



LEGION DRILLING



SITE INVESTIGATION & REMEDIATION SERVICES

For more details www.legiondrilling.com.au | call us on 1300 131 019 | quotes@legiondrilling.com.au

A BELIEF THAT THIS SHOULD BE DONE BETTER

PRECISION. PERFORMANCE. PEACE OF MIND.

Sustainable methods for site investigation

- Sonic and direct-push rigs to maximise sample recovery and reduce waste costs.
- Direct sensing technology for High-Resolution Site Characterisation (HRSC) & in-situ testing eliminating unnecessary wells, consumables and laboratory costs.
- In-situ remediation technologies avoiding excavation and other impacts to site activities.

A few reasons to move to Legion this year

- ✓ Specialist provider of site investigation and remediation solutions nurturing close relations with our clients.
- ✓ Competitive and reliable quotes tailored to your needs and turned around fast.
- ✓ Always at the technological forefront. Pioneers in the introduction of game-changing technologies (e.g., sonic drilling, direct sensing, activated carbon injection).
- ✓ Drillers with know-how. Rig operators holding water-well licences and Certificate III in Drilling Operations.
- ✓ Environmental (CEnvP) and Mining Engineers supervising all direct sensing and remediation projects.
- ✓ Superior health and safety standards. Onboarded crews and plant compliant with the strictest mine sites.
- ✓ Offices in Brisbane, Sydney and Townsville with an arsenal of equipment to exceed any expectations.

ENVIRONMENTAL SERVICES

- ✓ Sonic Drilling
- ✓ Direct Sensing for HRSC
- ✓ In-Situ Chemical, Carbon & Fluoro-Sorb® Injection
- ✓ Direct-Push Soil Sampling
- ✓ Discrete Groundwater Sampling with SP16
- ✓ Well Installation (incl. Prepacks) & Decommission
- ✓ Landfill Gas Bores
- ✓ Service Location, Concrete Coring & Hydro Excavation
- ✓ Solid & Hollow Stem Augers
- ✓ Rotary Air & Down Hole Hammer (Rock Drilling)



GEOTECHNICAL SERVICES

- ✓ Diamond Coring
- ✓ CPT, Seismic CPT, DMT & Vane Shear Testing
- ✓ 'Disturbed' and 'Undisturbed' Sampling
- ✓ SPT & Shelby Tube (U50, U63, U75)
- ✓ Installation of VWP's and Other Instruments
- ✓ Hydraulic Packer Tests
- ✓ Tubex & Casing Advance Systems



SONIC DRILLING



CONFIDENCE IN CHALLENGING CONDITIONS

Seamless onboarding at mine sites

- Experienced crews inducted and onboarded at multiple sites, including BMA, Glencore, QAL and Rio Tinto.
- Rigs and vehicles fully compliant with the strictest mine site requirements.
- Dedicated drilling supervisors and management team overseeing all projects.
- Superior health and safety standards.
- Remote camp facilities available.

Maximise sample recovery

- ✓ Often the preferred drilling method for tailing facilities, dams, landfills, mineral exploration, geothermal projects and overwater applications.
- ✓ 100% sample recovery in most formations, from alluvium and gravels to tailings and landfills.
- ✓ Drill through overburden without fluid circulation.
- ✓ Sample and case off overburden in a single run. Remove casing during grouting.
- ✓ Seat sonic casing on competent rock and start wire-line diamond coring.
- ✓ Sonic rigs with mounted SPT hammers available.
- ✓ Bulk soil sampling up to 200 mm.

IN-SITU TESTING



FOR TAILINGS & GEOTECHNICAL INVESTIGATIONS

Design with confidence

- ✓ Full suite of in-situ testing tools available, including Seismic CPTu, DMT and electrical vane shear tester.
- ✓ Team of engineers (MSc, PhD) and experienced technicians committed to complete every project to the highest quality standards.
- ✓ Evaluate liquefaction potential with less uncertainty. Manage risks responsibly.
- ✓ Deliverables turned around fast that include raw field data (native & Excel format), processed logs and full reports. 3D visualisations can be built upon request.
- ✓ Competitive rates with the option of demobilising the CPT/DMT tooling while keeping the rig on site for additional sampling or installations.

Advantages of Geoprobe® rigs for in-situ tests

- Multi-purpose rigs capable of pre-drilling, casing, sampling and installation of VWP's and other instruments.
- Compact, track-mounted machines for difficult access locations, including tailings impoundments and dam embankments.
- Ground pressure of only 0.27 kg/cm² further reduced with track mats. Go where others cannot.
- Advance CPT tooling with up to 15 tons of static push.

CONE PENETRATION TESTING (CPT)

FREE WEBINAR



QUALITY FIRST

Seismic piezocone (SCPTu)

- Additional measurement of compression and shear wave velocity (v_p , v_s) with Marchetti's SPDMT module.
- Dual-array system for accurate, true-time calculation of v_s .
- Use v_s to better estimate liquefaction risk, cementation and stiffness parameters.
- Use v_p to identify water-saturated intervals.

In-situ testing at its finest

- ✓ Rapid (20 mm/s), near-continuous profiling of multiple geotechnical parameters using Geomil systems.
- ✓ Rigorous procedures in place to fulfill any demands.
- ✓ Local, NATA-accredited facilities can be used to calibrate probes before your next project.
- ✓ Sensitive probes available for very soft soils and tailings.
- ✓ Single-use piezo-elements for simultaneous measurement of pore pressure (CPTu).
- ✓ Dissipation testing can be conducted overnight when required.
- ✓ Equipment such as vacuum chambers, CPT funnels and dummy probes always on site.

FREE WEBINAR





FLAT DILATOMETER (DMT) & VANE TESTER



USING THE RIGHT TOOLS FOR THE JOB

Flat dilatometer test (DMT)

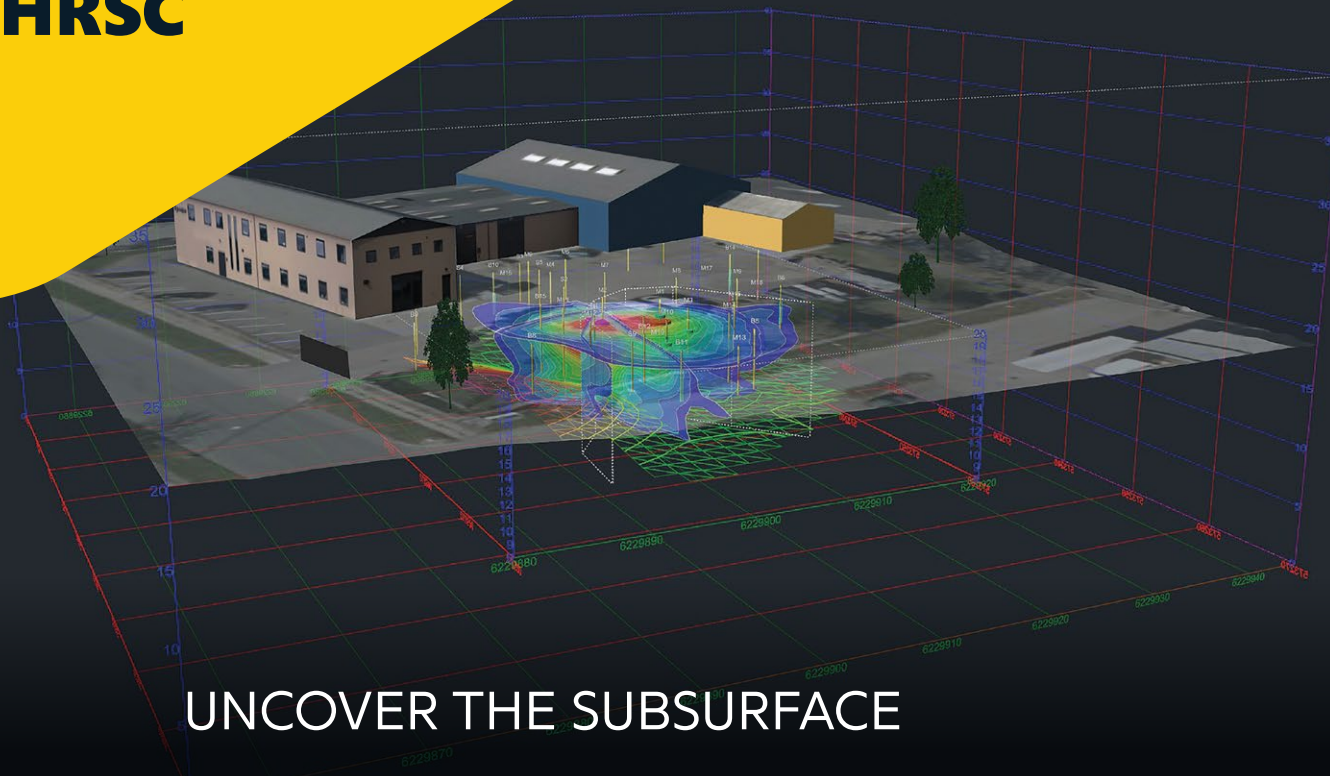
- ✓ Steel membrane pneumatically expanded against the formation to obtain information on soil stiffness and stress history.
- ✓ Ideal method for settlements, compaction control and liquefaction assessment.
- ✓ Blade shaped tool highly sensitive to horizontal stress. It disturbs the formation less than conical probes.
- ✓ Faster collection of data than conventional methods such as SPT and physical sampling.
- ✓ Able to run dissipation tests at a larger measurement scale than CPT.

Electrical vane shear tester

- Estimate undrained shear strength and remoulded (residual) shear strength of fine-textured materials.
- Cased system to avoid friction on inner rods with slip joint yielding high quality measurements.
- Fully software controlled. Measure torque and rate of rotation more precisely than manual systems.
- Rotation speed adjustable between 0.1 and 20 degrees per second.

DIRECT SENSING TECHNOLOGY FOR HRSC

ONLINE DEBATE



2D/3D/4D data analysis and visualisation

- High data density facilitates the development of cross sections and 3D/4D models.
- Cross sections can be easily customised with freely available software.
- 3D/4D models to calculate subsurface volumes and optimise excavation and remediation plans.
- Engage stakeholders, clients and leads with empowering visualisations.

Direct sensing, direct savings

- ✓ Build sound conceptual site models with high-resolution data on contaminant distribution and hydrogeological properties. Reduce uncertainties and financial risks.
- ✓ Avoid excessive costs associated to unnecessary installation of wells, drilling works, analysis of physical samples and poor design of remediation systems.
- ✓ Minimise drilling-derived waste requiring transport and delivery to treatment facilities.
- ✓ High daily production rates resulting in thousands of data points (collected every 1–2 cm).
- ✓ Analyse logs on real time to develop adaptive field plans. Make the most of your time in the field.
- ✓ Get multiple tools on site (including MiHPT and UVOST) at the same flat rate.

Webinar #1



Webinar #2



ULTRA-VIOLET OPTICAL SCREENING TOOL (UVOST)

LASER-INDUCED FLUORESCENCE (LIF) TECHNOLOGY

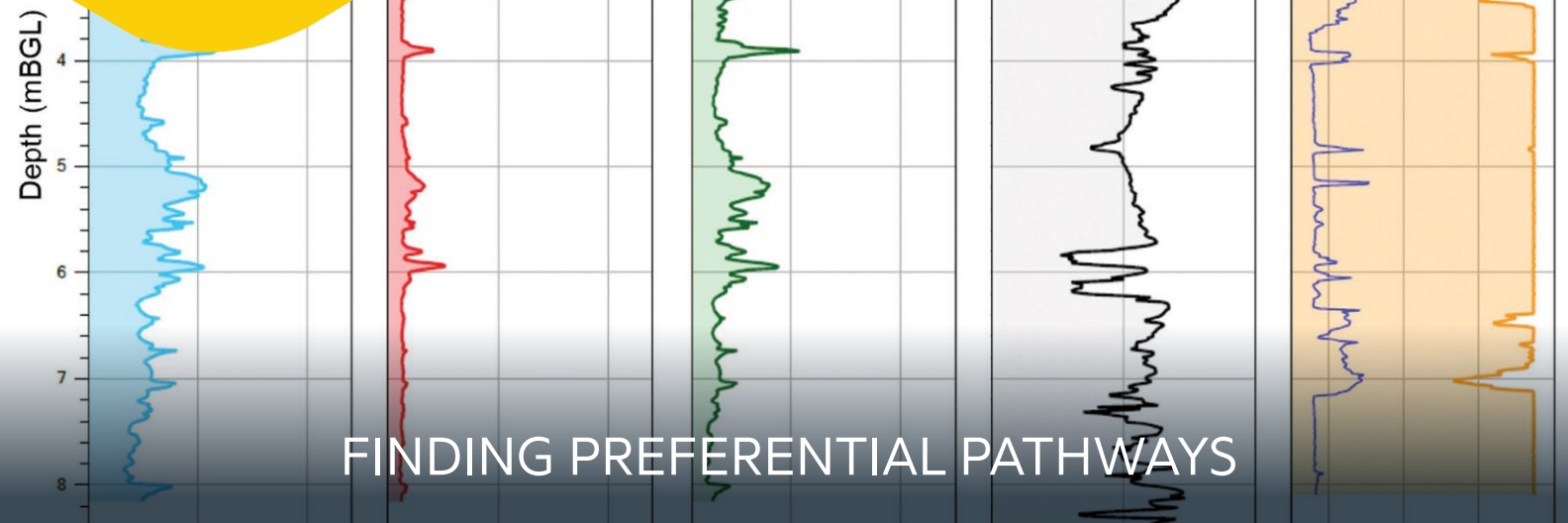
Rapid delineation of LNAPL source zones

- ✓ Designed to delineate petroleum LNAPLs such as petrol, diesel, jet fuel and crude oil.
- ✓ LIF system facilitating identification of LNAPL types, weathering degree and other subsurface conditions.
- ✓ Differentiate LNAPL and natural fluorescence by measuring intensity and lifetime at four wavelengths.
- ✓ Increased UVOST response in coarser-textured materials, often revealing the presence of preferential migration pathways.
- ✓ Experience using other LIF probes such as TarGOST (shown in the picture).
- ✓ High production rates. Complete 6–10 locations per day under typical conditions.

UVOST versus monitoring wells

- Do not miss LNAPL found below the water table anymore.
- Entrapped and residual LNAPL act as persistent sources of contamination but will not enter any well.
- Prevent misinterpretation of in-well LNAPL thicknesses corresponding to confining or perching conditions, etc.
- Avoid overkill remedial designs and management plans.

HYDRAULIC PROFILING TOOL (HPT) AND SP16



PFAS? VOCs? Collect discrete water samples with the SP16

- Expose a protected screen as little as 0.1 m to collect groundwater samples at multiple depths.
- Sealed, 'PFAS-free' system to collect representative samples and avoid cross contamination.
- Sample with a check valve, mini-bailer, bladder pump (for VOCs) or syringe pump (for PFAS) and 3/8" tubing.
- Measure water levels with small-diameter dippers.

High-resolution hydrostratigraphic characterisation

- ✓ Determine preferential flow pathways and lower permeability zones potentially acting as confining layers or capillary barriers.
- ✓ Use the Membrane-Interface & Hydraulic Profiling Tool (MiHPT) to unveil the hydrogeological features governing contaminant transport.
- ✓ Estimate water-saturated hydraulic conductivity using empirical and physically-based models.
- ✓ Use the electrical conductivity sensor to infer the presence of clays, brines, leachates and so on.
- ✓ Run dissipation tests to estimate the water static level and vertical hydraulic gradients.
- ✓ Complete 5–7 locations per day under typical conditions.

FREE WEBINAR



MEMBRANE- INTERFACE PROBE (MIP)



MOBILE LAB FACILITY

Profiling volatile organic compounds

- ✓ System consisting of a heating block and a semi-permeable membrane to sample VOCs present in the solid, aqueous, NAPL and gas phases.
- ✓ Mobile gas chromatograph housing three detectors: photoionisation detector (PID), flame ionisation detector (FID) and halogen-specific detector (XSD).
- ✓ Do not play dice when selecting sampling and injection intervals.
- ✓ Able to detect VOCs from sub-ppm to NAPL levels. Use UVOST first if petroleum LNAPLs exist.
- ✓ Disconnect the chemical detectors to collect gaseous samples or measure subsurface temperature profiles.
- ✓ Complete 3–5 locations per day under typical conditions.

Performing on-site chemical analyses

- Chlorinated alkenes (e.g., TCE): PID and XSD respond.
- Chlorinated alkanes (e.g., TCA): XSD responds. PID (10.6 eV) does not.
- Fuels with aromatics (e.g., BTEX): PID and FID respond.
- Weathered petroleum hydrocarbons: Lower PID:FID ratio.
- Methane: Only FID responds.

DIRECT SENSING

IN-SITU REMEDICATION SYSTEMS

FREE WEBINAR



SEARCH AND DESTROY

Tailored amendment delivery

- Direct-push injection technology for tailored delivery throughout target treatment zones.
- Fixed wells for recirculation strategies.
- Injection through packers in fractured media.
- Trenches for shallow permeable reactive barriers (PRBs) to prevent off-site contaminant migration.

In-situ chemical injection & custom solutions

- ✓ In-situ chemical oxidation and reduction (ISCO/ISCR) systems can rapidly transform and eliminate a wide range of organic contaminants.
- ✓ Application of surfactants increases the hydraulic, biological and chemical availability of subsurface contaminants.
- ✓ Chemical injection technologies produce minimal waste and no excavation or pumping costs.
- ✓ Team of specialised fitters and welders turning your remediation ideas into reality. Build and modify on-site treatment units, hydraulic recovery systems, phasechange technologies and solar-powered solutions.
- ✓ In heterogeneous environments, consider injection of powdered activated carbon or Fluoro-Sorb® slurries.

FREE WEBINAR



ACTIVATED CARBON & FLUORO-SORB® INJECTION

TRAP & TREAT

Biological- and carbon-based options

- ✓ Combined enhancement of sustained sorption and biodegradation or dechlorination mechanisms to trap & treat petroleum hydrocarbons and chlorinated solvents.
- ✓ BOS 200® unique formulation combines terminal electron acceptors, nutrients and a facultative bacteria blend on a powdered activated carbon platform.
- ✓ Emplacement in all geological settings, from sandy aquifers and low-permeability zones to fractured rock.
- ✓ Passive system effective in the long term with limited rebound effects and rapid concentration reductions.
- ✓ Ideal solution for PRBs. Powdered carbon is not expected to travel substantial distances after injection.
- ✓ Direct support from our US-based partners AST Environmental and Remediation Products, Inc. (RPI).
- ✓ Little remediation-derived waste. No excavation or pumping costs.

IN-SITU REMEDIATION

Fluoro-Sorb® for in-situ PFAS sequestration

- Modified clay adsorbent binding across the spectrum of PFAS, including PFOA, PFOS, PFHxS and PFNA.
- Injected as a slurry for targeted, in-situ delivery to impacted zones or PRBs.
- Fluoro-Sorb® expands as it adsorbs PFAS, which allows for greater sorption kinetics and capacity at nanoscale.
- Limited competitive sorption effects.

FREE WEBINAR



CLEARANCE & SERVICE LOCATION



CERTIFIED UTILITY LOCATION WITH GPR & EMF

Concrete Coring & Hydro-Excavation

- Concrete coring and hydro-excavation equipment independent of rigs for maximum flexibility.
- Different diameters available to suit your project needs.
- Plan ahead the clearance works to optimise your time when the rig is on site.

Ground Penetrating Radar (GPR) & Electromagnetic Field (EMF) Detection

- ✓ Highly experienced team of DBYD-accredited locators with GPR and EMF systems to detect utilities safely and confidently complying to AS 5488:2022.
- ✓ GPR can identify buried tanks, pipes and services. EMF units respond to metallic pipes and cables.
- ✓ GPR with dual antenna for simultaneous investigation of shallow and deep targets.
- ✓ EMF with passive and active detection modes capable of tracking individual utilities.
- ✓ Under favourable conditions, GPR can be used for near-surface site characterisation complementing other tools like HPT and CPT.

OUR CLIENTS

AECOM



aurecon

BHP



GLENCORE

Jacobs



JOHN HOLLAND

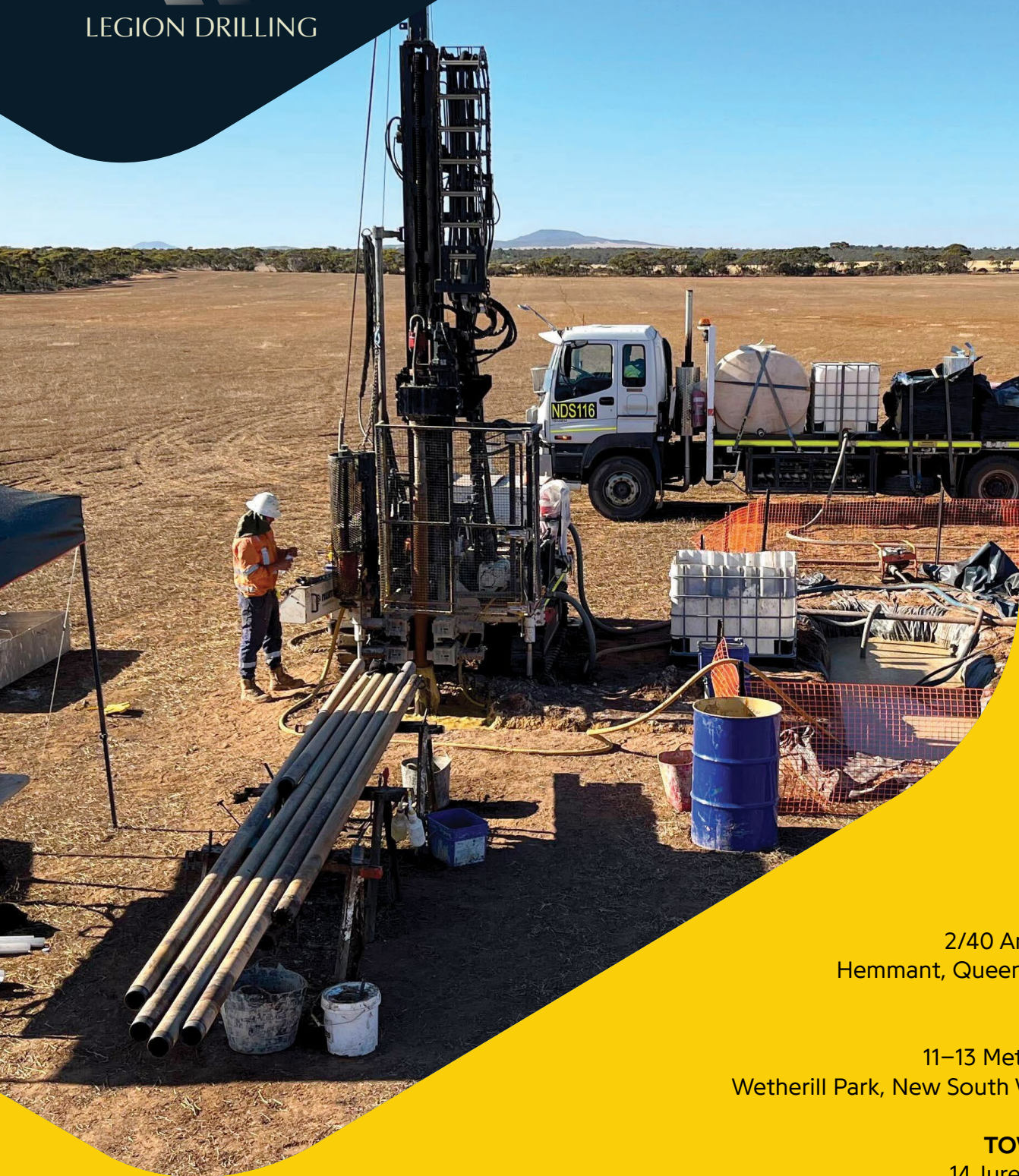
RioTinto

Santos





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