



Inspection of rock stability in the raw water tunnel for Nedre Romerike Waterworks IKS, outside Oslo (Photo: NGI - NRV IKS).

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Safeguarding future water supplies

How do you make sure that critical water supplies are not disrupted in the future?

That was the overriding purpose when NGI was summoned to map rockfall inside the nearly 4 km long raw water tunnel of Nedre Romerike Waterworks (NRV IKS), the waterworks outside Lillestrøm, about 25 km north-east of Oslo. In addition NGI was asked to recommend measures to protect the water tunnel from future incidents.

Rockfalls have occurred at two locations inside the tunnel that leads raw water from the Glomma river to the water treatment plant of NRV IKS. Both incidents were documented a few years ago. However, it seemed that the amount of falling rock had increased since the last tunnel inspection, totaling a mass of approximately 150 cubic meters at one of the locations.

The raw water tunnel is secured with reinforced concrete at the most troublesome places. In addition, a large metal tube takes the water through the section that has been most exposed to falling rock.

-There are natural causes behind these incidences. On the surface, we can observe fault zones in the bedrock in two separate directions. At locations where they intersect, there are weak zones that are prone to rockfalls, explains NGI's Bahman Bohloli, senior specialist in rock mechanics.

Together with colleague Kristine Thorsen Sæthern from NGI and two NRV IKS staff members, they have inspected the tunnel. They were inside for three days and spent three additional days to map the bedrock surface above the tunnel.

Safety regulations implied that the engineering geologists had to wear drysuits whenever inside the tunnel. Some of the challenges included a vertical descent of 20 meters, long stretches negotiating narrow and low passages in an inflatable boat, and tiresome wading in sticky mud.

-Having mastered these challenges, it was very satisfying to be able to finish the report with our recommendations," says Bahman Bohloli with a smile.

Some of the recommendations include concrete castings and reinforced steel arches as well as extensive use of rock bolts.

The next step for NRV IKS is to contract an entrepreneur for the construction work to be carried out inside the tunnel. However, such work cannot be done before 2019. Only then will it be possible to close off the water from Glomma. The neighbouring Ullensaker municipality will finish its new water plant that year, enabling NRV IKS to get alternative water supplies during the time it takes to close the tunnel and carry out the reinforcements.

In case of an emergency, NRV IKS can currently get alternative water supplies

from Oslo and Aurskog-Høland. However, this will only amount to 38 per cent of the need, explains general manager Thomes Trømborg of NRV IKS.

-If there is a large rockfall inside the tunnel before we can connect to the Ullensaker water plant, we can risk serious water shortages. This is why we have such a high level of awareness and implement high-quality procedures for the future improvements. We do everything we can to ensure safe water supplies for the future, says Trømborg.

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FACTS

- Nedre Romerike Waterworks (NRV IKS) is an inter-municipal company that produces and supplies drinking water to six municipalities north-east of Oslo.
- NRV IKS is owned by the municipalities Fet, Sørum, Nittedal, Lørenskog, Rælingen and Skedsmo.
- Raw water is pumped from the Glomma river and lead through a 3.6 km long tunnel to NRV IKS's water treatment plant.
- After purification, the drinking water is distributed to the six municipalities, covering a total population of approximately 160,000, a large hospital and a variety of manufacturing industries and businesses.
- The NRV IKS waterworks opened in 1982 and produces on average 500 liters per second.
- With its 620 km, Glomma is the longest river in Norway. The river's precipitation area covers 41,000 square km, which almost equals the size of Denmark.
- The rock quality in the tunnel has been assessed using the Q-system, developed by NGI and used worldwide. Read more about Q-system [here](#).

The Norwegian Geotechnical Institute (NGI) is a leading international centre for research and consulting within the geosciences. NGI develops optimum solutions for society, and offers expertise on the behaviour of soil, rock and snow and their interaction with the natural and built environment. NGI works within the markets Offshore energy; Building, construction and transportation; Natural hazards, and Environmental Engineering.

NGI is a private foundation with office and laboratory in Oslo, branch office in Trondheim, and daughter companies in Houston, Texas, USA, and Perth, Western Australia. NGI was established in 1953.

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