ARTICLE

Material Reuse through geoBIM at HS2 Phase 1 – Area North Earthworks: Winner of Bentley Systems Going Digital Awards on Geotechnical Engineering

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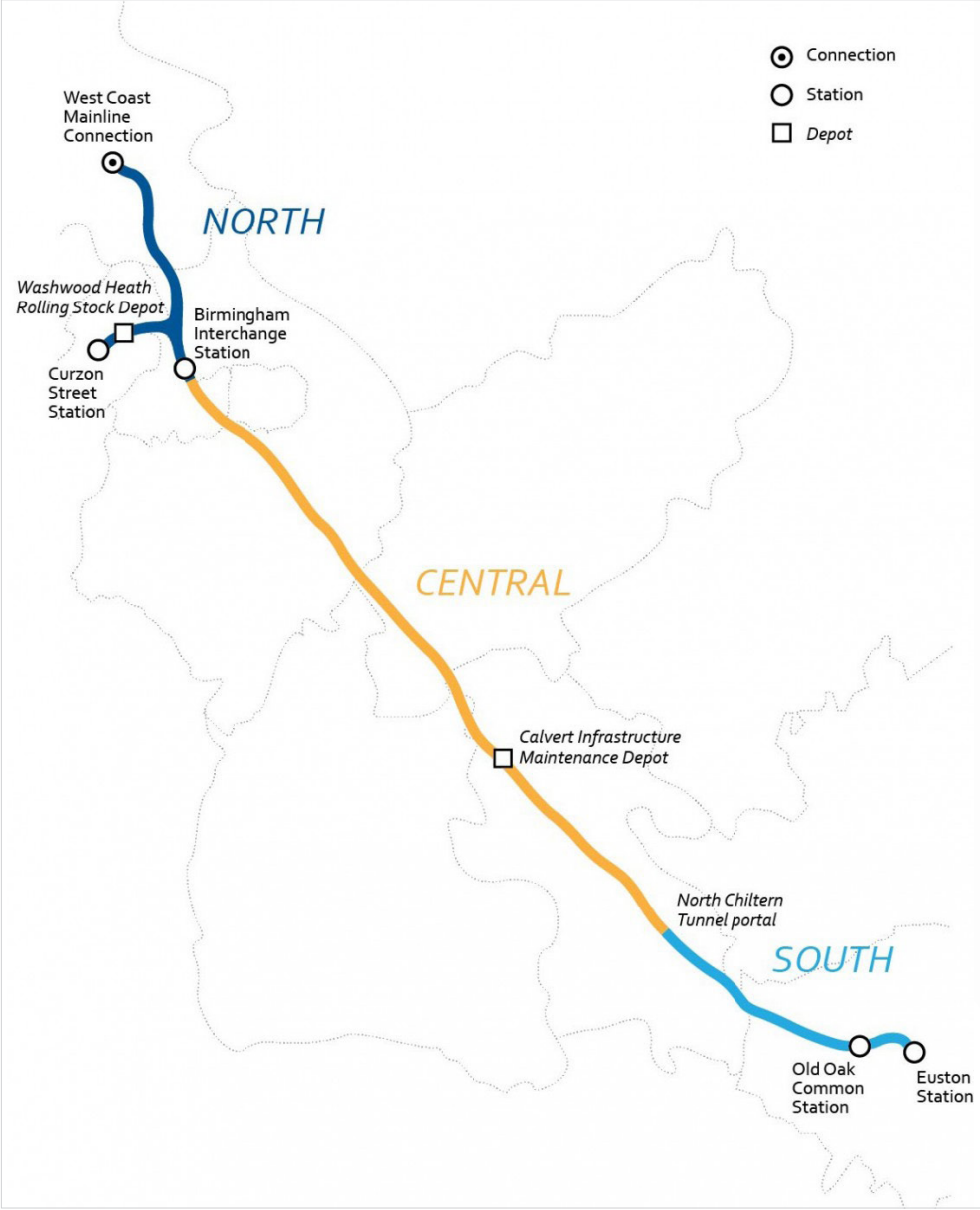
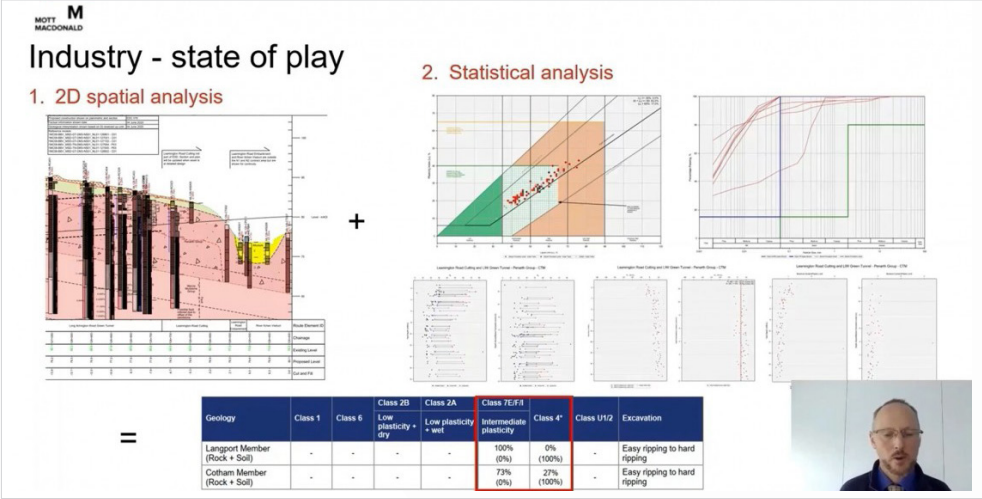
The 90-kilometer HS2 Phase 1 rail route has approximately 25 million cubic meters of material earmarked for excavation, which is equivalent to 10,000 Olympic swimming pools, making the volume of earthworks one of the largest sources of carbon emissions.

High Speed 2 (HS2) is UK's flagship transport project. A 250+ miles of new high-speed railway line between the North West and the South East of UK which will deliver faster travel to many towns and cities across Britain. Many civil engineering works are already underway with £23 billion contracted into the supply chain.



High Speed 2 (HS2) Railway Line

Although the industry has a robust process of collecting valuable statistics, including output reports that detailed the geology and the type of material to be excavated, none of these were set in a third dimension for 3D numerical analysis and understanding. As a result, the outputs were generic for the earthworks leading to conservatism by the contractors while having to make their mass haul decisions, assessing the quality of material available and plant specification for use on site.



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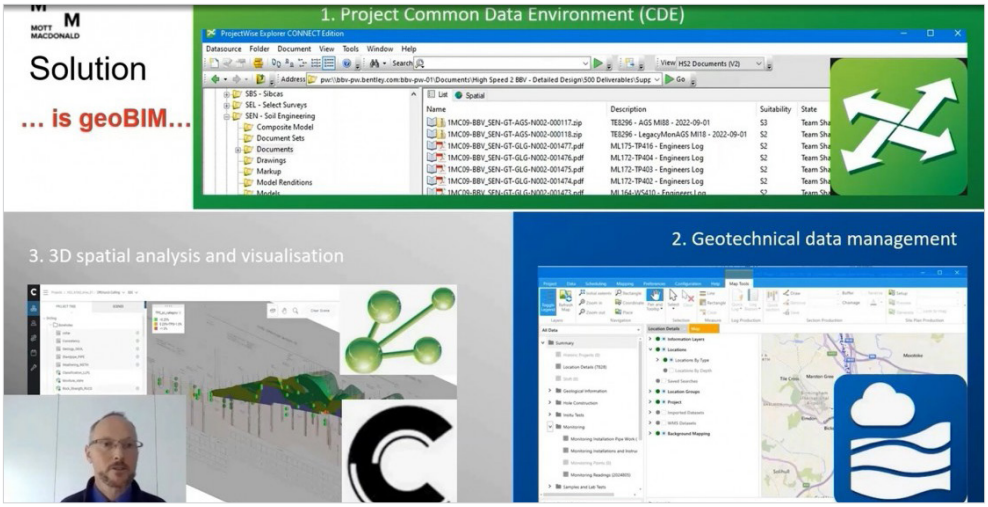
An additional challenge was the huge amount of data to be processed and controlled, which included:

- 7,500+ boreholes increasing through time
- Just-in-Time ground investigation, where it was important to know exactly what data they had at what time
- Managing and disseminating the information between the GI and the design team across four different companies plus other stakeholders while working in tens of different offices across four continents with around-the-clock working

By leveraging Bentley Systems tools, Mott MacDonald developed geoBIM for their material reuse assessment, a tool that integrates geological information and building information, incorporating 3D spatial analysis to drive efficiency in the project workflows and have a positive impact on sustainability.



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ProjectWise® provided a common data environment as the single source of truth to key documents and trackers, including any documented errors, corrections, and actions taken. This allowed the full design team to remain up to date with the current GI data available.

ProjectWise was also used for hosting all design models that fed into the material reuse assessment, providing up-to-date information on the revision, stage, and status of each of the design models.

All the above information flowed into a geotechnical database powered by OpenGround® Cloud allowing central data management for hundreds of users and real time access of a huge data set, consisted by millions of rows of raw AGS data from 50 different ground investigations, across multiple teams and offices.

By setting up the proper APIs, OpenGround data were integrated directly into Seequent's Leapfrog to track the progress and the state of the ground investigations at each of the design cutoffs and provide up-to-date information to the design teams.

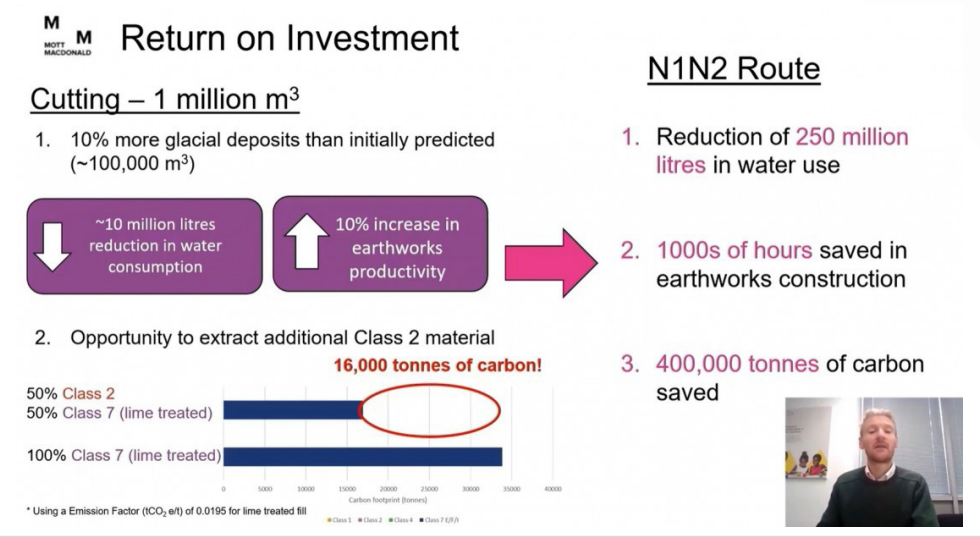
More specifically, borehole sticks from OpenGround Cloud data were integrated within Leapfrog Works to generate the stratigraphic geological model. After considering the material reuse parameters through the HS2 technical specification, specific properties to model in a numerical analysis were decided and the respective data sets were integrated from OpenGround Cloud. Analysis for each data set within each stratigraphy was conducted and then were all combined to create a material reuse model for each cutting. These models were compared to the geology and the stratigraphic model to sense check whether they looked sensible and decide how material was to be extracted. Slope stability analsyis was also performed through Seequent's GeoStudio®.

While core analysis was undertaken by Seequent's Leapfrog® Works, Seequent Central was used for sharing the tracking of the model across all project teams.

The single source of truth and consistency of the above approach allowed the project team to devote less time on checking and more time on reviewing the results. It also saved time on potential rework. While each manual assessment can take two days to complete, through geoBIM it can updated in seconds.

The clear audit trail of results gave confidence to the entire project team and client of the results they were receiving. The 3D representation models were a power communication tool for the client to understand and take more informed data-driven decisions on mass haul.

The return on investment of the above approach was significant reduction on water consumption, working hours and carbon usage for each cutting. Translating these savings across the N1N2 route, this equates to 250 million liters in reduced water use and 400,000 tonnes of carbon saved across the project, 10% of the overall carbon footprint.



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"Any project that has the mass moment of material can benefit from this process, particularly if it's implemented right at the start of the process so the maximum sustainability and economic benefits can be realized," Jonny Neville from WSP said.

"This project requires that we look after taxpayers' money and make sure we are reducing those construction delays, helping that be more viable and reduce the impact on society. This is where Seequent and Bentley coming together. The combined effort of that software that has helped the team to model the solutions to address the challenge. If you can connect the built world above the ground with the hidden world below it, then there's some real value, and in this particular case the team saved a massive amount of time in their analysis," Jo Knight, CCO of Seequent said.

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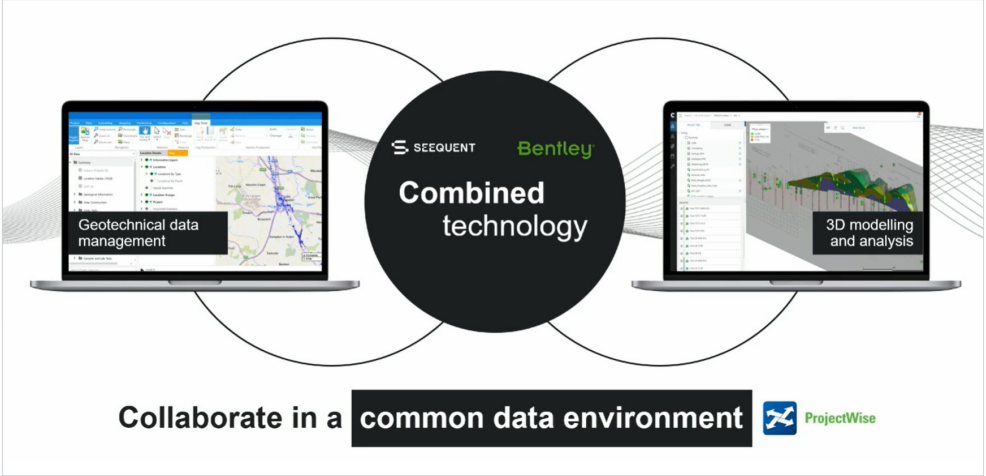

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