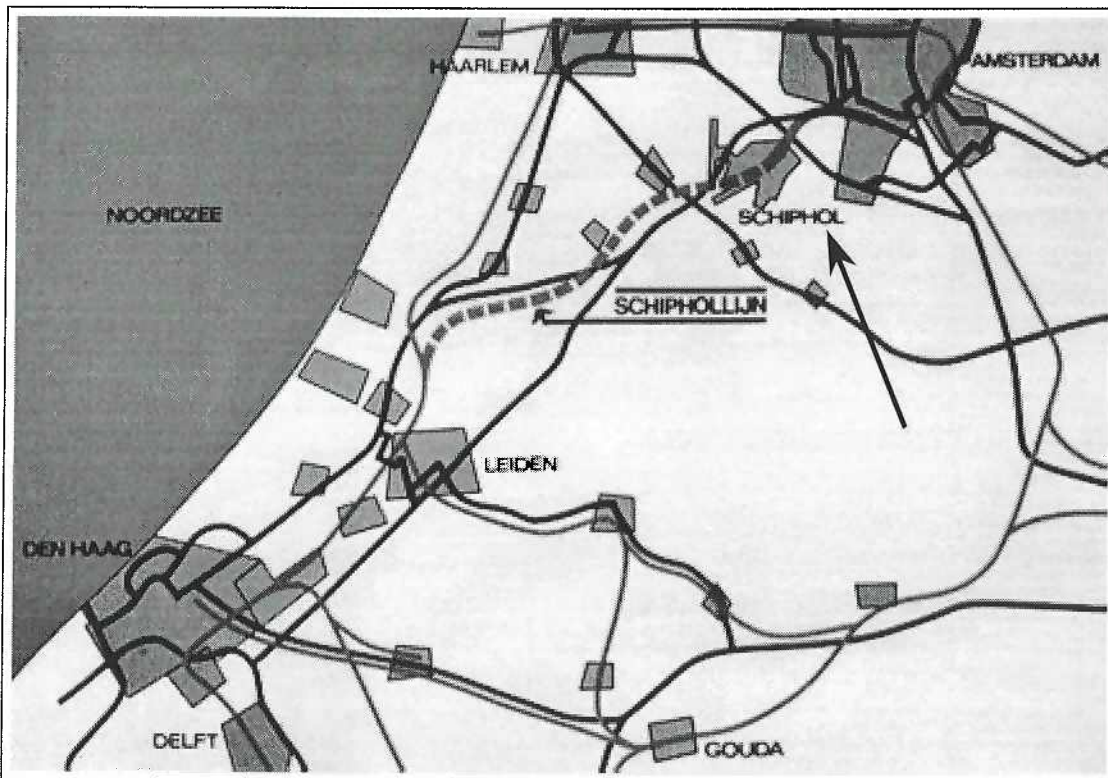


# THE SCHIPHOL RAILWAY TUNNEL

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## 1. Introduction

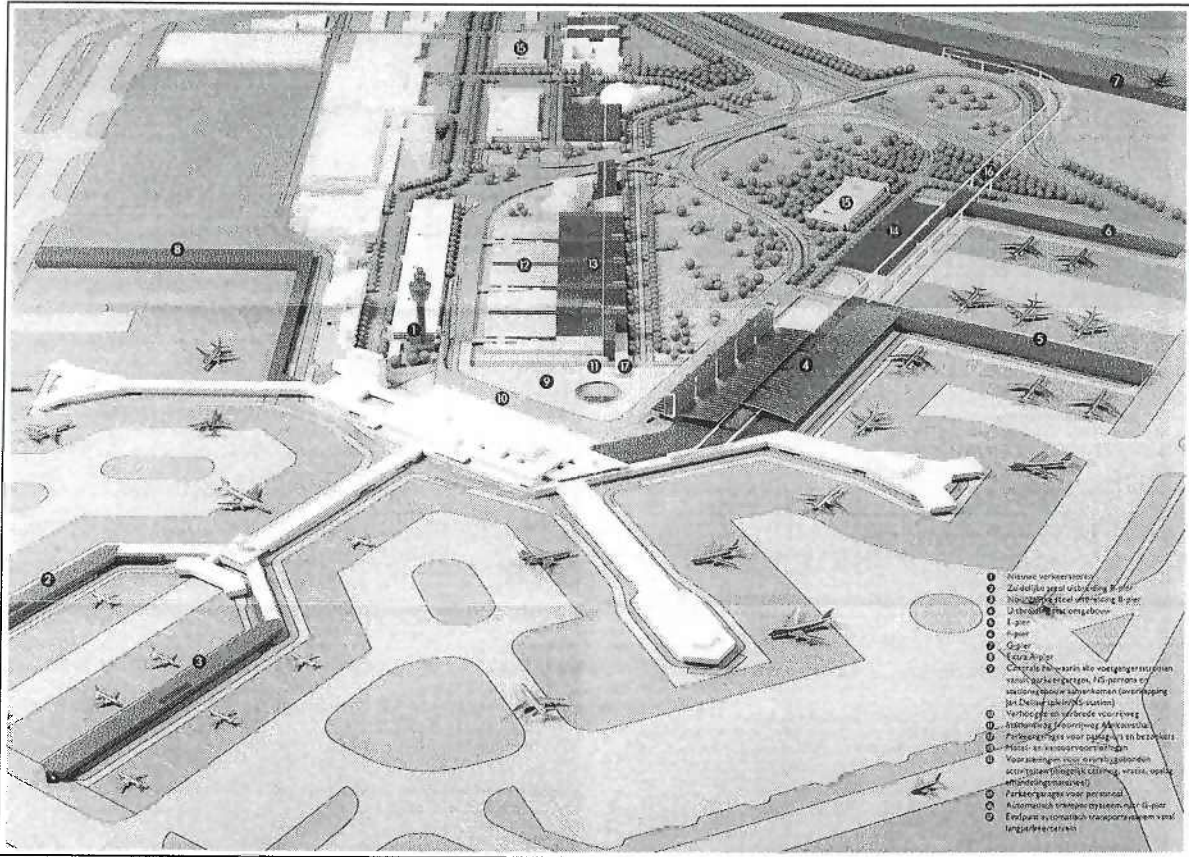
Schiphol, the most important airport in Holland, is situated in the Haarlemmermeerpolder near Amsterdam.



"Location of the airport"

This airport wishes to grow into one of the five largest airports in Europe, with the status of a main entry port into the continent. That means that the number of annual passengers is planned to increase from 16 million in 1990 to 34 million passengers by the year 2005.

In connection with this planned growth Schiphol airport had developed their ambitious Master Plan 2003, which provided for an expansion of the airport with the provision of new car parks, hotels, offices, roads, fly-overs and a new terminal.

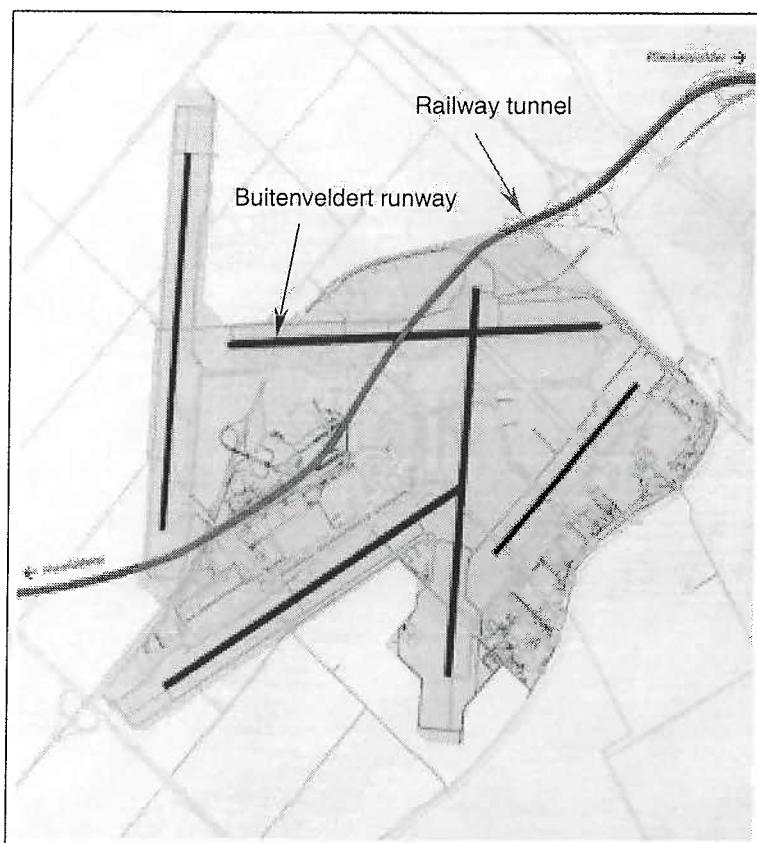


"Master Plan 2003"

The Dutch railway company NS was first informed by the airport authorities about their plans in 1988.

### Circumstances

There has been a 5.5 km long double-track railway tunnel under Schiphol Airport since the 1970's. As the airport was aiming at doubling its capacity as part of the Master Plan 2003 and Dutch Railways wanted to increase the number of tracks for the line to four as part of its Rail 21 plan, a major project to double the size of the railway tunnel under Schiphol was instigated in 1989.



"Railway tunnel beneath Schiphol"

The conditions which had to be met here were that all air traffic and rail activities had to be able to continue unimpeded, and that passengers should be inconvenienced as little as possible. A clear and detailed agreement between all parties in respect of the activities to be carried out was therefore needed, with preparation and planning assuming a very important role.

Doubling the width of a 5.5 km long tunnel in such a busy airport presented a major challenge. 800 metres of the new tunnel had to be integrated within the existing tunnel for the station-part and 4700 metres had to be built directly alongside the existing tunnel. The preparation time for the job was very short.

For that reason NS decided to appoint a building consortium made up of two major contractors to try and meet this challenge. Only three months after the formation of the consortium, the first sheet piles for this project were driven in April 1989.

## 2. Soil conditions along the tunnel route.

As said before the tunnel was located in a polder four metres below sea level.

The first soil layer occurring at ground level along the tunnel route consists of 1.5 metres of sand fill, formerly brought in from elsewhere. The second layer, from  $-5.5\text{m}$  to  $-10.5\text{m}$  NAP<sup>1</sup> consists of a mixture of in-situ sand and clay.

Below these layers, at a level from  $-10.5\text{m}$  to  $-11.0\text{m}$  NAP, a consolidated peat layer was found, which forms a barrier between the atmospheric groundwater surface at  $-4.8\text{m}$  NAP, and the brackish and slightly pressurised water trapped below, which has a pressure head of  $-4.50\text{m}$  NAP. Below the peat layer is dense Pleistocene sand with a high compressive resistance.

For the construction of the tunnel the cut-and-cover method was chosen. The chosen construction sequence was as follows:

1. Driving compressive and tension piles from ground level.
2. In order to excavate the construction pit in the dry down to a level of  $-6.50\text{m}$  NAP and fix a layer of struts and wailing's, the natural groundwater was lowered by pumping within the sheet pile cofferdam to  $-7.0\text{m}$  NAP. To prevent the bottom of the pit from bursting up because of the unbalanced water pressure, the pit was subsequently refilled with water to a level of  $-4.50\text{m}$  NAP. The remainder of the excavation was then carried out under

<sup>1</sup> NAP = reference level [Nieuw Amsterdams Peil]

