Underground Master Plan of Helsinki
A city growing inside bedrock

City of Helsinki - Geotechnics, Ilkka VÄHÄAHO

ITACUS Open Meeting 2009 – Budapest

- Tuesday 26 May 2009 from 14.00 hours to 17.30 hours in the FORTUNA room in the Budapest World Trade Center

Need of Developing a Vision for the Use of the Underground

What dilemmas face Underground Master Planning?

Statistics of Underground Helsinki

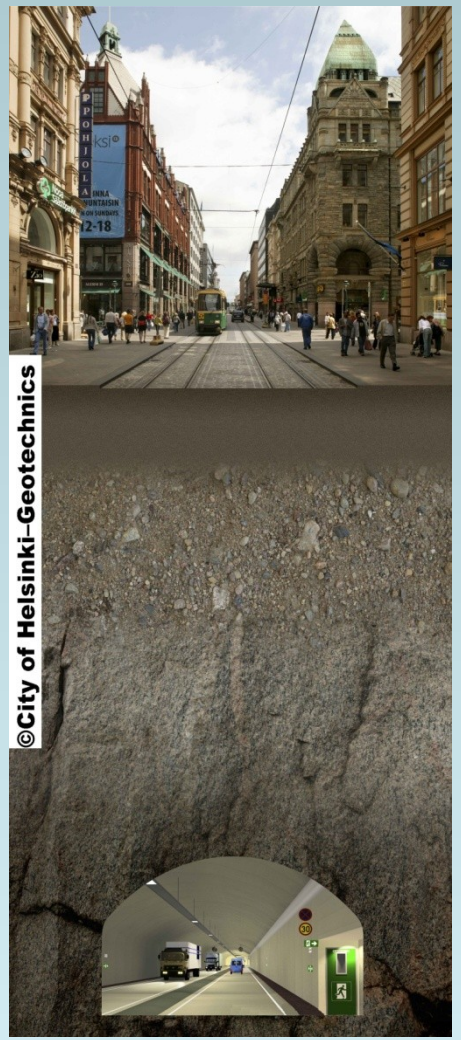
- Underground space (parking, sports, oil- and coal storages, metro etc.) 9'500'000 m^3
- More than 400 premises
- Technical tunnels 220 km
- Raw water tunnels 24 km
- Utility tunnels "all in one" (district heating and cooling, electrical and telecommunications cables, water) 45 km

Underground Reservation Categories

1. Community technical systems
2. Traffic and parking
3. Maintenance and storage
4. Services and administration
5. Unnamed rock resource (does not yet have a designated purpose)

The Underground Master Plan of Helsinki

- Reserves designated space for public utilities and private utilities in various underground areas of bedrock over the long term
- Provides the framework for managing and controlling the city's underground construction work
- Allows suitable locations to be allocated for underground facilities



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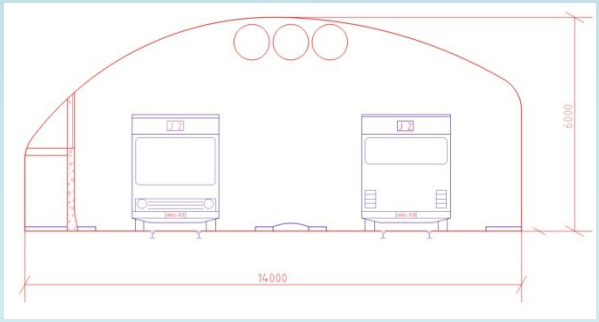
The Underground Master Plan of Helsinki

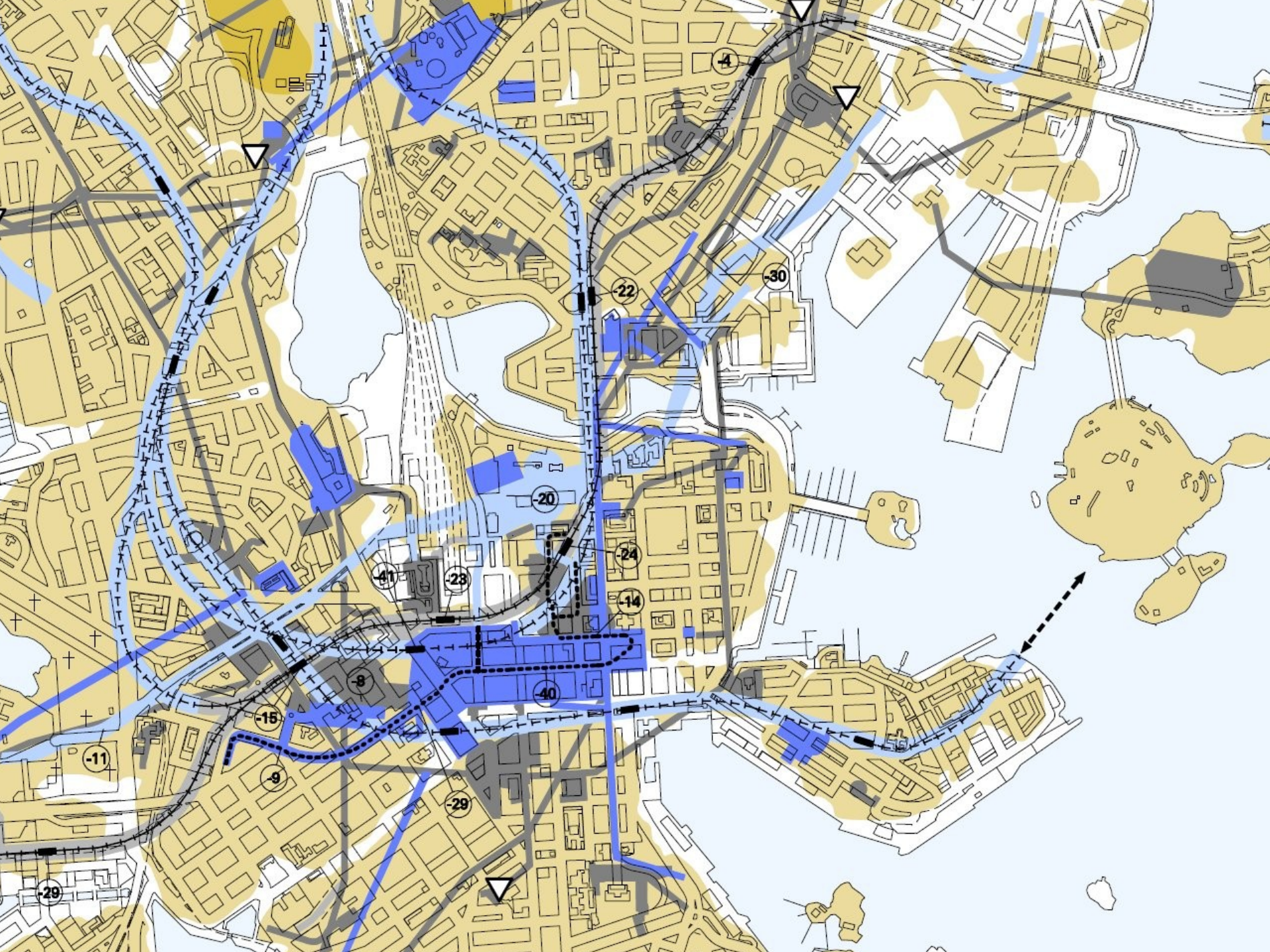
- Connects underground premises to each other to form coherent and interrelated complexes
- Makes sure that space reservations for public long-term projects, such as tunnels and ducts for traffic and technical maintenance, are retained for future construction

Example of Integrating Urban Structure



Underground Master Plan of Helsinki Includes

- More than 400 existing underground spaces and tunnels
- More than 200 new reservations in the register for long-term underground projects
- Both existing and future underground facilities and tunnels (grey indicating existing facilities and blue planned facilities)
- Space reservations on the Master Plan map are presented two-dimensionally
- In the city centre area, approximate floor elevations are indicated using circled figures
- Existing vital access links to underground technical maintenance facilities/tunnels are shown on the map with triangles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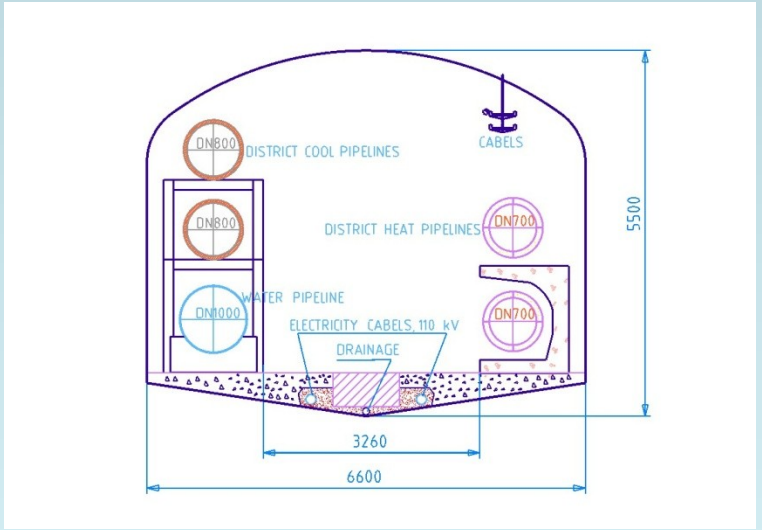
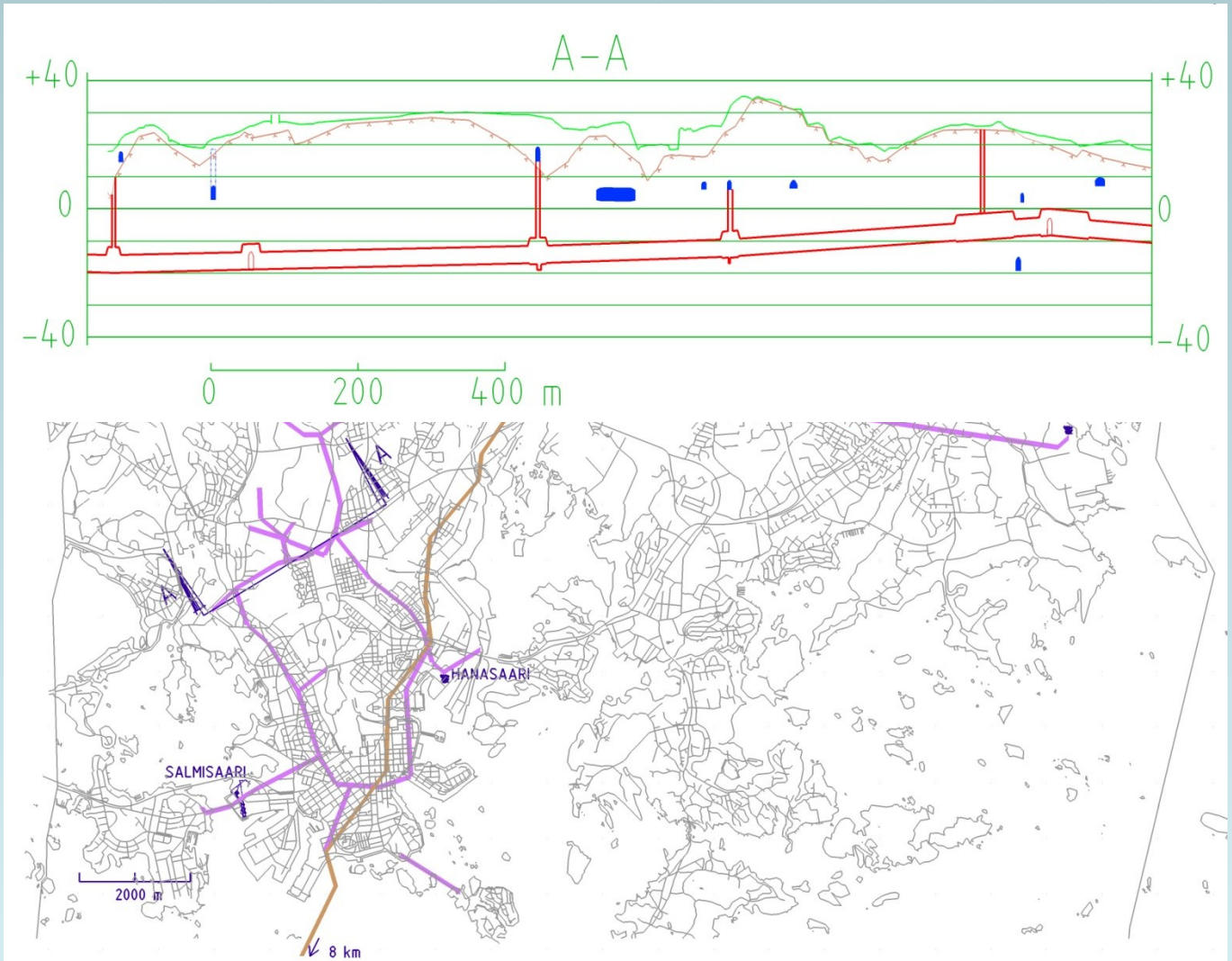
Community Technical Systems

- Underground facilities for municipal and other technical services (such as energy, water supply and telecommunications) are, by nature, large-scale closed networks
- Utility tunnels are located at such a depth that space reservations for them do not have a significant effect on other underground facilities



Community Technical Systems



Initial Survey for Unnamed Rock Resources

- An initial survey examined the areas and elevation levels in Helsinki which are suited for construction of large, hall-like facilities
- A model was used based on rock surface data and applying a standard-sized measurement cave (width 50 m, length 150 m, height 12 m)
- The model of the bedrock is based on base map data for exposed rock and land surface elevations and point data obtained using drill machine borings
- The survey also took into account local weakness zones and rock resources that have already been put to use

Initial Survey for Unnamed Rock Resources

- In general it can be said that the bedrock in Helsinki is not far below the ground surface, and that there are plenty of locations suitable for construction of underground facilities
- Outside the city centre, the survey found 55 rock areas that had a sufficient size for accommodating large underground facilities near major traffic arteries
- In many areas future underground projects can make use of entrances to existing underground facilities, which have been marked with triangles on the Master Plan map

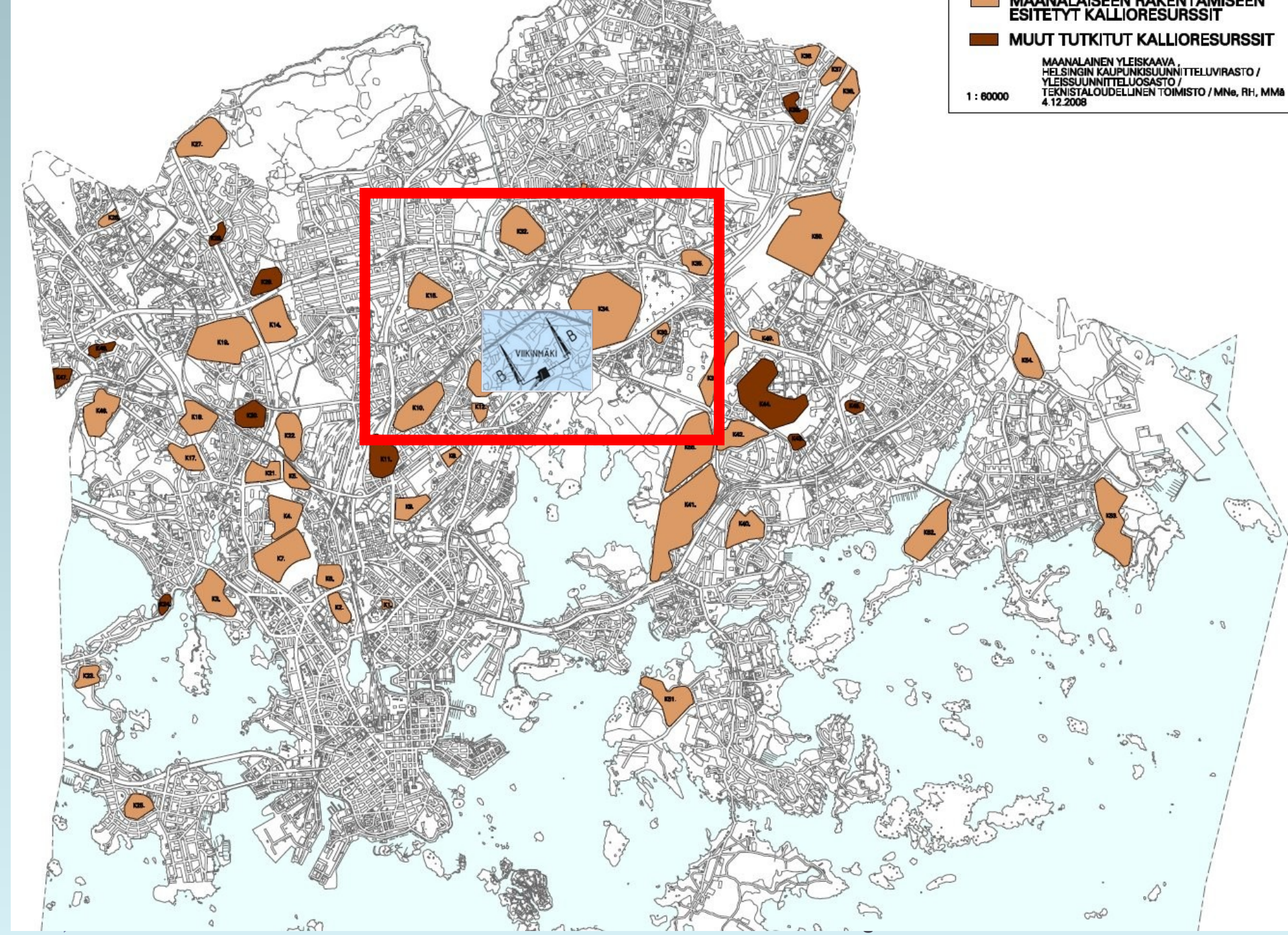
Unnamed Rock Resource Reservations

- When selecting these resources the survey took into account their
  - Accessibility
  - The present and planned ground-level uses of these areas
  - Traffic connections
  - Land ownership
  - Possible recreational, landscape and environmental protection values

Underground Master Plan of Helsinki Includes

- About 40 unnamed rock resource reservations without a designated purpose
  - The average area of these reservations is 30 ha
  - Unnamed reservations have a total area of

    1,400 ha (= 14 km^2) representing 6.4% of the land area of Helsinki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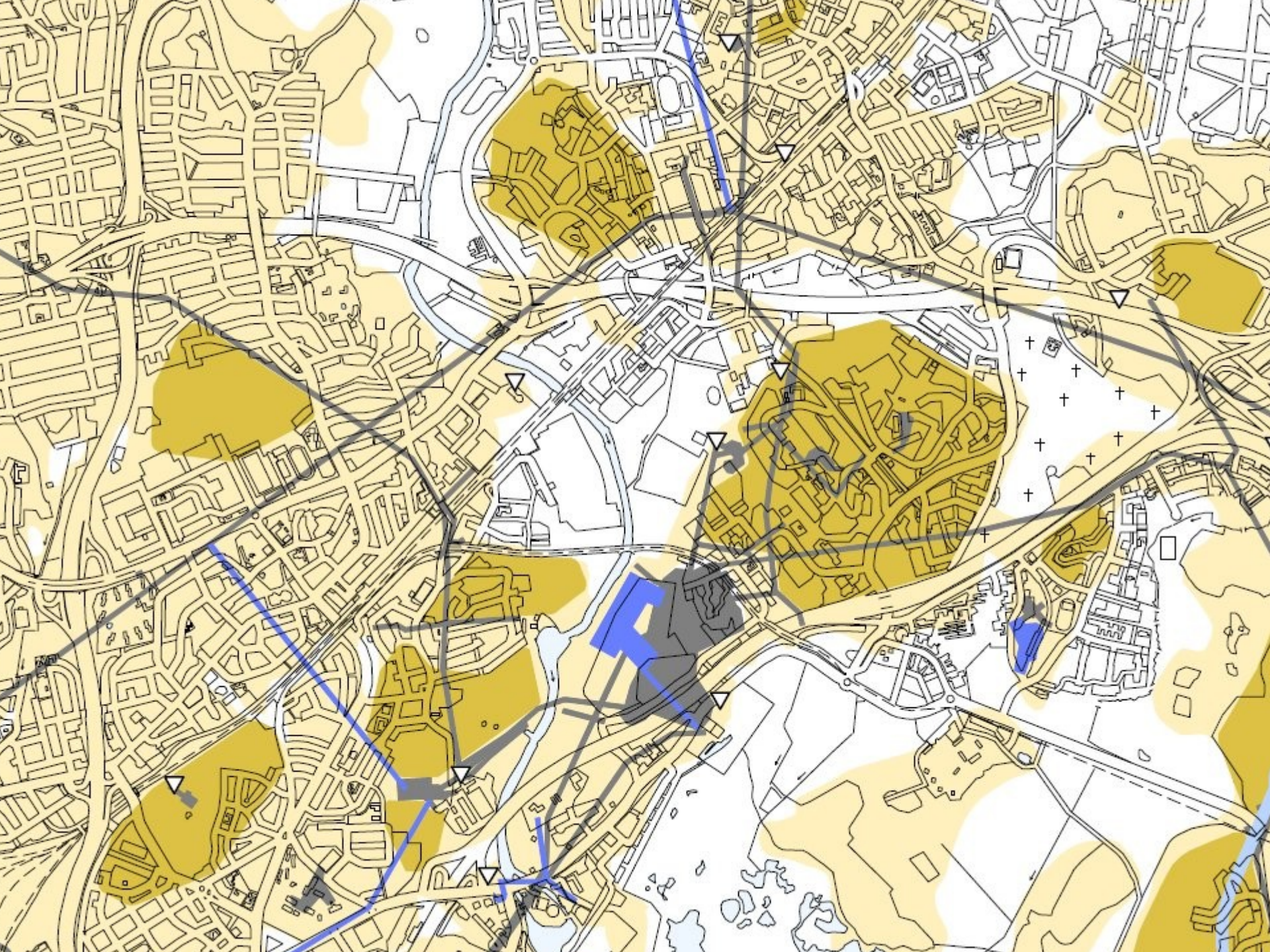

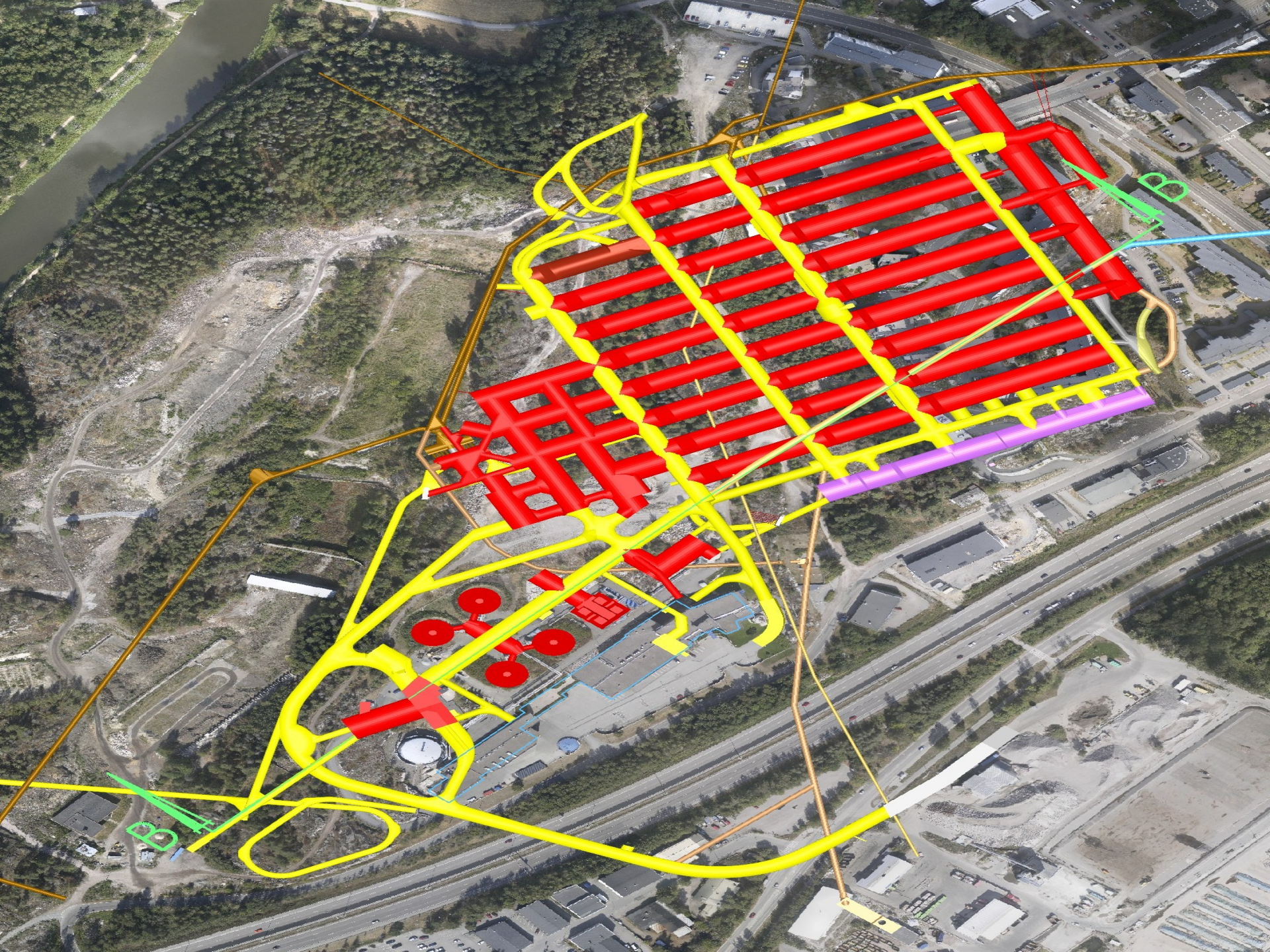
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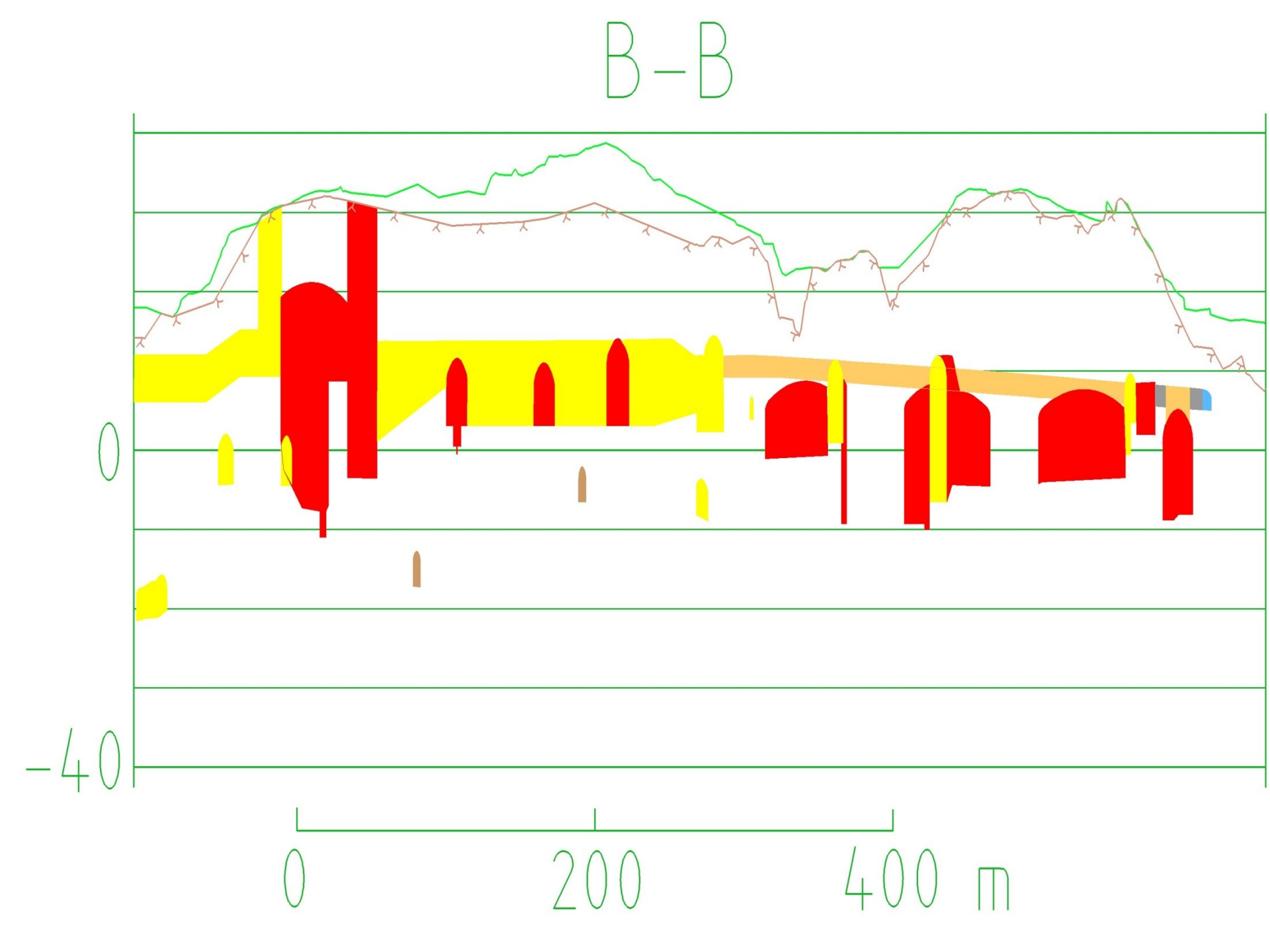
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Lessons Learned from Viikinmäki Case

- Viikinmäki waste water treatment plant is the central plant for treating wastewater from six towns and cities
- It is less than 10 km away from the centre of Helsinki
- The plant treats 280'000 cubic metres of wastewater every day from about 750'000 people
- Completed at a cost of approximately 180 million euros, the treatment plant began operating in 1994
- It replaced 16 smaller treatment plants, all above ground, thus allowing these sites to be zoned for more valuable uses
- The construction of the underground wastewater treatment plant took place simultaneously with the construction of ground-level infrastructure and residential buildings

Benefits
of Underground Community Technical Systems

1. Reliable energy supply via a network
2. Optimisations of energy generation with major transmission networks
3. Expenses are shared by several users
4. Land is released for other construction purposes
5. The city's appearance and image are improved, as the number of overhead lines can be reduced
6. Construction work carried out on underground pipes and lines has significantly fewer disadvantages
7. Blast stones resulting from construction of the tunnels can be utilised
8. Pipes and lines in tunnels require less maintenance, and are easier to maintain
9. Any breakages in pipes, lines and cables do not pose a great danger to the public
10. Tunnels are a safer option against vandalism

Further information:

- www.geotechnics.fi ▪ CaseBank

- UNDERGROUND MASTER PLAN OF HELSINKI

  A city growing inside bedrock

- TECHNICAL SERVICES AND UTILITY TUNNELS IN HELSINKI

  Reliable and optimised large-scale networks in bedrock