GEOTECHNICS
geotechnical and geoenvironmental specialists

We have a proven track record of management of the environmental and health and safety requirements on our sites, compliant with our **ISO14001** accreditation and the requirements detailed within the Environment Agency's **SHEW Code of Practice**

We have developed a dedicated approach internally to working on Environment Agency projects, including bespoke risk assessments, checklists, briefings and training

SHEW CoP
Managing safety and the environment during design and construction.

The success of our approach has been consistently verified by the Environment Agency themselves through numerous **excellent site audits**

SITE FOCUS

Meeting the requirements of the

ENVIRONMENT AGENCY

SOMERSET FLOOD DEFENCES, 2016-17

A large and complex ground investigation was undertaken for Team Van Oord at the site of a proposed flood defence scheme

The scope included a significant volume of Cable Percussion boreholes, Cone Penetration Testing (CPT), Trial Pits, in-situ permeability monitoring, groundwater monitoring and geotechnical laboratory testing

AINSPOOL GI, 2018

A ground investigation was undertaken for Mott MacDonald at the site of recurring flood events within an area intended to be protected by the Ainspool flood bank

The scope included a Ground Penetrating Radar (GPR) survey, Cone Penetration Testing (CPT), and Trial Pits, with associated geotechnical laboratory testing handled by our own in-house geotechnical laboratory

ROMSEY FLOOD DEFENCES, 2017

A ground investigation was undertaken for Mott MacDonald at the site of a proposed flood defence scheme

The scope included a Cable Percussion boreholes, Trial Pits, in-situ permeability testing, and groundwater monitoring using Leveloggers. Geotechnical laboratory testing handled by our own in-house geotechnical laboratory

PALMER'S BREWERY, 2018

Team Van Oord appointed us to undertake a ground investigation at the site of a failing river bank retaining wall

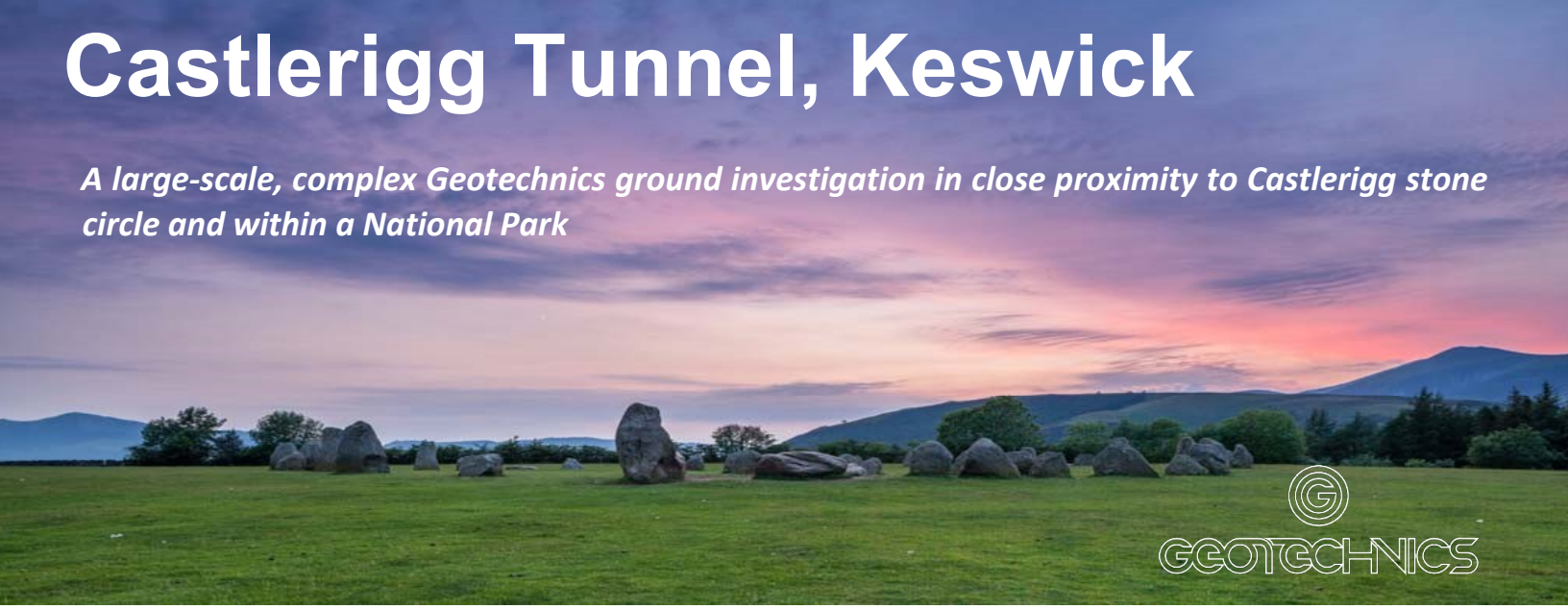
The investigation comprised cable percussive and dynamic sample boreholes, concrete coring within inclined holes, in situ and laboratory testing handled by our own geotechnical laboratory, and reporting

Please get in touch if you would like more information regarding our experience working on Environment Agency sites, our Specialist approach, or any other enquiries

E: mail@geotechnics.co.uk **T:** 024 7669 4664 W: www.geotechnics.co.uk

COVENTRY CHESTER EXETER YORK

Castlerigg Tunnel, Keswick



A large-scale, complex Geotechnics ground investigation in close proximity to Castlerigg stone circle and within a National Park

The facts:

Client:	United Utilities
Overall Project Value:	£10M
Value of the Ground Investigation:	£875k
Completion date of the GI work on site:	July 2016

The team:

Overall project control was maintained by United Utilities Engineering who worked closely with an extensive list of stakeholders including: Environment Agency, Natural England, Highways England, and Cumbria County Council. Working with the tunnelling contractor the UU engineering team were responsible for the geotechnical design, scoping, procurement and implementation of the works.

Geotechnics Ltd, acting as Principal Contractor, were responsible for the delivery of the intrusive and nonintrusive phases of the site investigation. Managing all the site-based activities including the laying of 3.5Km of aluminium trackway, construction of a new highway access, Access bridge and embankment. Past experience of working in this area meant Geotechnics Ltd were acutely cognisant of the stakeholder challenges surrounding the overall scheme and we're able utilise personnel and specialist sub-contractors, such as Drilcorp and Terradat, who had built up good working relationships with land owners over previous elements of the project.

The Initial non-intrusive Seismic refraction survey was completed by Terradat to produce an initial bedrock profile. Using their proprietary tractor towed seismic generator they were able to rapidly asses overburden thickness, rock strength and consistency along 3 possible tunnel alignments. This early stage works proved invaluable in the design and implementation of the intrusive phases whilst allowing on-going solution refinement.

The project:

The Castlerigg tunnel forms an important part of the 36km long Thirlmere link Raw Water Aqueduct. Located just outside Keswick within the Lake District National Park the project involves the construction of a 1300lin/m tunnel drive through mixed geology at depths of up to 60m. Passing under the 5000-year-old Castlerigg stone circle the tunnel will remove the need to construct around 7.5km of conventional open cut main and reduce overall project programme by around 6 months.

From early in the project it was identified that Castlerigg and its surrounds formed a natural topographic and cultural obstacle to a gravity pipeline and a tunnelled solution formed part of the initial optioneering, though further review at desk study stage identified that the most economic option would be to divert the main around Castlerigg. The aftermath of storm Desmond in December 2015 however meant that the planned route would now require major stabilisation works within both the river Greta SSSI and the steep slopes above. The costs associated with these additional works combined with the continued long-term risk to a strategic asset meant the preferred alternative was no longer considered viable and a tunnelled solution was developed. Set against the back drop of the aftermath of storm Desmond and the closure of the A595 the project team were required to design, scope, procure and deliver an extensive ground investigation whilst adhering to significant programme and stakeholder constraints.

The works were awarded to Geotechnics Ltd acting as Principal Contractor and comprised:

- **Rotary drilling** **2634lin/m**
- **Seismic profiling** **1700lin/m**
- **Downhole acoustic imaging**
- **High pressure lugeon testing**
- **Specialist rock testing**

The original proposals called for an investigation to cover 3 route options estimated at £1.3M. Early geophysical works (Phase 3) allowed the development of a preliminary ground model enabling the discounting of one option. The remaining 2 options were then further investigated with the completion of an initial 125m pilot hole (Phase 3.1). Completion of a pilot drill prior to the main works allowed both

further confirmation of the geophysical ground model and provided feedback on the likely drilling conditions to enable mobilization of appropriate plant and equipment.
Early use of geophysics and the pilot bore allowed plant and equipment to be pre-ordered and cached at work sites. Prepositioning of plant and equipment allowed drilling crews to achieve utilisation in excess of 95% during the main works, with only 100hrs non-operational across a total of 1615rig/hrs. This optimization of the main (Phase 3.2) works meant significant reductions in preliminary costs such as temporary trackway, site accommodation, security, etc resulting in a reduced overall cost.

As further data became available it was apparent that high and in places artesian groundwater levels allowed the elimination of a 2nd option meaning the remaining Ground Investigation scope could be further amended to allow additional costs savings resulting in a final outturn cost of £881k.

The phased approach and continual review meant it was possible to complete the ground investigation as part of the optioneering process allow optimization of both solution and ground investigation.

The original proposed route involved diverting the aqueduct around Castlerigg with a section of the proposed route running alongside the River Greta, however following the a larger proportion of the embankment in which the pipeline was to be constructed was removed during storm Desmond. Following this, a strategic review determined that the planned route was no longer feasible from a long-term security of supply standpoint and an alternative route was required.

The original route had already been subjected to an EIA and planning application and was at tender stage the resulting 7.5km re-route had major impacts on both the planning application and tender program. In order to retain the planned 2019 completion date UU engineering was challenged with completing the design, procurement and implementation of the Ground Investigation within the existing tender period and to meet the previously set planning dates. To further exacerbate an already challenging program the main access route for the works the A595 was subject to significant public scrutiny due to its long-term closure, meaning any works that impacted on the reopening of the road would have major stakeholder implications for the wider business.

Failure of the team to deliver adequate and quality information in the timeframe required would have resulted in considerable risk to the main construction program with the potential to miss key targets set by the regulator with associated financial penalties. However, through carefully planning, a phased

approach and an integrated delivery team it was possible to deliver the works to a program originally considered unfeasible.

The Castlerigg scheme represented a unique set of challenges. From a technical perspective the depth of tunnel drive combined with a high groundwater table meant conventional testing and monitoring equipment and processes were unsuitable. One such challenge was undertaking permeability testing at depths below groundwater in excess of 100m with water pressures over a 1000kPa. To address this acoustic downhole imaging was used to determine optimum test section maximising packer efficacy combined with strengthened packer sleeves to allow increased inflation pressures.

As highlighted, a section of the investigation required works within the A595 a main trunk road closed due to storm Desmond. These works had the potential to cause additional delays and disruption to both the repair efforts and the reopening of the road. Ensuring the work was achieved within the closure, required close cooperation with Highways England and Cumbria County council along with the various contractors involved. UU engineers attended Bi-weekly progress meetings ensuring that operations on both projects did not adversely impact the other.

The use of a phased approach combined with hold points within the program allowed the solution design to be developed in tandem with the investigation, recovered data fed into solution refinement which in turn allowed a more focused and targeted approach to the next GI phase. This incremental approach not only led significant cost savings, the “heads up” knowledge it generated contributed to significant increases in productivity allowing the delivery of a unique project to a challenging program whilst reducing cost.

The longstanding working relationship and trust built up between United Utilities and Geotechnics Limited, meant early contractor involvement from the outset. Inclusion of the tunnelling and drilling contractor in the design and scoping process allowed an open exchange of requirements and ideas leading to full confidence that the main targets for the site investigation were suitable and achievable.

UU Engineering were able to identify potential issues at an early stage and plan appropriately meaning contractors were able to develop and adapt equipment to deliver the technical requirements of the investigation in a seamlessly. Careful planning and precise programme management were key to ensuring maximised productivity whilst maintaining the highest health, safety, and environmental practices.
Whilst the project was completed efficiently and to a challenging programme the core UU message of “Nothing we do is worth getting hurt for” underpinned all operations the project team were aware of the potential risks associated with crews trying to meet tough targets. The mantra of “Safe and steady not rough and ready” was always applied to both field and design operations. This principle of consistency and efficiency was a priority combined with an enhanced scheme of audits and supervision over and above industry standard resulted in a total of 8415hrs worked without accident or incident.

The result was a highly professional team effort delivering a technically demanding project in exceptional circumstances. Efficient delivery of quality data using innovative and bespoke solutions has meant that it is still possible to complete a major capital project whilst adapting to a changing environment.

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Case Study

Barrow – Long Sewer Outfall Investigation

Key facts:

Project Name	Ground Investigation for Long Sea Sewer Outfall, Barrow
Client	United Utilities
Date	May 2013

Plans for a new United Utilities sewer outfall structure in Barrow-in Furness, some 1400m across an inter-tidal area opened up an opportunity for Geotechnics to showcase the potential of their versatile, capable and environmentally sensitive Hagglund Hybrid Cable Percussion rig.

Barrow WwTW is situated to the east of the main dock area of Barrow-in-Furness and was constructed in 1996 to treat flows from Barrow, Dalton, Walney Island, Lindal and West Barrow. The outfall however, has been in existence since the late 19th century, the difficult excavation works having originally been carried out by hand as an open cut channel to carry sewage and industrial effluent flows through from the newly reclaimed land behind the sea wall. To assist in the excavation, a railway was reportedly constructed across the sands and mudflats alongside the trench. During high tides, the engines were kept on nearby Headin Haw island which was formerly occupied by a gunpowder magazine associated with the iron ore industry in the area. A cast iron pipe was later installed in the outfall channel and buried, with a brick built headwall at its discharge point.

The mudflats south of Barrow Docks are subject to a number of designations including a special area of conservation (SAC) and a special protection area (SPA) due to the habitat it provides for numerous species of fauna and flora. Following a recent review of these designations it was identified that the existing outfall is adversely affecting the eel grass which is a protected feature of the area. In order to minimise their impact on these protected habitats, United Utilities undertook a programme of studies and optioneering exercises to identify a suitable position to which the outfall could be relocated.

It was soon realised that any construction would be challenging due to soft ground, rapid tides, ecological issues and interaction with existing activities and stakeholders in the area.

Geotechnics was engaged under the United Utilities site investigation framework to provide geotechnical and geoenvironmental information relating to the site. This would enable United Utilities Engineering to provide sufficient information relating to ground conditions to allow subsequent tenderers to accurately assess the requirements and constraints of the scheme and to price it accordingly.

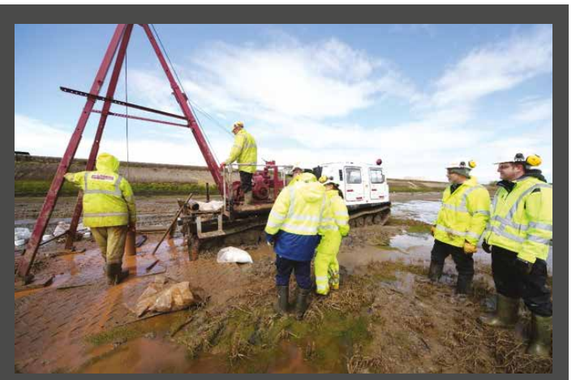
The difficult access and obvious risks associated with working in a potentially dangerous area were coupled with working in a protected environment that is classified as a Special Area of Conservation (SAC), Special Protection Area (SPA), a Site of Special Scientific Interest (SSSI) and a Ramsar (Wading birds).

Prior to intrusive works United Utilities Water plc commissioned bathymetric and land magnetometer surveys to provide information on the topography of the proposed pipeline route across the foreshore and ensure the safe passage of works through an area understood to have been heavily bombed during WWII.

Favourable tides in May 2013 were chosen to carry out the works. Prior to mobilisation method statements detailing stringent environmental controls were required to satisfy both the Marine Management Organisation and Natural England that the protection of the area would not be compromised.

Geotechnics' Hagglund Hybrid Cable Percussion rig was designed and built to work in environmentally sensitive areas that reduce the damage to the ground to a bare minimum. Access to the foreshore was not possible via an existing ramp due to this being protected species rich grassland.

As an alternative Geotechnics proposed the design and construction of two ramps along the proposed sea defence wall that would enable safe access to and from the tidal area on a daily basis. Natural England requested that these ramps be made of local derived stone and that these be removed and reinstated after the works.



Geotechnics carried out sixteen boreholes over the length of the pipeline route with the Hybrid Hagglund Cable Percussion Rig with boreholes taken to depths varying between 7.00m and 12.05m below ground level. In addition, fifteen Static Cone Penetration Tests were completed to depths varying between 2.86m and 11.45m below ground level by Lankelma Ltd. Careful monitoring of the tides ensured safe working practices.

The static cone penetration tests were undertaken using an 18 tonne CPT track-mounted rig (UK8) equipped with a 20 tonne capacity hydraulic ram set. A piezo and magnetic combination

cone was used at all locations to provide UXO (Unexploded Ordnance) clearance, cone tip resistance, friction sleeve resistance and dynamic pore water pressure.

The wealth of experience exhibited by Geotechnics and United Utilities' staff teamed with approved specialist contractors resulted in another high quality professional investigation in a demanding and potentially dangerous environment.

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024 7669 4664

www.geotechnics.co.uk

GROUND ENGINEERING AWARDS 2014
FINALIST

Coventry Office
The Geotechnical Centre
203 Torrington Avenue
Tile Hill
Coventry, CV4 9AP

Chester Office
The Geotechnical Centre
Unit 1B, Borders Industrial Park
River Lane, Saltney
Chester, CH4 8RJ

Exeter Office
The Geotechnical Centre
7 Pinbrook Units
Venny Bridge
Exeter, EX4 8JH

Yorkshire Office
Unit 1
Bypass Park Estate
Sherburn-in-Elmet
Yorkshire, LS25 6EP

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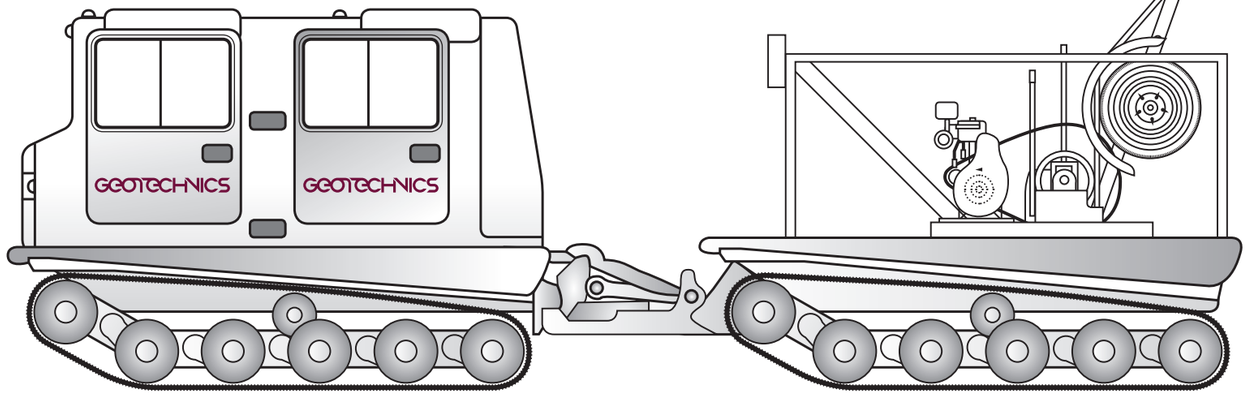
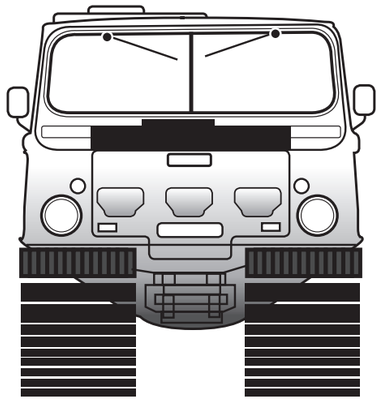
The Hägglund
hybrid rig



6.86m

5.8m



1.85m

The Hägglund Bandvagn 206, or Bv 206 to use its common name, was originally developed by Hägglunds (now part of BAE Systems Global Combat Systems) for the Swedish Army.

An articulated, tracked, all-terrain vehicle designed to work in extreme environments, the Bv 206 was used initially to carry troops and equipment through snow and bog, its standout feature being its low ground pressure. This has led to the Bv206 being hailed as an environmentally friendly option as its low ground pressure and articulated steering system ensures it has minimal impact on sensitive terrain.

The Bv 206 is lightweight, due to its glass reinforced body. All four tracks are driven independently, providing excellent traction.

Since their rollout in 1980 over 11,000 Hägglund Bandvagn 206s have been produced with their outstanding credentials leading to them being utilised in over 37 countries worldwide, and not just as military vehicles. Bv 206s have been adapted to serve a wide variety of activities, including Fire and Rescue, Search and Rescue, ambulances, transport to remote oil wells, polar exploration, and disaster aid and support.

Geotechnics Limited recognised the potential of the Hägglund Bv206 for undertaking site investigation drilling works where soft ground conditions or environmental sensitivity would normally limit the available options, or even make site investigation impossible. By adapting the BV 206s trailer unit with a mounted cable percussive rig, Geotechnics Limited has successfully undertaken site investigations for our clients on several schemes where standard approaches and techniques were not feasible, and has delivered significant time and cost efficiencies.

The **Facts**

	Front car	Rear car	Total
Kerb weight	2710kg	3000kg	4340kg
Payload	580kg	290kg	2000kg
Gross weight	3290kg	3290kg	6340kg
Passengers	5 (6)	11	16 (17)
Cargo space	2.5m^3	5.5m^3	8m^3

Engine: Diesel or Petrol

Output: 100kW (136 BHP) / 5200rpm

Torque: 216Nm / 3000rpm

Diesel Engine: Four stroke in line, 5-cyl, 3 litre

Output: 93kW (125 BHP) / 4500rpm

Torque: 235Nm / 2000rpm

Gearbox: Fully automatic, 4 forward, 1 reverse

Case **Study**

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