



Wassara

WATER-POWERED DRILLING IN TUNNELING





“The drilling with Wassara was straight forward. We were able to keep the time schedule and had no problem with meeting the accuracy demand. The borehole surface was optimal for the following anchoring process”

Johannes Glückert, Technical Manager [at Züblin Spezialtiefbau](#)

STRAIGHT FORWARD DRILLING

Wassara's technology uses water to power the hammer. This makes it the ideal choice for many drilling applications in tunneling – drilling long straight survey, grout and drainage holes, forepoling, anchor drilling and drilling for cut-off walls and anchors. The water-powered DTH hammer is capable of penetrating most formations in a cost-efficient and environmentally-friendly way.

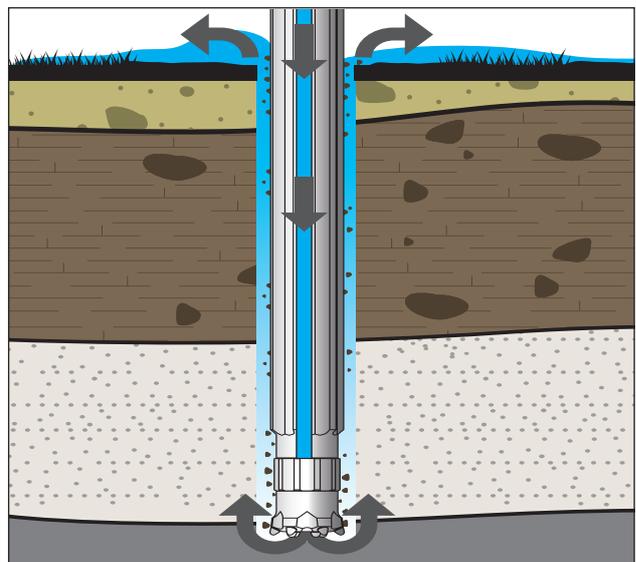
Suitable for many tunneling applications

Tunneling presents drilling challenges such as water-rich formations, high back pressures, requirements on the borehole (length, accuracy, etc.) and environmental concerns in sensitive areas. Wassara drilling technology is the solution to these challenges and has been used successfully in many tunneling applications over the years:

- Anchor drilling – Immersed tunnels
- Cut-off walls
- Ground reinforcement
- Forepoling
- Survey, grout and drainage holes

How Wassara works

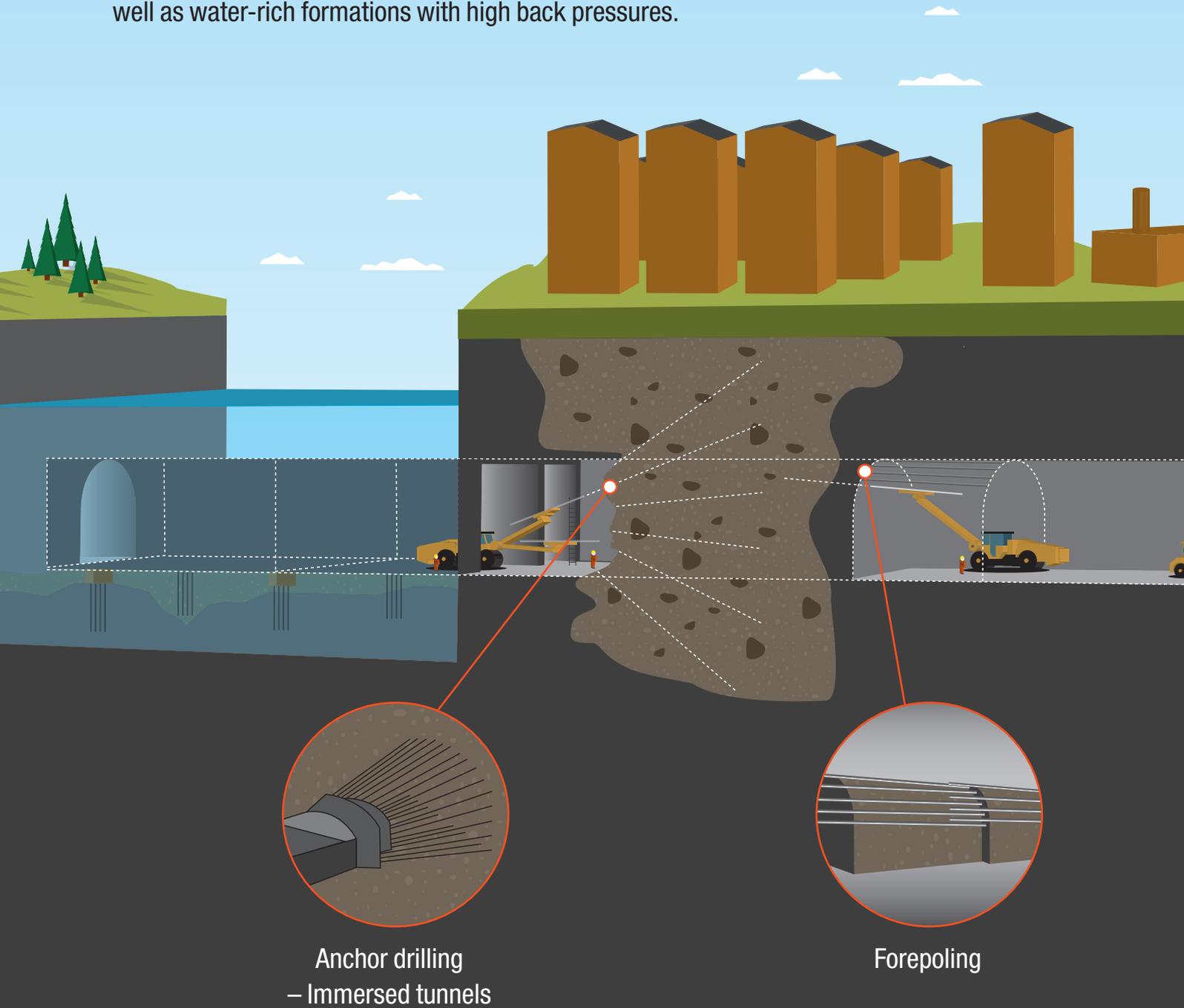
The Wassara technology uses high-pressure water to power the DTH hammer. Water enables a high frequency and high power output. When the water leaves the hammer it has a sufficient velocity to bring the cuttings and debris to the surface and clean the hole. Besides clean and straight holes with a minimum of deviation, Wassara offers superior benefits like high productivity, borehole quality and minimum impact on the formation you are drilling in.



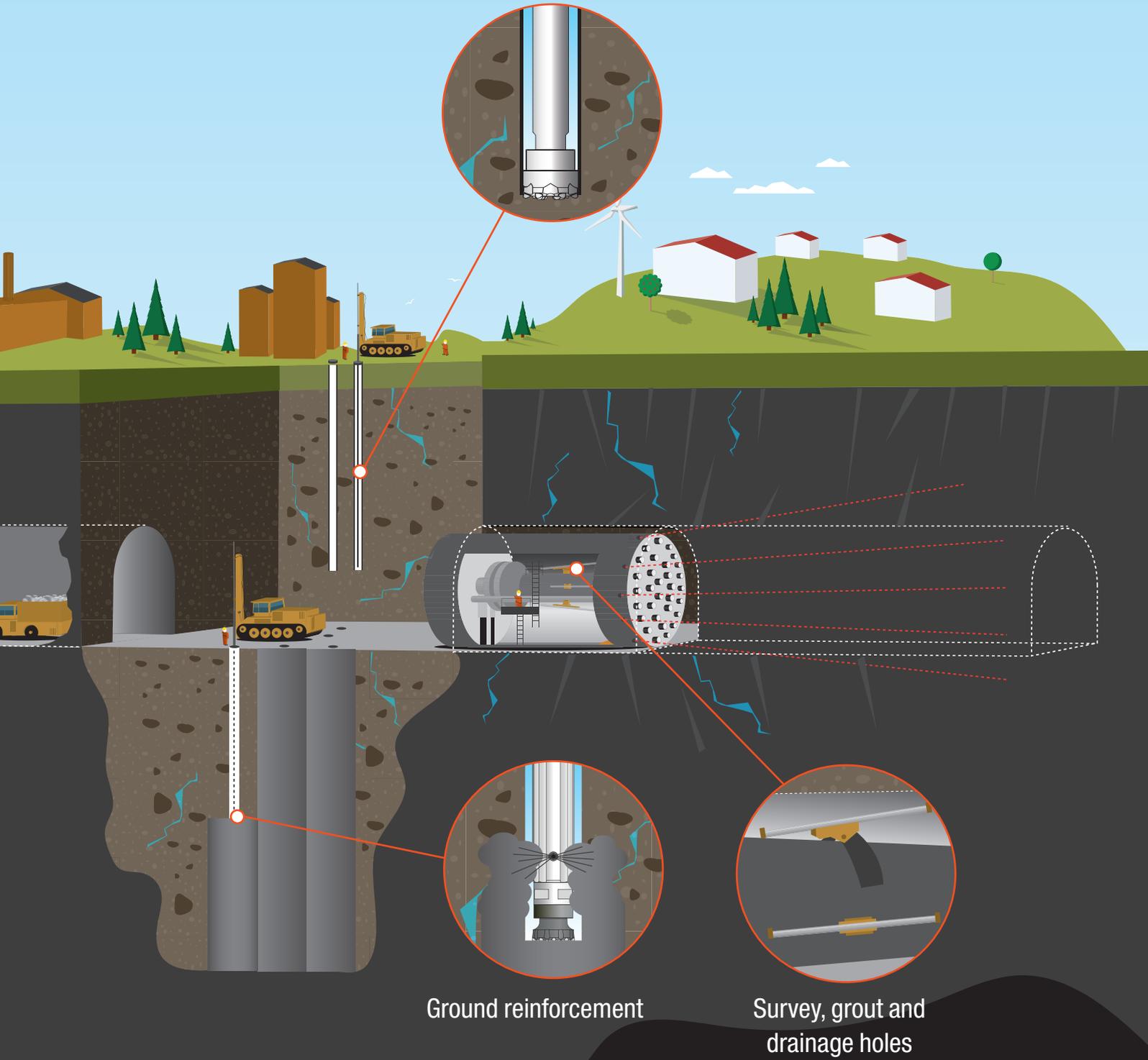
The principles of water-powered drilling

ACCURATE, FAST AND COST-EFFECTIVE DRILLING

The water-powered DTH hammer from Wassara is the versatile choice for most drilling applications in tunneling. It can penetrate hard, soft and fractured rock as well as water-rich formations with high back pressures.



Cut-off walls

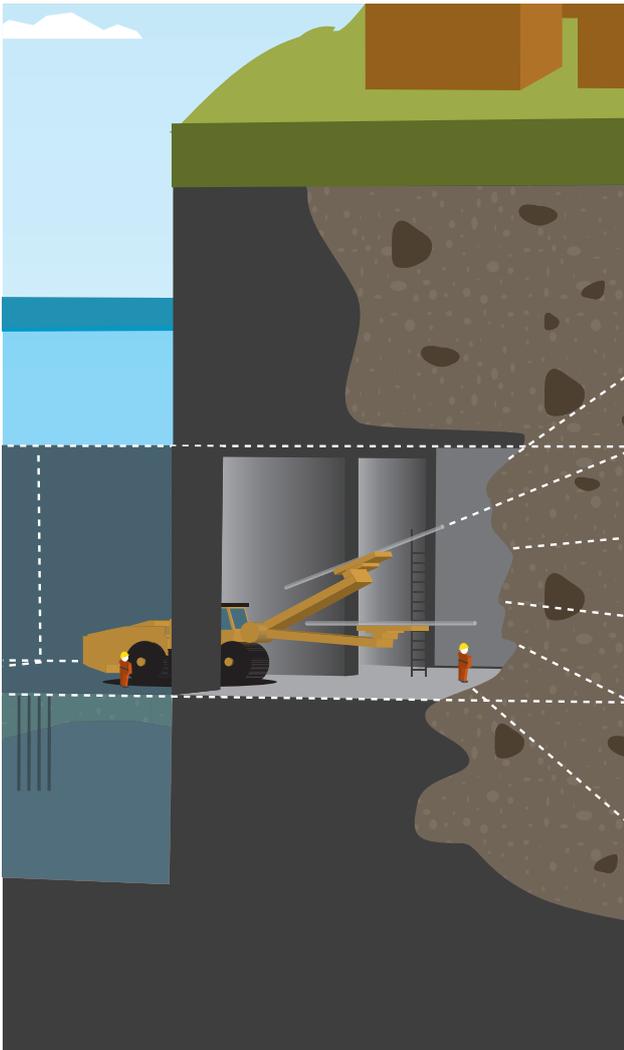


Ground reinforcement

Survey, grout and drainage holes

ANCHOR DRILLING

Securing immersed tunnels with Wassara



Hole straightness

Anchoring of immersed tunnels involves drilling long holes with strict accuracy requirements. The water-powered DTH hammer from Wassara has a proven track record of its ability to drill long straight holes.

High drilling performance

A Wassara water-powered DTH hammer will maintain a high rate of penetration in most kind of formations. The Wassara hammer performance is unaffected by water in the formation, even at high back pressure.

High quality borehole surface

Water-powered DTH drilling gives an optimal borehole surface for the anchoring process. The borehole surface needs to be clean and have enough roughness to ensure successful grouting of the anchor.

DRILLING FOR SECURING AN IMMERSED TRAIN TUNNEL IN STOCKHOLM, SWEDEN

Mission & challenge: 330 meter of a 6 km long tunnel required a very advanced tunnel construction method. The tunnel element needed to be secured to the rock by a total of 69 anchors, each containing 19 strands, Ø 16 mm wide. 44 of the anchors were located in longitudinal direction of the tunnel and distributed conical around the cross section.

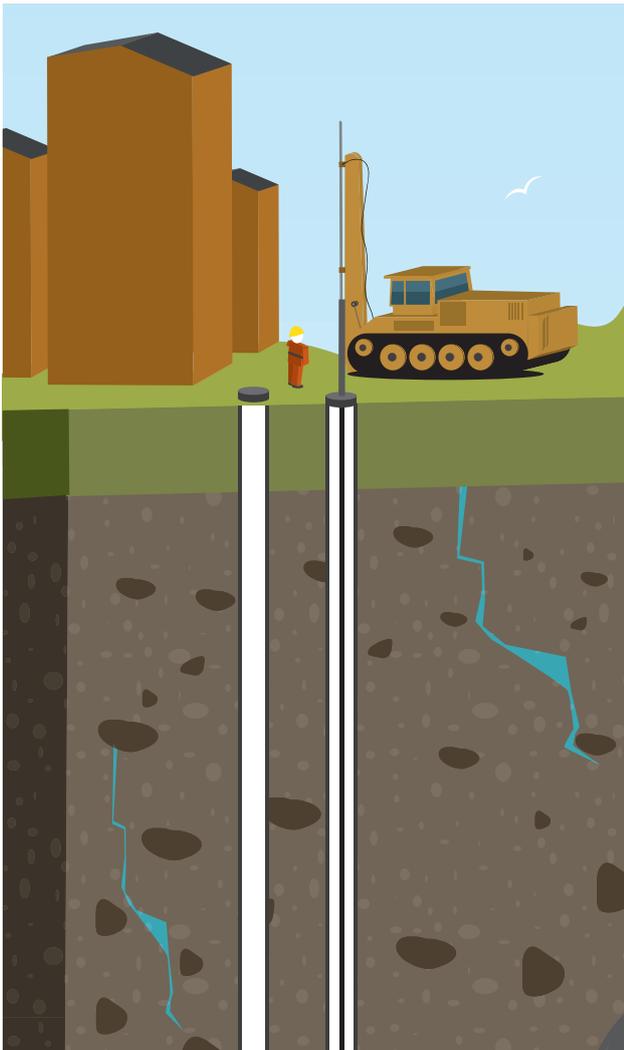
Result: The customer was able to keep the time schedule and had no problem with meeting the accuracy demand.



Söderström Case Story

CUT-OFF WALLS

Drilling for ground water control and wall stabilization with Wassara



Drills water rich formations

During construction of a tunnel shaft or ramp it is necessary with cut-off walls for ground water control and wall stabilization. Cut-off walls often involves drilling in water rich formations which is easily done with the water-powered Wassara DTH hammer.

Low impact on surrounding structures

Tunnel shafts and ramps are often constructed in urban areas which means a risk of damage and settlement of surrounding structures due to drilling. This risk is greatly reduced with the water-powered Wassara DTH hammer since it does not pressurize the formation in the way that pneumatic DTH drilling does.

Single pass jet grouting

One way to create cut-off walls is by making jet grouting columns. The unique Wassara Jet Grouting hammer will perform the job in one single pass which significantly increases the production rate. Performance will remain high even when there are boulders in the ground.

NEW SUBWAY STATION IN RIO DE JANEIRO

Mission & challenge: To build two shafts for a new entrance for a new subway line by jet-grouting 200 columns placed in two rings for each shaft. The columns should reach down to 15-20 m and 20-25 m depth, respectively.

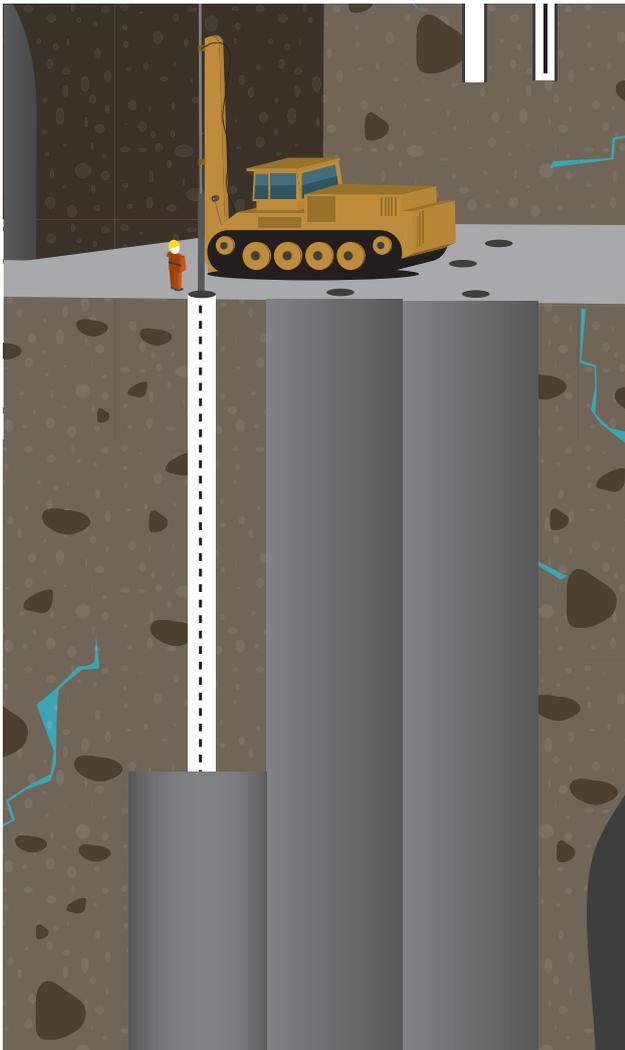
Result: Wassara's jet grouting hammer completed the job and enabled a significant time saving compared to the conventional methods, thanks to the good penetration rate in difficult formation (sand, boulders etc.).



Rio de Janeiro Case Story

GROUND REINFORCEMENT

Foundation and reinforcement work for tunnel shafts with Wassara



Straight and clean grout holes

One ground reinforcement technique is jet grouting whereby a jet grout column is produced in situ in the ground. Holes drilled for jet grouting need to be straight. Jet grouting holes can either be pre-drilled using the water-powered Wassara DTH hammer or it can be done in one single pass with the unique Wassara Jet Grouting hammer.

Environmentally friendly

A water-powered Wassara DTH hammer runs with pure water and no oil is needed. This means that the ground is not polluted with oil during drilling. Furthermore, water will bind dust which gives a cleaner environment at site.

Low impact on the ground water table

Drilling in water-rich formations means there is a potential risk of adverse effects on the ground water. The ground water level itself is not influenced by the water-powered Wassara DTH hammer since the formation is not pressurized by the hammer.

STRAIGHT, CLEAN HOLES WITH JET GROUTING AT NIAGARA, CANADA

Mission & challenge: To add another turbine at the dam, an 11 km-long tunnel needed to be constructed. A total of 400 holes were drilled to the depth of 67 m. to reinforce the ground around the opening of the tunnel.

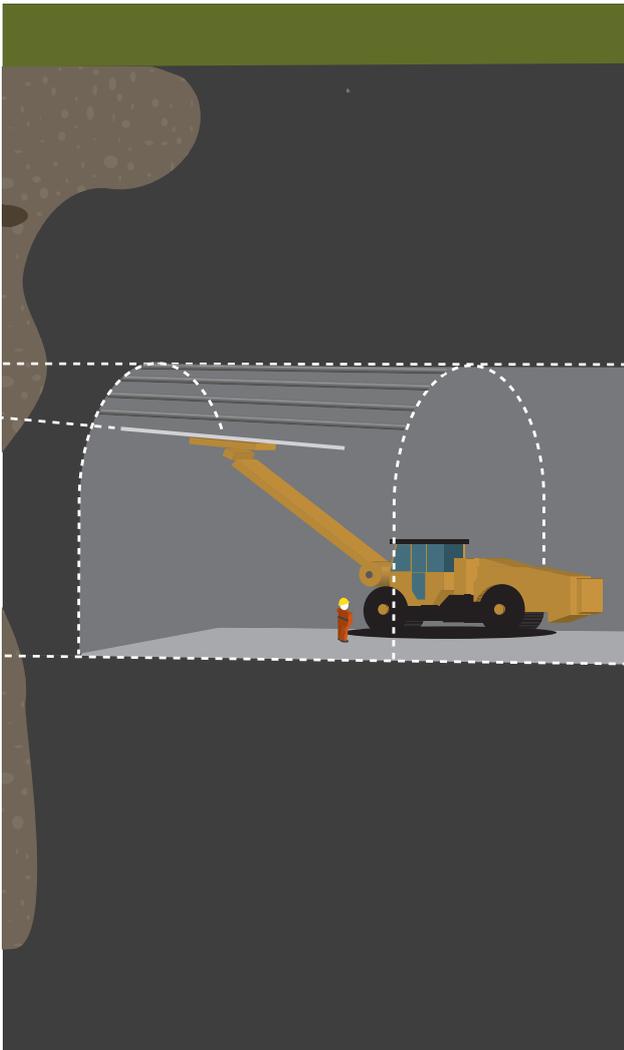
Result: Wassara's precise and safe technology once again demonstrated its advantages in an advanced project. The boreholes were straight and clean, which was a requirement, to determine how much grouting the ground could tolerate.



Niagara Case Story

FOREPOLING

Umbrella drilling with Wassara



High performance casing advancing

During construction of a tunnel there could be sections with very difficult ground conditions such as high water inflow and/or unstable fractured rock. Under such circumstances it might be necessary to stabilize and seal the section to be excavated using different forepoling techniques such as pipe roofing or ground freezing. In either case there is a need for casing advancing. The water-powered Wassara DTH hammer is well suited for casing applications under severe conditions. High water flows will not interfere with its performance. Water will act as a lubricant for the casing making it possible to case longer holes.

Drills water-rich formations with high back-pressures

When forepoling in fractured rock with high water content (like under seas, in high mountains etc.) there is a high probability of encountering high water flow at high pressure. Drilling with the water-powered Wassara DTH hammer under these conditions will work fine since the hammer performance is not affected by high water flow at high pressure.

Safer drilling in urban areas

Forepoling in urban tunneling projects often face a risk of damaging buildings and nearby infrastructure due to settling. This risk is minimized with the water-powered Wassara DTH hammer since it does not pressurize the formation in the way that for example air DTH drilling does.

NEW MOTORWAY THROUGH WESTERN STOCKHOLM, SWEDEN

Mission & challenge: To stabilize the tunnel segment between Sättra and Lovön. To do this, 60 drill holes with a depth of 16 m were drilled in each segment.

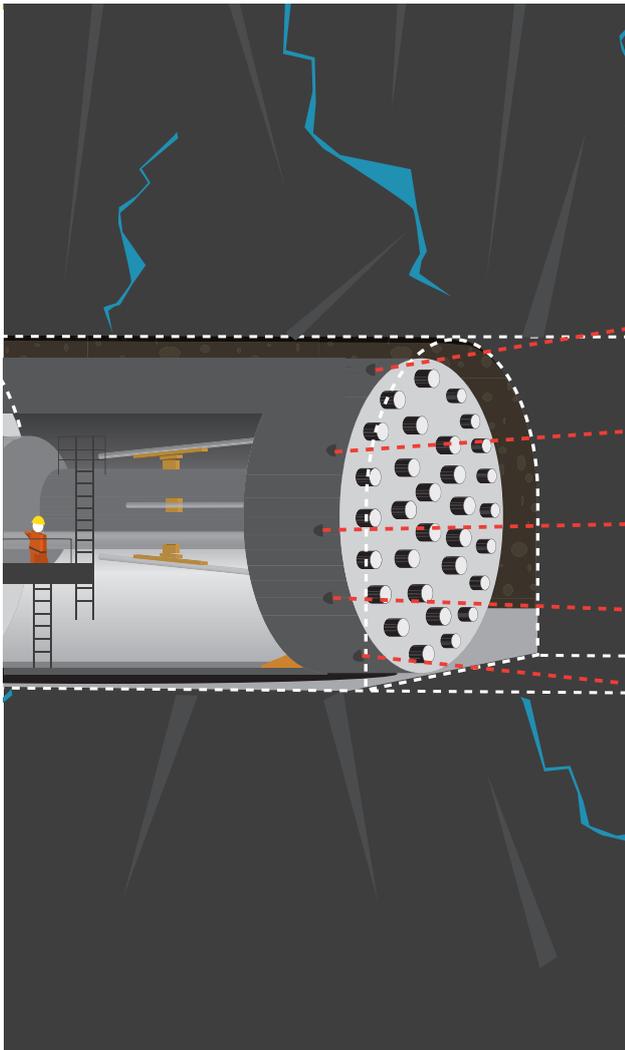
Result: Thanks to Wassara's technology, the result was relatively fast and straight drilling, low impact on the formation and could be performed despite high water pressure and flows in the formation.



Förbifart Stockholm Case Story

SURVEY, GROUT AND DRAINAGE HOLES

Drilling long straight holes with Wassara



Long straight holes

Regardless of tunneling method, traditional drill and blast or Tunneling Boring Machine (TBM), there is a need to drill long straight holes in order to minimize stops in production for surveying and grouting purposes. The water-powered DTH hammer from Wassara has a proven track record of its ability to drill long straight holes while maintaining performance throughout the entire hole length.

Drills through difficult formations

The water-powered DTH hammer can penetrate hard, soft and fractured rock as well as water-rich formations with high back pressure.

High drilling performance

A Wassara water-powered DTH hammer will maintain a high rate of penetration in most formations. The Wassara hammer performance is unaffected by water in the formation.

PROBE DRILLING FOR TBM AT BRENNER BASE TUNNEL, ITALY/ AUSTRIA

Mission & challenge: Probe drilling of 100- 200m for TBM in challenging formations. Wassara's W70 and W100 hammers were used for this.

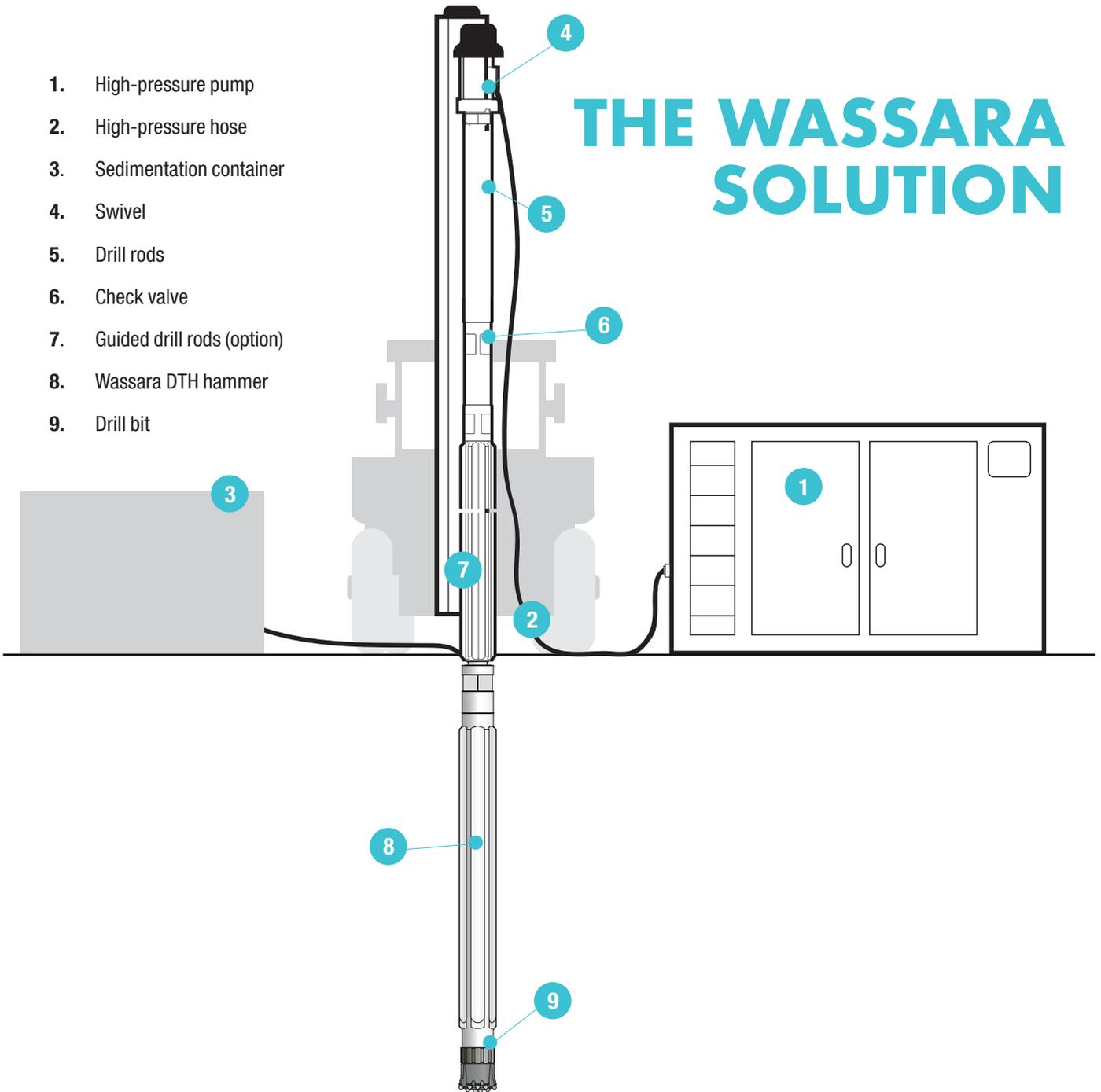
Result: Reduced stoppage time for TBM due to fast and accurate probe drilling.



Brenner base tunnel Case Story

THE WASSARA SOLUTION

1. High-pressure pump
2. High-pressure hose
3. Sedimentation container
4. Swivel
5. Drill rods
6. Check valve
7. Guided drill rods (option)
8. Wassara DTH hammer
9. Drill bit



Hammer range

Hammer	Ø Drill bit	Water consumption	Max operating pressure
W50 (2")	60mm, 64mm (2 3/8", 2 1/2")	45-150 l/min (12-40 USgpm)	170 bar (2500 psi)
W70 (3")	82mm, 89mm (3 1/4", 3 1/2")	70-270 l/min (18-70 USgpm)	180 bar (2600 psi)
W80 (3.5")	95mm, 102mm (3 3/4")	70-270 l/min (18-70 USgpm)	180 bar (2600 psi)
W100 (4")	115mm, 120mm, 127mm (4 1/2", 4 3/4", 5")	130-350 l/min (35-95 USgpm)	180 bar (2600 psi)
W120.G3 (5")	130mm (5 1/8")	240-500 l/min (63-130 USgpm)	180 bar (2600 psi)
W150 (6")	165mm (6 1/2")	270-570 l/min (70-150 USgpm)	180 bar (2600 psi)
W200 (8")	216, 254mm (8 1/2", 10")	280-744 l/min (73-197 USgpm)	150 bar (2200 psi)
W280 (12")	305mm, 311mm (12", 12 1/4")	1 200 l/min (317 USgpm)	150 bar (2200 psi)

Hammer range – Jet grouting

Hammer	Ø Drill bit	Water consumption	Max grouting pressure
W100JG	153mm, 165mm (6", 6 1/2")	130-350 l/min (34-93 USgpm)	150 bar (2200 psi)
W120.G3 with JG Monitor	152mm (6")	240-500 l/min (63-130 USgpm)	500 bar (7 250 psi)



Wassara – cost-efficient and environmentally-friendly drilling

LKAB Wassara is a Swedish company developing and manufacturing unique water-powered drilling systems for high performance in surface as well as underground drilling operations. The heart of the Wassara drilling system is the world patented water-powered down-the-hole hammer.

Wassara's drilling systems have been used for more than 30 years in various applications within many industries; mining, ground engineering, dams, geothermal, marine, oil & gas storage. Our experience covers more than 30 million metres drilled in different locations around the world. Reference studies can be found on our website.

LKAB Wassara was founded in 1988 and is owned by LKAB. LKAB is an international high-tech minerals group that produces iron ore products for the steel industry and other mineral products for many other industries and applications.

Explore more at www.wassara.com