Tunnelling and environmental challenges

Kristian Downs of water treatment specialist, Siltbuster, discusses the environmental risks posed by an expansion of tunnelling works and what can be done to address them

As we emerge from the COVID-19 pandemic, it is no surprise to see governments around the world investing in infrastructure spending to help springboard an economic recovery and tunnelling projects are set to play a crucial part. However, it is important to realise the environmental risks posed by this expansion of tunnelling works and what can be done to address them.

THE RECOVERY

It is clear that infrastructure investment will play a big role as governments around the world look to bounce back from the economic uncertainty triggered by the global Corona pandemic.

With the global gross domestic product (GDP) down by 4.5 per cent in 2020, and the Eurozone GDP reduced by 7.5 per cent, nation-states are looking to recover through the tried and tested method of incentivising and stimulating spending within the construction sector.

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The World Economic Forum estimates that every dollar spent on infrastructure has the potential to generate between five and 25 per cent in economic returns. This 'multiplier effect' is something that has the potential to allow countries to bounce back stronger than before COVID.

In addition to stimulating economic recovery, infrastructure spending will improve transportation, communication, and energy facilities; all while creating jobs across many divisions and their associated supply chains. This includes material production, design and consultation, equipment supplies and specialist engineering services.

TUNNELLING PROJECTS

As part of the international infrastructure spending plans, tunnelling works are set to expand enormously. With schemes delayed throughout 2020 due to uncertainty, a whole variety of projects have now been approved and are set to start this year and into 2022. These include the Fehmarn Belt Fixed tunnelling scheme, connecting the Danish island of Lolland with the German island of Fehmarn, the UK's HS2, and the E39 Rogfast, the sub-sea road tunnel in Norway connecting the cities of Kristiansand, Stavanger, Haugesund and Bergen.

All of these projects take place throughout different geographies, geologies and topographies. This means that different site-specific methods and machinery will be required. But one constant remains. All of these projects must be completed safely and with no adverse effects caused to the surrounding natural environment.

THE RISKS POSED

If not approached appropriately, there is a risk that tunnelling works can cause environmental damage. The disturbance and excavation of once vegetated soils via "cut-and-cover" tunnelling temporarily exposes the once protected geology and makes it susceptible to water erosion.

In a storm event, exposed soil will be stripped and carried off into sensitive receptors, such as rivers and lakes. Large volumes of sediment can be displaced over very short periods of time.

While mineral fractions might not seem dangerous at first, the stark reality is that man-made disturbances to the natural order can be catastrophic to flora and fauna alike. Suspended solids can block fish gills and cause suffocation, cover spawning grounds affecting reproduction and hinder visual predators relying on a clear line of sight for feeding. Also, due to the extremely high mobility of solids in suspension, the degradation of vast distances

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of inland waterways can occur from a seemingly small amount of available material.

When tunnelling at depth, a new challenge is presented associated with groundwater ingress. The linear concrete segments that are positioned to encase recently excavated tunnels are typically sealed with mortar-based grouts. These cementitious compounds are highly reactive with water and have the potential to elevate its pH to 12 or 13. This is equivalent to the pH of bleach and oven cleaner. Unsurprisingly, highly alkaline water has corrosive and toxic consequences, presenting a real threat to hydrogeological environments.

Tunnelling by drill and blasting also brings with it its own set of unique challenges. The use of ammonia-nitrate-based explosives for the breaking and removal of rock has the potential to cause any associated ground or surface waters to adopt an elevated nitrate concentration which will in all likelihood exceed acceptable levels stipulated in discharge permits.

PREVENTING THE RISKS

All of the risks discussed above can be addressed and prevented by early consultation and effective design and water zone management. By adopting a transparent and collaborative approach, contractors and environmental experts can identify high-risk areas at the planning stage and assess adequate defensive measures to protect vulnerable receptors and avoid expensive project delays.

This does not have to be at a great cost either. By carefully reviewing existing geological ground investigation reports and site plans, effective water management strategies can be implemented to capture, store and process the specific volumes relative to individual sites and their unique circumstances.

However, it is only through a cooperative, pre-emptive approach, and not the reactive response of old, that will ensure we awake to a post-COVID world where our rivers and environment have not suffered in the name of economic recovery.

Kristian Downs is international business development manager at Siltbuster. He has worked on the Grand Paris Express, the most ambitious new subway project in the Western world and the largest transport scheme in Europe, as well as tunnelling projects such as the West Link in Gothenburg and the Metro in Copenhagen.