Barcelona’s future subway line nine (L9) crosses the city from North to South and from Besos delta to the Llobregat delta through several geological formations. The large amount of geological studies (existing boreholes and compilation of hydrology information) shows a very complex geological setting. The diversity of materials and geological structures determines the excavation and the construction processes of the stations and tunnel along the trace. Specially, in the district of Zona Franca L9 cross the Llobregat delta materials and part of Montjuïc Miocene materials. The whole of materials to cross forms complex structures in which appears a prequaternary substrate with Miocene materials (sand, gravel and clay) and Pliocene (clay and sand). Over this substratum, deltaic materials have been deposited.

This study is situated in Foneria station, on the left bank of the Llobregat delta, precisely in the Passeig of the Zona Franca. This station and the tunnel of the L9 have to cross a complex hydrogeology structure, where free aquifers and underlying captive aquifers are separated by aquitards. Even though aquitards properties and continuity is not so well known, the phreatic levels are close to the surface due to the topography and the proximity to the coast. A correct knowledge of geometry disposition of the different hydrology units determines the design and construction of the tunnel and stations like for example, the length of concrete walls.

In principle, Foneria station should be constructed using concrete walls with a length between 55 or 60 m because of the existing low permeability breaches with a clay matrix. The main reason to make the concrete walls this deep is to avoid leaks during the excavation and to reduce the risk of siphoning. Since the station is 40 m deep, this solution suppose building between 15 and 20 m of concrete walls without a structural function.

The objective of this study is to search for better economical alternatives to the proposed solution in the original project. A detailed study of the geology of Zona Franca is made to detect possible levels to make arrive the concrete walls of Foneria that are higher than the breaches. Once detected the possible little permeable levels, injection and pumping tests are make and modelled in several ways especially through automatic calibration codes. Dealing with the geometric complexity and heterogeneity, the interpretation of the tests becomes complex. A numerical model has been developed and used for the interpretation of pump test. For a correct conceptualization of the environment and altogether pumping tests interpretation a numerical model including the necessary geometric singularities has been made. With this model we quantify accurately the permeability of the aquitards ant other relevant hydraulic parameters.

The model is later used to simulate the construction of the concrete walls and the excavation. The model allows estimating the water flowing to the excavation which will have to be pumped when actual construction is carried out.