

Project identification

## Blauwe Ader: Hasseltstraat - Midden Brabantweg

Type of project

Drilled sewage pipeline (pipe jacking -microtunnelling)



Client

Municipality Tilburg

In co-operation with

Project assignment

Exploration of variable routes;- Making a preliminary design;- Making an integrated Design & Construct contract, - Construction management based on risk management

Country

The Netherlands

Location

Tilburg

Project duration

2014-2016 Design and tender phase

2016-2018 Construction

Construction cost

€ 9.000.000,- (excl. VAT)  
(excl. VAT)

Project phase

Completed

Consultancy fee

€ 328.000,- (excl. VAT)  
(excl. VAT)

Office

Laan 1914 no 35  
3818 EX Amersfoort  
P.O.Box 28013  
3828 ZG Amersfoort  
The Netherlands

Telephone

+31 (0)88 348 2540

E-mail

info@TEC-tunnel.com

URL

www.TEC-tunnel.com

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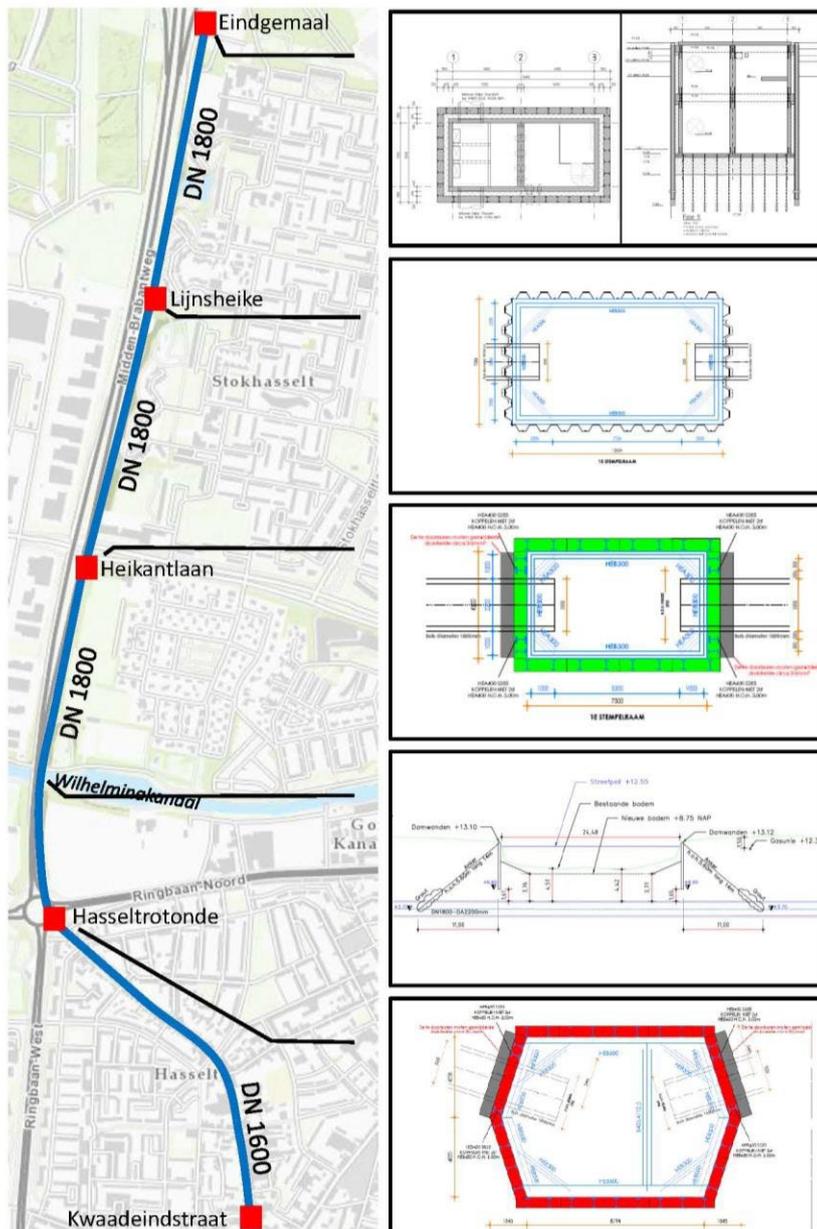
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## Sewage pipeline

To prevent flooding's after heavy rainfalls in the centre of Tilburg the 'Blauwe Ader' (Blue Vein) is realized. De Blauwe Ader is a sewage pipeline that is drilled by pipe jacking. The sewage pipeline is realized in four sections:

- |    |                                   |                        |
|----|-----------------------------------|------------------------|
| 1. | Kwaadeindstraat - Hasseltrotonde: | DN 1600 mm over 957 m; |
| 2. | Hasseltrotonde - Heikantlaan:     | DN 1800 mm over 900 m; |
| 3. | Heikantlaan - Lijnsheike          | DN 1800 mm over 670 m; |
| 4. | Lijnsheike - Eindgemeal           | DN 1800 mm over 790 m. |

Route of the pipeline in Tilburg, design of four jacking / receiving pits and the passage under the Wilhelminkanaal



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Five jacking / receiving pits were completed as inspection shafts. The sewage pipeline transports rainwater from the city centre to the edge of the city. During the first 15 years after completion, both rainwater and first flush wastewater will be discharged into the sewage pipeline, which will be pumped out by a pump station to a WWTP. After 15 years, the Blauwe Ader will act as a discharge sewage pipeline for the rainwater which will then be discharge in a waterpark. Only the first flush wastewater will then be pumped to the WWTP.

## Activities Witteveen+Bos (partner of TEC vof):

- Exploration variant routes based on a multi-criteria analysis. Important design principles where existing infrastructure (Hasseltrotonde and the Wilhelminakanaal), Environment, cables and pipes, governments property's;
- Making cost estimates for variant routes;
- Collecting customer requirements for the preliminary design and the contract;
- Making an integrated Design & Construct contract based on the Dutch UAV-GC 2005;
- Exploration pipe jacking route Rueckertbaan: preliminary designs and cost estimates;
- Project management and coordination of the municipality of Tilburg and contractor combination;
- Monitor progress and planning;
- Contract management and Risk management
- Coordinate, organize, plan SCB (risk-based contract management) System audits, Process audits and audits with an audit team;
- Assessment and acceptance of the final design and construction design of the contractor. Associated specializations Witteveen+Bos:
  - Sewage technology;
  - Above and below ground infrastructure;
  - Pipe jacking/micotunnelling. Including backup calculations on:
    - the design of the contractor;
    - the support pressure;
  - Geotechnics: sheet piling, quay construction Wilhelminakanaal, grout anchors;
  - Cutter Soil Mix (SCM) technique;
  - Construction technique: stamps, wells, underwater concrete;
  - Dewatering;
- Process reports SCB audits;
- Assessing and advising contract mutations and performance.



## Three design features:

1. Seven jacking/receiving pit locations where prescribed of which two jacking/receiving pit locations were optional: only five jacking/receiving pit locations were used by realizing 4 long drill sections;
2. Route Kwaadeindstraat - Hasseltrotonde: this longest section under a densely populated area contains in the horizontal dimension a small bend radius  $R = 300$  m located at Textielplein;
3. The passage under the Wilhelminakanaal and between the grout anchors was narrow but in control;

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## Pipe jacking

The two drill installations are both microtunnelinstallations type AVN of the German tunnel machine builder Herrenknecht AG. The remote controlled AVN machine drills tunnels for a new (sewage) pipelines beneath existing buildings. An AVND Machine provides controlled face support pressure and can be used if overburden is shallow or diameters are large.



## Press installation

A press installation consisting of 2 hydraulic cylinders with a pressure crown, a fixed pressure wall and a guide carriage with running wheels are installed in the press pit. The cylinders exert the necessary pressure force on the concrete pipes through the pressure crown to press them through the water seal into the soil. The water seal, a rubber sleeve specially adapted to the tube mounted on a steel plate, is mounted against the wall of the jacking pit. The press is operated from the switchboard in the machine container. During drilling, bentonite is injected through the concrete pipes from the bentonite mixer as a support liquid and to reduce the friction until the receiving pit is reached. After pressing, the hollow spaces around the tubes will be filled with a filling mortar.

## Machine container

A compact container (machine container / control room) contains the operating equipment to carry out the reinforcements. In this container, besides the central computer with monitor and the control panel, there is also the hydraulic high-pressure unit and a fully equipped parts warehouse. The drill carriage is lowered into the jacking pit and then positioned at the correct level. Two hydraulic jacks are mounted on the drill sled with a joint pressure force of up to 7,000 kN, spread over an area of 4.0 m wide x 2.5 m high. The rear wall of the jacking pit is designed so that it can absorb up to 10,000 kN. The maximum compressive force is limited to the maximum permissible pressing force according to the calculation note of the pipes and of the jacking pit. The machine container is hydraulically adjusted so that these values cannot be exceeded.

## Drilling head

The drilling head itself consists of the fully steerable drill head and a fixed part where normal atmospheric pressure prevails, here are the measuring and control equipment of the drilling shield, control cabinets, etc. The diameter is almost the same as the outside diameter of the drill pipes. A digger wheel scrapes the ground in front of the drill bit. The loosened soil passes through the openings of the cutting wheel into the crushing and mixing chamber. The entire finishing area and the mixing chamber are filled with drilling fluid (slurry water). Through the openings in the mixing chamber the digging mortar is removed with slurry water by a closed pipeline system to a surface sanding installation. In this installation the sand is separated from the slurry. The recycled slurry water is returned to the drilling shield and the front space via the pump and the pipe system.



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### **Integrated contract**

This project has been established by an integrated Design & Construct contract. Because the main purpose of the sewage pipeline is very functional and not visible (underground transportation of rainwater) the client offered the contractor many design freedom. Contract management was based on risk management supported by the audit team which contributed to an atmosphere of cooperation between the client and the contractor. Therefore, the contractor was able to realize the sewage pipeline without using two optional jacking/receiving pits in the route. Benefits of this integrated contract like: relative low construction cost, limited additional cost and limited delays have been achieved both by the client and the contractor.