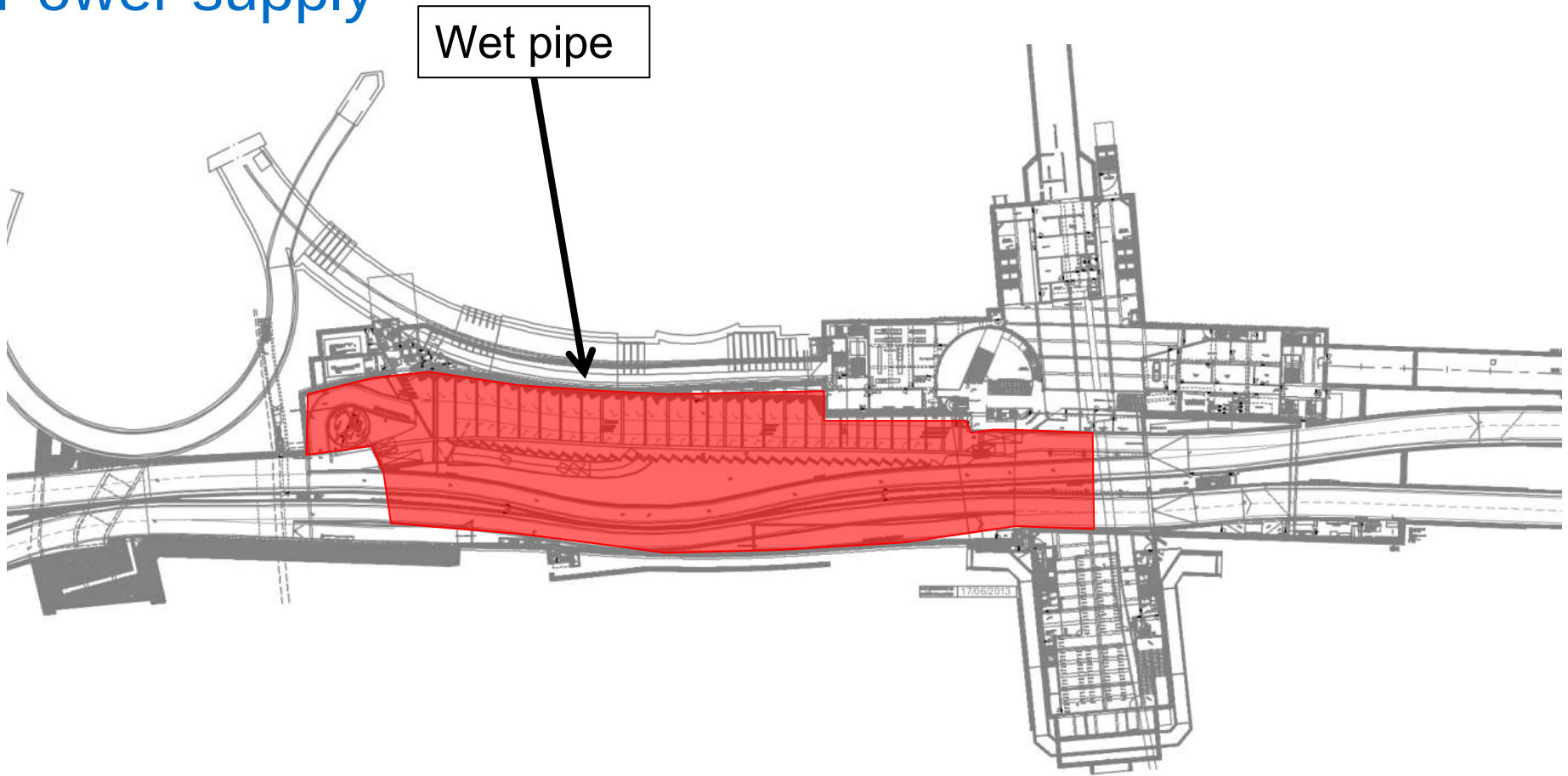
Automatic sprinkler system

Power supply



Automatic sprinkler system

Power supply



Thank you for your attention

80

For questions or remarks please contact:

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