JIM BENSON

LOCATION – *AUCKLAND, NEW ZEALAND*

TECHNICAL SKILLS

Underground Infrastructure Design & Construction

Tunnel & Shaft works expert

Hands-on temporary and permanent works designer

MANAGEMENT SKILLS

Managing and Directing teams up to 300 people

Project Director

Project Manager

Independent Checking Engineer

Expert Witness

Tunnel Works Expert

ITIG (International Tunnelling and Insurance Group – 2019 -2022) Committee Member and Working Group Leader – Culture, Competence and Collaboration, High consequence events; Digital Models.

CURRENT ROLE – Tunnel Works Expert & Consultant's Construction Site Representative

PROFILE

Jim specialises in managing and co-ordinating the design of complex multidiscipline mega infrastructure. Jim is a Chartered/Registered Civil and Geotechnical Engineer in 4No. countries with 30 years' experience in civil engineering, predominantly tunnelling and underground construction. He has led, directed, held Managing Director, Director, Project Director, Design Manager, Expert Witness, Tunnel Works Expert and 'Hands-on' Designer roles on large scale infrastructure such as hydropower, railways, metros, roads, water supply & sewage treatment projects. He has also designed cement works, maritime structures, bridges and buildings.

Jim has provided strategic and spatial planning advice of national importance for up to six layers/levels of underground infrastructure in Singapore.

Jim's 25 years D&B experience with Contractors has enabled him to both develop and modify temporary and permanent works using a combination of steel, concrete, GRP, Macalloy bars, timber, jacking and directional drilling systems. This includes constructability, and construction sequencing, tunnelling, geological assessments, soil structure interaction, ground movement prediction, damage assessments, temporary and permanent support designs, structural design, interface assessments, instrumentation and monitoring. On Metro projects he has optimised construction at pinch points to deal with Contractor's methods and Client requirements such as alignment and spaceproofing constraints. The software he has managed includes PLAXIS2D/3D, FLAC3D, UDEC, SAP200, WALLAP, UnWedge, DIPS, LEAPFROG, PHASE2, and Seep-W.

Jim has designed all forms of temporary and permanent tunnel and ground support in both soft ground and rock – segmental TBM linings, cross passages, NATM (sprayed concrete linings), cut and cover (top down & bottom up), ground treatment (cementitious and chemical grouting, ground freezing) pipe-pile rooves, drill and blast, road headers, and timber headings. Shaft/station box designs include diaphragm walls, secant piles, bored piles, pipe piles, sheet piles, and caissons. Interface resolution includes underpinning, horizontal pipe piling, mini piles, ultra-fine cementitious grouting.

EDUCATION AND QUALIFICATIONS

B.E. (Civil), University of Canterbury, NZ	1988
Chartered Engineer - 466480, United Kingdom	1995+
Professional Engineer Hong Kong Civil (2003), Geotechnical (2016) – RP0409660	2003+
Professional Engineer Singapore - Civil – PE4266	2006+
Professional Member, Institute of Materials, Minerals and Mining	2008+
Chartered Professional Engineer, New Zealand - 1154881	2017+
International Professional Engineer – IntPE (NZ) - 1154881	2017+
Producer Statement Author – Auckland Council (High Risk) – PSA3674	2017+
Confined Spaces, Site Safe, Construct Safe – New Zealand	To 2023

PROFESSIONAL ASSOCIATIONS

Committee Member – International Tunnelling Insurance Group – Working Group Leader (High consequence & low likelihood events; Culture, Competence, & Collaboration), Digital Models.	2019 - 2023
Fellow, the Institution of Civil Engineers (2006) - Member (1994), ICE Reviewer (2005 onwards)	1994
Honorary Fellow, Chartered Institution of Water and Environmental Management (2010) - Member (1997)	1997
Member, Hong Kong Institution of Engineers (2003), Reviewer (2013 onwards)	2003
Member, the Association of Project Management	2006
Member, Institute of Materials, Minerals and Mining	2008
Member, Engineer Australia	2022
Member, Engineers New Zealand, Practice Area Assessor (2019)	2016
Tunnelling Society member - Britain, Singapore, Hong Kong, Australia; New Zealand	2019

PROFESSIONAL EXPERIENCE

Snowy 2.0 (2024 to present) – Tunnel Works Expert & Consultant's Construction Site Team Representative for the 2.2 Gigawatt project – based 14/7 FIFO on site managing a team including geologists, tunnelling engineers, grouting specialist, structural engineers and a steel lining expert within the Design JV (Tractebel, Lombardi, Coffey). The works are based at 3 main sites - Lobs Hole, Tantangara and Marica. The construction includes 4No. TBMs plus drill and blast tunnels totalling 30km, shafts up to 250m deep, caverns up to 36m in span including an underground Powerhouse Complex, as well as intakes structures and surface works. Up to 17 concurrent tunnel faces managed 24/7 by SHL/FGJV/DJV. AUD 16bn.

Melbourne Northeast Link (2021 to 2024) - Project Manager then Project Director for approx. 300 WSP/Golder staff on the AUD 26bn Melbourne Northeast Link, central package, a 3 to 5 lane dual carriageway underground motorway approx. 20km in length from the Greensborough Highway in Watsonia to Bulleen Road with twin 15.6m dia. TBM tunnels under the river Yarra for 6km. Services included procuring and supervising the geological site investigations, as well as the design of critical cut and cover packages at Watsonia, Bulleen, Manningham, Vent Tunnels, SEM tunnels, and Lower Plenty Road. The geological conditions include Melbourne formation, with variable degrees of fracturing, and overlying alluvial deposits. Jim oversaw the site investigations (AUD 27m) and managed the technical design (AUD 26m), commercial/contractual responsibilities; and then Construction Phase Services (CPS).

EQC NZ – Engineering assessments of retaining walls and infrastructure damaged by cyclones Hale and Gabrielle in 2023. Prepared reports for Insurance companies conducting loss adjustments.

NZ Battery (2021) – Lake Onslow pumped hydropower – Assisted New Zealand government (MBIE) to prepare the Request for Proposal (RFP) for their feasibility study to provide a 3 to 8.5 terra watt hour supply. The objective of the scheme is to store sufficient energy to resolve New Zealand's dry year problem via a fast response reserve. The project is estimated to have a construction and commissioning duration of up to 10 years and cost up to NZD 16bn.

Auckland City Rail Link – C3 – Stations and Tunnels – (2020) Specialist Designer, Trouble shooter and risk assessor associated with – 5No. TBM Tunnel cross passages, and openings for the 3.45km TBM segmental lining. Internal structures to TBM bored tunnels, Karangahape Road, and Aotea Stations.

Sydney Westconnex M4/M5 City West Link – Victoria Road – Rozelle Interchange & Western Harbour Tunnel – (2019 to 2020) - Independent Verifier – Tunnels, Cross passages, and In-tunnel passages

Auckland Waitemata Harbour Crossing – NZTA. (2019) - Specialist advisor providing CAPEX and OPEX cost estimates for underground, at grade, and viaduct solutions for Busway, Lightrail and Conventional (Heavy) rail options. Infrastructure (stations, tunnels, bridges, viaducts) includes sub-sea and subterranean solutions. Costs include all civil, structural, architectural, electrical, mechanical, building services, ventilation, evacuation, permanent way, signalling, instrumentation control, design, contingencies & claims, client management and commissioning. Land acquisition and rolling stock was excluded.

Burrawang to Avon Tunnel – Water New South Wales (2019 to 2020). Design Director advising the multi-discipline team, optioneering analysis, business case, and strategic future proofing to form a resilient water supply for Sydney and New South Wales, Australia to 2100, delivering an additional 10GL/annum to Sydney by 2028 and 35GL/a (by 2040), consisting of 20km of 4m ID Tunnel, and 65GL increase to Avon Dam, an 8km 900mm Ø pipeline, and a pumped storage 200 MW Hydro-Electric Power Plant (HEPP) including peaking reservoir. Responsible for co-ordinating 50No. multi-discipline team to develop the preferred Concept Design and Economic Cost Benefit Analysis. The skill sets managed and co-ordinated included complex yield and hydrological modelling to the year 2100 (WATHNET software). HEPP generation (mini, generation only, pumped storage), Geotechnical, Tunnelling, Constructability, Environmental, Cost Estimating, Business Case and Operational model for the greater Sydney water supply network.

Melbourne Metro – Victoria, Australia (2019 to 2020). Cross Yarra Partnership (Lendlease Engineering, John Holland, Bouygues Construction, Capella Capital). Specialist designer optimising the cross passage temporary and permanent works design, construction sequence, probing, ground treatment and support. Specialist technical reviewer responsible for assessing the existing Melbourne Underground Rail Lin Tunnels for estimated ground movement impacts due to Melbourne Metro construction activities.

Mt Eden Stormwater Sewer Relocation – C6, NZ (2017 to 2019): March-Bessac, Producer Statement Author. Responsible for the temporary and permanent works designs, details, durability, hydraulics and Producer Statements associated with 2No. 15m deep 6mØ shafts and 800m radius 2m dia. curved pipejack 422m in East Coast Bays Formation (ECBF). Prepared the Tunnel and Shaft structural design calculations for the Reviewer and Authorities from first principles, based on a rage of geological conditions, to justify the PLAXIS analysis results.

Northern Corridor Improvements – SH1/18, NZ (2017 to 2020): Alliance - NZTA, Fulton Hogan, HEB, Opus and Jacobs, Specialist Designer. Responsible for the detailed design of the 6mØ jacked caisson shaft 7A and 1.2mØ pipejack interface. Services included site inspections to verify temporary and permanent works, structural integrity and suitability of ground conditions for the construction methods to proceed.

East Tamaki Dam Spillway Upgrade, Auckland, New Zealand (2017-2019): Auckland Council, Project Director. Project Director for the design of a spillway upgrade to an existing flood detention dam. The design involves regulatory and consent considerations with respect to the recommended 900mm freeboard. The study includes investigating and improving the intake screens, working platform, and spillway mechanism. A contractual Geotechnical Baseline Report is applied to contractually manage underground risks for the anticipated construction methodologies.

Burnham Military Camp Tunnels, NZ (2017): New Zealand Defence Force (NZDF), Project Director. Inspected the 3km tunnel network and advised on safety and structural integrity issues. The report referenced NZ Health and Safety at Work Act (2015), WorkSafe and NZTS Small diameter tunnel guidelines (2017), as well as several other NZ and international standards, and codes of practice. The recommendations included sweeping changes to the status quo of the underground tunnel infrastructure.

Devonport Naval Base Tunnels, NZ (2017): New Zealand Defence Force (NZDF), Project Director. Provided specialist tunnelling, geotechnical and structural advice regarding 1No. 330m long road tunnel, and 4No. unlined access tunnels within the East Coast Bays formation. Reported on possible backfilling solutions that complied with confined space requirements.

Ruakura 2No. 12 ML Reservoirs, Waikato, New Zealand: Client, Hamilton City Council, Project Director. Provided specialist geotechnical and structural solutions to effectively manage liquefaction and settlement risks associated with pre-loaded formation, granular sub-base and construction logistics associated with 2No. 12 mega litre reservoirs. Led the OPUS design team and technical reviews.

Hong Kong - Sung Wong Toi & To Kwa Wan Stations & Tunnels (Shatin to Central Link), Samsung – Hsin Chong Joint Venture, Temporary Works Designer – Consultancy Agreement. Hands-on re-design of 40m deep Emergency Egress shaft and To Ka Wan shaft to convert insitu reinforced concrete into fast to construct pre-cast concrete elements in compliance with various lifting and fire engineering restrictions. The 1109 project has 2No. stations at Ma Ta Wai and To Kwa Wan, and 1.6km of twin bored tunnels in mixed ground with slurry TBMs.

Liantang / Heung Yuen Wai Boundary Control Point – Site Formation and Infrastructure works – Contract 2, Hong Kong, Dragages Hong Kong Limited, Temporary Works Designer – Consultancy Agreement. Contracted as the specialist temporary works designer to Dragages. Produced designs and drawings for Temporary Ramps, Roads, Retaining Structures, TBM Segment, Cooling Plant slabs and Workshop rafts, Cable draw pits, Batching Plant and Silo slabs. Conveyor and Tower crane foundations, and tunnel infrastructure.

Lai Chi Kok Viaducts – Contract HY/2003/01 – Route 8,): ADR Partnership Limited, Claims Consultant – Negligence. Analysed pleadings, statements of claim, counter claims, witness statements, progress reports, cause and effect, variations, instructions, RFI's, flow of information/drawings/deliverables, claimed versus assessed amounts. Prepared detailed build up and Quantum analysis reports for King Wood & Malleson. The case was settled based on Jim's tabulated Pros and Cons.

Lotte Engineering and Construction (Lotte) vs Mongolyn ALT Corporation (MAK): Bae Kim and Lee LLC, Hong Kong (2012) Expert Witness – Foundations, Waterproofing and Dewatering – MAK Hyatt Regency Hotel aka MAK Tower. Analysed statements of claim, statements of reply and counter claims, drawings, correspondence, flow of information and deliverables, and prepared detailed Expert Witness Report for Bae Kim and Lee. SIAC (Singapore International Arbitration Centre - 2013).

Puyo Hydro Electric Power project - 30MW, Philippines (2012-2014): FirstGen / Jacobs, Owner's Engineer. Providing specialist tunnelling and geotechnical design for the 6.5km tunnel including inputs to the Geotechnical Investigations, GBR (Geotechnical Baseline Report) strategy for the successful tender design. Jacobs (SKM's) works included 35No.man years of services.

Shatin to Central Link, Contract 1103, Hong Kong (2011-2012): GB Foundations and Construction, Specialist Designer. PLAXIS-2D analysis and design of 6mm steel lining to Water Supply Services (WSD) tunnel with 6m clearance to MTR-SCL tunnels constructed using drill and blast techniques.

Li Yu Tang Gas Main Tunnel, Chengdu, Sichuan, China (2012): Chevron, Specialist Tunnelling Advisor. Assessed existing conditions, risks and construction to flooded gas main tunnel under 10 bar hydrostatic pressure. Recommended ingenious construction alternative involving tremie concrete, pumped foam concrete and sequential grouting regime.

Northern Line Extension – Nine Elms Station – UK – Banham Group vs Transport for London & Halcrow, United Kingdom (2014): Richard Max & Co. representing Banham Group, Expert Witness – UK Civil Procedure Rules 1998. Prepared a series of proofs for the planning, design and construction of Nine Elms Station. Critiqued the alignment limits of deviation, Consultants design documents and audit trail. Reference was made to London Underground Limited Design Standards, Codes of Practice, and Guidance documents. Various constraints and construction methods were investigated including top down, bottom up for the

station; as well as Earth Pressure Balance TBMs and mining in London Clay for the platform tunnels. The advice highlighted feasible construction alternatives which enabled the client to 'win' and settle out of court, in order to achieve their financial and operational objectives. The opposition lawyers (Pinsent Masons) insisted Jim's evidence "must not see the light of day".

Tun Razak Stock Exchange, Kuala Lumpur - Malaysia (2013): 1MDB, Tunnelling Advisor. Engineering review and advice associated with transport circulation and utility tunnels. Developed 3D scheme design alternatives that included Mined Tunnels, TBMs, Horizontal Pipe piles, and elevated viaduct construction options. Ground conditions consisted of KL Limestone adjacent to Kenny Hill formation. Existing constraints included Cochrane KVMRT station, Variable Density TBMs (blow out prevented by thixotropic gels), SMART tunnels, and the 12No. lanes of Jalun Tun Razaq/MEX-KG/SMART.

T213 – Thomson Line – Caldecott Station & Cripple Siding Tunnels, Singapore (2013): Leighton Asia Ltd, Tunnel Design Manager. Responsible for the detailed tender design including NATM sequential excavation that involved, 2 stage colloidal silicate grouting, canopy tubes, triple concurrent headings, sequential excavation, lattice girders and fibre reinforced shotcrete – all modelled using PLAXIS. The Station Box utilised Secant Bored Piles and the seepage analysis was verified using SEEP-W. The ground conditions consisted of highly fractured Bukit Timah granite with a variable G3 rockhead.

T208 & T216 - Thomson Line – Springleaf & Stevens Stations & Tunnels, Singapore (2012): Leighton Asia Ltd, Tunnel Design Manager. Responsible for tunnelling advice that assisted Leighton Asia Ltd to win T208 – Springleaf Station and tunnels. Led the PLAXIS soil structure analysis the design of tunnel linings, secant bored piles, underpasses, TBM retrieval shafts, specialist grouting techniques. Bukit Timah granite with overlying completely decomposed granite and Kallang formation. Construction included TBM, cut and cover, and Horizontal Pipe piling.

F3 to M2 - Pennant Hills to Thornleigh Road Tunnel, Sydney, Australia (2013): Global-Link-JV (Ghella-Acciona), Peer Reviewer. Peer Review of construction, tunnelling and cavern options. Optioneering advice related to alignments, TBMs, Road Header, canopy tubes, bolting patterns with bolts up to 12m in length, ground treatment, groundwater drawdown, settlement, spaceproofing and lining designs in Hawkesbury sandstone, Ashfield shales, residual soils and fill.

F3 to M2 - Pennant Hills to Thornleigh Road, Sydney, Australia (2012): Transurban, Tunnel Designer – Scheme Design. Specialist tunnelling advice to Transurban with respect to constructability, crown profile and lining designs based on Road header and Canopy tube construction in Hawkesbury sandstone and Ashfield shales.

City Rail Link, Auckland, New Zealand (2012): Auckland Transport and New Zealand Transport Agency, Specialist Advisor. Prepared the NZD 2.86bn (2012) cost estimate and specialist technical advice (highlighting risks) for presentation to Auckland Mayor (Len Brown), Councillors, NZTA, Auckland Transport and other stakeholders for 1 No. Cut and cover station at Aotea Square, 2 No. station cavern platform stations at Karangahape Road and Newton Road, connected via twin bore 6.5m I.D. Earth Pressure Balance TBM tunnels. Geology included East Coast Bays formation, Parnell Grit, alluvium and volcanics. The Reference Class Forecasting (RCF) techniques compared project costs in Hong Kong, Singapore, UK and Shanghai to reduce budgeting bias, quantify unknowns and reduce cost estimating uncertainties. Advised potential high-level risks with respect to strategy, planning, design, procurement and construction. Advised possible mitigation measures. The NZD 2.86bn budget was published in the Herald newspaper.

Waitemata Harbour Tunnel, Auckland, New Zealand (2012): Auckland Transport and New Zealand Transport Agency, Specialist Advisor. Prepared the tunnelling cost estimate and technical advice for the twin bore, 15.5m excavated diameter TBM tunnels. 2.7km twin bored tunnels plus 0.8km of cut and cover road and rail tunnels. The costs estimate was added to adjacent infrastructure budgets. The geology included alluvium, volcanics and East Coast Bays formation.

Mount Victoria Tunnel Duplication, Wellington, New Zealand (2012): New Zealand Transport Agency, Tunnelling Advisor. Specialist advice to NZ Transport Agency regarding the proposed dual tunnels. Technical interrogation and optioneering (value engineering) to lower risks, reduce costs and shorten the construction programme. The proposed tunnel includes two lanes of traffic and a dedicated cycle/pedestrian walkway. Recommendations included optimising the cable routing and excavated cross-sections. Geology consists of Greywacke, siltstone and sandstone

Hong Kong - DSD Stonecutter's Island Effluent Tunnels and Disinfection Facilities DC/2009/18, (2011-2012): Chun Wo – CEC - JV, Independent Checking Engineer (Design and Build). Responsible for checking the temporary and permanent works designs. The works are part of the expansion of the treatment capacity of the existing Stonecutters Island Sewage Treatment Works from 1.7 to 2.44 million cubic metres per day. Construction includes a drill and blast tunnel, primary and secondary support, chambers, E&M, Building Services and dechlorination plant. The main shaft was constructed from diaphragm walls. The works are associated with the Harbour Area Treatment Scheme Stage 2A upgrading works.

MTR C1002 Kwun Tong Line Extension, Yau Ma Tei to Whampoa Tunnels, Hong Kong (2011-2012): Chun Wo – Hip Hing - JV, Independent Checking Engineer (Design and Build). Responsible to Chun Wo – Hip Hing JV for checking the temporary works associated with Whampoa Station and overrun tunnel.

MTR C823A Express Rail Link – Tai Kong Po to Tse Uk Tsuen Tunnels, Hong Kong (2011-2012): Maeda – China State – JV, Independent Checking Engineer (Design and Build). Responsible for checking the shafts and tunnels at Kam Tin. A Hitachi 9.22m Earth Pressure Balance TBM constructed the 2 No. 1.2km tunnels at one end of the project and 2 No. 800m long tunnels at the other end which interface with the 823B contract.

MTR C823B Express Rail Link – Shek Kong Stabling Sidings & Emergency Rescue Sidings, Hong Kong (2011-2012): Maeda – China State - JV, Independent Checking Engineer (Design and Build). Responsible for checking the Shek Kong Stabling Sidings & Emergency Rescue Sidings Tunnels. Construction involved diaphragm walls, excavation and lateral support, large culverts and drainage diversions.

Zamyn Uud Regional Logistics Centre, Mongolia, China (2012): ADB Bank / Government of Mongolia, Project Manager and Engineer's Design. Successful Bid Manager/Project Director for USD 50m Rail/Road Logistics Centre at the Mongolia/China borders. The scheme involved the assessment of issues associated with the transfer of goods and passengers, and construction involved roads, bridges, railways and cargo handling facilities. The ADB assisted the MRA (Mongolian Railway Authority) with funding.

1500km Railway – Mongolia – Technical Advisor (USD 6BN), Mongolia (2011-2012): MTZ (Government of Mongolia), Engineer's Design. Successful Bid Manager and Project Director responsible for bidding and winning the 1500km FEED (Front End Engineering Design – Technical Advisor) to the Mongolian Government – MTZ. The railway passes through the extreme climate of the south Gobi Desert between Dalanzadgad and Choibalsan including a major interface at Sainshand with the Trans-Siberian railway. Developed strategy for developing a further 3000km of railways.

Ukhaa Khudag – Gashuun Sukhait Rail Project, Mongolia (2009-2012): Leighton Mongolia LLC, Bid Manager/Project Director/Project Manager (Design and Build). Responsible for the design management and delivery of 225km of continuously welded rail with temperature range of -40°C to 45°C. Responsible for all project management, specifications (procure and construct), and 600No. drawings translated into Mongolian. 28.2mtpa coal Operational requirements and Train simulations generated the final design.

MTR C810A and B Express Rail Link – West Kowloon Terminus Station, South, Hong Kong (2011-2012): Laing-O'Rourke-Hsin Chong Paul Y - JV, Independent Checking Engineer (Design and Build). Responsible for checking C810A (USD1.1B) (2011 to 2012) the Leighton-Gammon - JV on 810A for slope construction. Using a semi-bottom-up top-down approach, over 1.7 million cubic metres of earth were excavated, and 600,000 cubic metres of concrete poured, and 150,000 tonnes of steel reinforcement fixed in the construction of the 28 metre-deep below-ground rail terminus building. The 11-hectare station has 15 No. platforms and is expected to handle the transit of 99k/pax/day.

MTR – C902 – South Island Line – Nam Fung to Admiralty Tunnels, Hong Kong (2010): Nishimatsu, Independent Checking Engineer (Design and Build). Responsible for checking all temporary works designs. Geotechnical Baseline Report was used to manage contractual ground risks. Soft ground portal used canopy tubes and steel sets, and the main tunnel was drill and blast.

MTR – C902 – South Island Line – Nam Fung to Admiralty Tunnels & Ventilation Building, Hong Kong (2010): Sembawang – Hsin Chong/Kumagai Gumi - JV, Tender Design (Design and Build). Responsible for all permanent and temporary works including design optimisation, alternatives, tunnel lining designs. The ground conditions consist of tuff and granite, along with geological features including the Wanchai Gap and Magazine Gap faults.

MTR – C824 - Express Rail Link – Guangzhou to Hong Kong, Hong Kong (2010-2012): Kier-Kaden-OSSA - JV, Independent Checking Engineer (Design and Build). Responsible for the design checking of the Ngau Tam Mei to Tai Kong Po Tunnels. The Construction consists of a 2.6km long single bore, double track tunnel, and a 400m long bifurcation cavern, stub tunnels, a 90m deep ventilation shaft, and a 40m deep emergency access shaft. The drill and blast construction encountered geology comprising tuff with fault zones and water ingress. The tunnels cross below, and within 22m of an existing WSD 3.4m diameter water tunnel.

MTR – C826 - Express Rail Link – Guangzhou to Hong Kong, Hong Kong (2010-2012): CRCC – Hsin Chong Ltd, Independent Checking Engineer (Design and Build). Responsible for checking all temporary works. The ground conditions consist of completely decomposed granite with overlying alluvial soils and marine clay. The northernmost section on the route runs between Mai Po shaft in the New Territories and Huanggang in mainland China. The project is 3.3km long with slightly more than 40% of the 8.7m I.D. twin tubes in the New Territories. A Herrenknecht Mixshield (slurry) TBM was used for the main tunnel drives with ground freezing for the cross passages.

MTR - C821 – Express Rail Link – Shek Yam to Mei Lai Road Tunnels, Hong Kong (2010): Vinci – Chun Wo – CRGL - JV, Tender Design (Design and Build). Responsible for the tender design of all permanent and temporary works including design optimization and alternatives. The ground conditions consist of granite with geological features including the Lead Mine Pass and Tolo Channel faults.

MTR - C803A and 803D - Express Rail Link – Terminus Station, Hong Kong (2010-2012): Bachy Soletanche Ltd, Independent Checking Engineer (Design and Build). Responsible for checking all temporary works including diaphragm walls. The ground conditions consist of completely decomposed granite with overlying alluvial soils and marine clay. There was also poorly compacted reclamation with sand (1994-1996). The station has 15 platforms.

MTR - C705 West Island Line – Kennedy Town Station and Tunnels, Hong Kong (2009 to 2012): Gammon Construction Ltd, Independent Checking Engineer (Design and Build). Responsible for checking all temporary works. The ground conditions include Tuff, Grade III granite, and completely decomposed granite. The cut and cover Station box is unique in so far as it is located in a valley feature that required a 3-D seepage analysis to justify the temporary and permanent works design. Soft ground tunnelling techniques and 2 bar grouting under a tree wall. The Blasting Assessment Report (BAR) required approval from a specialist All Reservoir Panel Engineer (ARPE).

MTR - C705 West Island Line – Kennedy Town Station and Tunnels – Hong Kong (2009 to 2012): Penta Ocean – Hsin Chong JV, Tender Design (Design and Build). Design Director responsible for the tender design of all temporary works, optimization design of permanent works, Blasting Assessment Report (BAR) and the tender submission. Soft ground tunnel and ground treatment under a protected tree wall. Slopes and reservoir were assessed and protected. The top down and bottom up cut, and cover options were optimised relative to an existing in-situ bored pile wall supporting a major housing development.

MTR - C703 West Island Line – Sheung Wan Tunnels, Hong Kong (2009 to 2012): Dragages-Bachy-Maeda JV, Independent Checking Engineer (Design and Build). Responsible for checking all temporary and permanent works. The ground conditions included Grade III granite, and completely decomposed granite, and passed through a number of existing physical obstructions including SGI and R.C segmental linings, piles, steel sets before breaking through an existing diaphragm wall into Sheung Wan Station crossover box. Construction involved ground freezing using brine, extensive grouting, drill and blast with numerous nearby sensitive receivers and a specialist Bessac TBM that excavated and removed existing tunnel linings.

MTR - C703 West Island Line – Sheung Wan Tunnels, Hong Kong (2009 to 2012): Leighton-CRCC JV, Tender Design –Target Cost. Design Director responsible for brainstorming options and tender design of all temporary works, the design optimization of the permanent works, and tender submission. Options included a TBM that dismantled the existing linings and a TBM that excavated the existing linings. Ground treatment in the form of grouting and ground freezing. The shafts were constructed from diaphragm walls, secant piles, bored piles, pipe piles and sheet piles.

MTR - C901 South Island Line (East) - Admiralty Station and Shatin Central Line Enabling Works, Hong Kong (2009 to 2012): MTRCL/Arup, Engineer's Scheme Design. Design Director for arguably Hong Kong's most complex Cavern station for the South Island Line and Shatin to Central Lines. The main cavern is formed with minimal cover due to low rock head and the close proximity of the existing Admiralty Station, and operating railways for the Tsuen Wan and Island Line. Responsible as a specialist sub-consultant for the Geotechnical

interpretation, draft Blasting Assessment Report (BAR) assessment of potential damage to existing infrastructure, as well as the specialist Cavern design, tunnel design analysis using UDEC and interfaces with TBMs, and underpinning the Island Line tunnels. Involved in value engineering and interrogating options. The main cavern span design options ranged from 12 to 24m.

International Finance Centre – Office Tower - 25 Floors - 3,000 sqm/floor (Chuangs Towers), Ulaanbaatar (2011 to 2012): Chuangs, Engineer's Detailed Design/Project Director. Project Director for the electrical and mechanical design and preliminary steel frame and foundation design that recommended piles due to seismic conditions. The design catered for the Ulaanbaatar district steam heating and hot water supplies.

Edelweiss Hotel, Ulaanbaatar (2011 to 2012): Chuangs, Engineer's Detailed Design/Project Director. Project Director for detailed design of the steel structure and E&M including district steam heating and hot water supplies. Recommended piled foundations due to slender shape and seismic conditions. 27 floors, 3000sqm/floor.

MTRC C1106 Shatin to Central Link Detailed Design for Hung Hom Station and Associated Tunnels, Hong Kong (2010 to 2011): MTRCL/Atkins, Detailed Condition Surveying/Project Director. Project Director for the condition survey to Hung Hom Railway Terminus Station. Particular attention focused on concrete elements that may be affected by future ground movement from the construction works and steelwork elements prior to A&A works being undertaken.

Hong Kong - Harbour Area Treatment Scheme Stage 2A Construction of Sewage Conveyance System (2008-2009): Paul Y McConnell Dowell, Tender Design (Design and Build). Design Director responsible for the permanent and temporary works design. The HATS Stage 2A Sewage Conveyance System (SCS) collects and conveys pre-treated sewage from eight existing Preliminary Treatment Works (PTW) located along the northern and south-western shoreline of Hong Kong Island, to the Stonecutters Island Sewage Treatment Works (SCISTW) for treatment before final disposal into the western harbour via an existing submarine outfall. Design included 20km of tunnels (3 to 5m in diameter) designed with an extensive grouting regime (OPC and microfine) and drill and blast. Scheme includes 15No. Shafts and adits for production and/or drainage purposes. The shaft depths and diameters ranged from 120m to 160m, and 10 to 14m respectively.

DSD Lai Chi Kok Drainage Tunnel, Hong Kong (2008 to 2012): Leighton Asia Ltd, Independent Checking Engineer (ICE). Design and Construct contract. Responsible to Leighton Asia Ltd for the checking of all temporary and permanent works for tunnels and drop shafts, including site inspections. The 4.9m I.D. tunnel passes through granite and soft ground, in close proximity to highway over bridges and other major infrastructure. Herrenknecht Slurry TBM with cutter changes up to 3.45 bar.

LTA-MRT-C916 - Downtown Line–Stage 2 - Beauty World Station and Tunnels, Singapore (Tender Design - 2008): McConnell Dowell (Singapore) Ltd, Design and Construct – Successful Tender Design. Project Director, responsible for the successful tender design of Beauty World (Civil Defence) Station and 1.1km of tunnels, including all temporary and permanent works. Value engineering generated unique temporary works (Station box - secant piles/pipe piles) solution to win the tender. The ground conditions comprise competent and decomposed Bukit Timah granite, and overlying soft Kallang Marine Clay. The Station and entrances were optimized spatially to allow for E&M, Ventilation, Civil and Structural requirements; as well as interfaces with a proposed overhead URA building and large existing surface water drainage channel. The tunnels were excavated with a 6.35m OD Herrenknecht slurry (mixshield) TBM.

LTA-MRT-C915-Downtown Line Stage 2 – Tunnels from Beauty World to Hillview, Singapore (2008): McConnell Dowell (Singapore) Ltd, Design and Construct - Tender Design. Project Director responsible to McConnell-Dowell for tender design of 2.3km tunnels, cross passages, and the Hillview/station box option. The ground comprised competent and decomposed Bukit Timah granite. Slurry TBM recommended.

Contract No. DC/2007/18 Yung Shue Wan and Sok Kwu Wan Village Sewerage, Stage 1 Works. ELS for Laying the Proposed Sewers through the Main Street (2008 - 2010): Kaden Construction Ltd, Contractor's Temporary Works Designer. Design Director responsible for the ELS design to construct sewers along the main street of Yung She Wan. Challenges included limited construction access and the close proximity of the existing village houses found on shallow foundations. The head room limitation was less than 3m and the vibration limit was 5mm/s due to nearby sensitive village houses. For these reasons, we devised a two-staged sheetpiling method to successfully resolve issues.

Detailed Design and Advisory Consultancy Services for Construction of Highway Tunnel across Rohtang Pass near Manali, India (2008): Government of India / Border Roads Organization, Proof Checking Engineer. Responsible for the detailed tunnel design checks including temporary and permanent support to the tunnels and portals. The Rohtang Pass located in the Himachal Pradesh in India. This is an 8.8km single tube bi-directional road tunnel that passes through the high Himalayan ranges 51 km from the nearest city Manali and at an altitude of 3978m with 3000m cover. Construction involved extensive grouting. The 3km depth generates rock burst issues. At the time of construction, this was the highest altitude road tunnel in the world.

KCRC Kowloon Southern Link, KDB200 - Austin Station and Tunnels, Hong Kong (2004 to 2008): Link200-JV (Leighton, Balfour Beatty (Gammon), Kumagai Gumi, John Holland, Designated 'Designer' for Detailed Design – Design and Build (Lump Sum). Designer' for the successful KDB200 Tender design, detailed design, and construction supervision for the Link200 joint venture on the KCRC Kowloon Southern Link. A 3.8km underground, double tracked electrified domestic passenger railway connecting east Tsim Sha Tsui and Nam Cheong Stations. The tunnels run level at the new Austin Station and existing ETST island platform Stations and are stacked along Canton Road. Responsible for the tunnel design and co-ordination of the alignment (min. radius 225m), permanent way, settlement analysis and impact assessment (Boscardin & Cording), segmental tunnel lining design, space proofing options, cross passages, sumps and trackside safety issues as the tunnels pass through marine fill, completely decomposed granite and grade G3 granite, with as little as 3m clearance between tunnels, buildings, foundations and the existing MTRCL Tsuen Wan Line tunnels below Salisbury Road. During Construction reassessed the effects to buildings and utilities due to increased volume loss. 8m OD Herrenknecht slurry TBM. Prepared the significant design prolongation claim. Also prepared station/ tunnel/shaft construction claims and justifications for additional time and money for the Contractor. Supported the specialist claims advisors, by classifying and defining the 'cause and effect' arguments to achieve a successful settlement. The MTRCL then took over KCRC towards the end of the project.

Gambas to Novena/May School Cable Tunnel, Singapore (2007): Singapore Power, Feasibility Study and Scheme Design. Project Manager for the study of an 18km cable tunnel supplying 10No. 400kV circuits. This required a ~6.2m ID tunnel. The ground conditions included Bukit Timah granite, Jurong Formation and Old Alluvium. Managed the option study, optimisation and preliminary design of E&M, Ventilation, Civil and Structural elements. Developed TBM and construction logistics, contract strategies, programmes and costs estimate. Presented procurement options to Singapore Power Board recommending Engineer's Design for greater control of the management, operations, maintenance and design requirements.

Beacon Hill Tunnel, Hong Kong (2007): TownGas, Feasibility Study and Scheme Design. Inspected the Beacon Hill Tunnel and recommended lining design as the Specialist Tunnelling Advisor including modifications to the Japanese Arches and Portal Structures. Advised on maintenance requirements including relining, drainage and structural integrity.

HKU Centennial Campus, Hong Kong (2006): Gammon Construction, Tender Design (Design and Build). Carried out an independent review of the tender submission in order to ensure it attained a maximum tender assessment score. Tender was successful. The scheme consists of twin drill and blast tunnels for reservoir storage (salt and freshwater). Approximately 500m in length and 10m in diameter.

DSD Hong Kong West Drainage Tunnel (2006): Impregilo/China State, Tender Design (Design and Build). Design Manager to Impregilo/China State for Pre-qualification. A 10.5km long 6.25-7.25m ID tunnel with 35 intake structures and a sea outfall. The scope required a reference design including hydraulics, civil engineering, architecture, landscaping, contract documentation and site supervision. The ground conditions were predominantly grade G3 Granodiorite and Tuff with overlying decomposed strata. The alignment passed in close proximity to existing infrastructure.

Ocean Park – Funicular Tunnel and Site Formation, Hong Kong (2006): Gammon Construction, Tender Design (Design and Build). Design Manager for the Gammon tender submission. A 1.2km long ~10-15m I.D. Funicular tunnel with a 10% gradient. The ground conditions are predominantly Tuff. Construction is from 2007 -2010.

CLP Castle Peak Cable Tunnel, Hong Kong (Design & Build) (2005 - 2006): Dragages (Hong Kong) Ltd, Design and Build – Detailed Design. Project Manager / Tunnelling Design Manager / Bid Manager for the successful Dragages tender design (based on an alternative). A 4.5m ID tunnel, 4.5km in length, connecting the existing Castle Peak Power Station with Tuen Mun, housing 8No. 132KV circuits. Responsible for the detailed design

and co-ordination with Dragages included managing the tunnelling, geotechnical, mechanical and electrical design during construction. Specific input to alignment design, 'drained' and 'undrained' segmental tunnel lining details, durability report and co-ordination of the spaceproofing requirements. Maximum overburden of 260m (cover). The ground conditions are predominantly grade G3 Granite and Tuff along with overlying decomposed strata. 5.25m OD Double shield hard rock Herrenknecht TBM.

DSD Tsuen Wan Drainage Tunnel, Hong Kong (Design & Build) (2005): Drainage Services Department Ltd, Construction estimate HKD 2bn. Bid Manager for the successful scheme design Tender. Prepared the detailed design documents including drawings, specifications and contract documents of the 5km long 6m ID tunnel, with three vortex intakes and a sea outfall. The scope required a reference design including hydraulics, civil engineering, architecture, landscaping, contract documentation and site supervision. The ground conditions were predominantly grade G3 Granodiorite and Tuff with overlying decomposed strata. The alignment passes in close proximity to existing KCRC Westrail and WSD water tunnels.

Mitcham to Frankston Freeway (EastLink), Melbourne, Australia (2004): Theiss – John Holland JV, Construction value USD ~2bn. Assistant Project Manager and Tunnel Design Manager for the initial detailed design, strategic planning, budgeting, programming, allocation of resources and fees for tunnelling, roads, bridges and utility diversions. A 3km tunnel in sandstone/siltstone. The tunnel was excavated through sedimentary Silurian Melbourne formation with intrusive dykes, using Roader Header and canopy tubes under the Mullum Mullum creek. Responsible for the co-ordination of tunnelling design requirements with the construction and design tasks.

Hobson's Bay Main Sewer Relocation, Melbourne, Australia (2004): Melbourne Water, Project Manager and Scheme Design (Alliance). Seconded to Melbourne Water as Project Manager to work with John Holland (Contractor) and GHD (Designer). A 3m diameter siphon with ground conditions of soft sandstone, gravels, sands, silts and clay ~35m below the river Yarra. Prepared the Cost reimbursable tender documents based on AS2124, chaired Risk Management workshops, managed the fast track D&C program. TBM tunnel and Diaphragm walls for shafts. Project shelved by Port of Melbourne Corporation.

CLP Chi Ma Wan Cable Tunnel, Hong Kong (2004): Dragages (Hong Kong) Ltd, Detailed Design (Design and Build). Tunnelling Design Manager responsible for the segmental lining design and horizontal directional drill (HDD) for 3No. 132KV circuits. within the 3.2km long, 4m internal diameter tunnel using a Robbins hard rock TBM. Tunnel alignment passes approximately 300m under a reservoir and the 0.8m HDD passes beneath a marine estuary at Pui O. Ground conditions consisted of Grade 3 granite. Construction value USD 100m (including Kwai Ching, Tsz Wan Shan and Tuen Mun cable tunnels).

KCRC Shatin to Central Link, SDC100, Hong Kong (2003 - 2004): Kowloon Canton Railway Corporation (KCRC), Scheme Design. Tunnel Design Manager for the SDC100 section of the Shatin to Central Link. The SDC100 section comprised 3.5km of rock and soft ground tunnels, shafts, a deep mined station and an Automatic People Mover. Extensive optioneering was carried out before developing the scheme that involved the use of TBM, drill and blast, NATM, Pipe pile and Cut and Cover construction methods as well as ground treatment. Responsible for management of all tunnel and geotechnical aspects for below ground design deliverables including the blasting assessment and analysis of a close proximity WSD water tunnel (~8m) in rock using Phase2, DIPS, UNWEDGE, and SEEP-W, close proximity MTRCL Kwun Tong Line tunnels (~4.5m) using FLAC-3D, and TBM launch shafts and Station box using FREW. This included input to the Geotechnical Basis of Design, Ground movement prediction, Instrumentation and Structural Options reports. Prepared Working Papers on TBM Methods, Tsz Wan Shan Station NATM construction in CDG (including risk assessment), WSD tunnel survey and construction interface, MTRCL Railway Protection Interface, and Explosive Magazine Site proposals. Supervised deliverables for tunnels and Automatic People Mover including reports, specifications and drawings for Construction, Tunnelling, Cut and Cover, Durability, Environmental Description, Fill Management, Existing Buildings and Structural Assessment and Trackside Safety.

Link Sewers to the Deep Tunnel Sewerage Scheme, Singapore (2000 – 2003): Singaporean Consultants - KTP, CKM, CHP, PWD, CDM, Fong Consult, Specialist Tunnelling Advisor. Specialist sub-consultant advice included site investigation, pipejacking, vortex drop shaft and hydraulic design, specifications, settlement, instrumentation and monitoring, construction methods, machine selection, risk assessments, tender evaluation to a number of local Consultants engaged by the Public Utilities Board. Specifically, Tuas-5, Link-U-Upper Thomson, Link-H-Lentor, Link-S&T-Novena, Link-R, Link-D2. The maximum length of pipejack was ~1km. The combined length of sewers is 50 km with internal diameters ranging from 0.25m to 3 m, shafts up to 35m deep, and ground conditions including Gombak Norite, Bukit Timah Granite, Jurong Formation

(Mudstone and Sandstone), Old Alluvium (Lightly cemented Sandstone), and Kallang Formation (very soft Marine Clay). The Upper Thomson – Link 'U' Sewer used a Herrenknecht Dual-Mode (alternating Slurry & EPM) TBM for the 3km at I.D.2.4m and 4 bar pressure (max.). Prepared alternative designs and extensive optioneering.

Tanah Merah Link Sewer, Singapore (2001-2002): Ed Zublin, Tender Design (Design and Build). Design of 44No. temporary shafts using caissons, cast in-situ, segments, secant piles and NATM on the Tanah Merah Link Sewer project.

Kranji Flow Equalisation Basin, Singapore (2001-2003): Ed Zublin, Tender Design (Design and Build). Tender design of temporary and permanent works to a Flow Equalisation Basin, including compliance with water retaining codes.

NEWater Project, Singapore (2000-2003): PUB/KTP Consultants, Specialist advice. Prepared the NEWater pipeline Specification in line with Singaporean regulations and international codes of practice.

Kallang Expressway Contract 421, Singapore (2000): Woh Hup, Tender Design (Design and Build). Design of the underground tunnels on the Kallang Expressway Contract 421. A 3-lane dual carriageway cut and cover tunnel in Marine Clay and Old Alluvium. The permanent and temporary works design included reinforced concrete piles, diaphragm walls (40m deep), sheet piles, and water retaining reinforced concrete box.

Route 9 Nam Wan Tunnel, Hong Kong: Gammon Construction/Arup, Detailed design (Design and Build). Prepared the successful Tender stage detailed design as sub-consultant to Arup. Designed the reinforced concrete tunnel lining for main tunnel and cross passages in rock for the Route 8 (Previously Route 9) Nam Wan Tunnels from Tsing Yi to Cheung Sha Wan in Hong Kong

Channel Tunnel Rail Link Contract 361, London, UK (Design & Build) (1999): Murphy Group, Detailed designer (Design and Build). Detailed designer for the cofferdams and temporary works to the specialist crossings RLX 105 and 103 on the Channel Tunnel Rail Link Contract 361. 10m deep excavation with sheet piles, steel walings, and concrete base slab

Padeswood Cement Works, Wales, UK (1998-1999): Castle Cement, Detailed Designer (Engineer's Design). Responsible for the Project Management of all Civil Engineering aspects including Client liaison, Planning, Civil design and Cost Control of the £620k fees. Reassessed Civil design brief and expanded scope of services to £1.2m fees. Process Plant design and supply by F.L. Smith.

Buxton Lime Industries Cement Works, Derbyshire, UK (Design & Build) (1998-1999): Thyssen-Krupp Polysius, Tender assistance and design. Project Manager responsible for Client liaison, Civil Contractor Selection, preliminary civil designs and quantities. Designed post tensioned silos from first principles and checked to DIN standards

Clinker Cooler Works, Dunbar, Scotland, UK (1999): Blue Circle Cement, Engineer's Representative – Civil works (Design and Build) – GBP 35m. Planned and co-ordinated all subcontractors works during the shutdown period using Powerproject software to ensure all works were undertaken safely and expediently. Supervised the civil subcontractor Tilbury Douglas Construction. Resolved unforeseen physical difficulties, design proposals and construction methodology in order to progress the works as quickly as possible. Assessed and evaluated all Civil/Structural/Geotechnical variations, claims and extensions of time to achieve a successful settlement. Model Form 'A' Conditions of Contract.

South Water Supply Project, Trinidad, West Indies (Design & Build) (1997-1998): Trinidad and Tobago Water Services (TTWS), Design Co-ordinator. Co-ordinated the South Water Supply Project team operating within Trinidad and Tobago Water Services Ltd (TTWS) and the Water and Sewerage Authority (WASA). Value $TT 643m (approx. £63m). The project required upgrading an existing 270 ML/d Water Treatment Plant to provide a new 70 ML/d stream. Other works involved providing an additional 11 ML/d to be treated by modifying eight existing Water Treatment Plants served by borehole water wells. The plants required refurbishment, upgrading and/or replacement. Sixteen new borehole water wells were drilled or refurbished. An existing 20km transmission main was provides with a new 900mm diameter dual steel pipeline. Further works included 70 km of new transmission and distribution pipelines with diameters varying (100 - 300mm). Design Co-ordination involved extensive information gathering and liaison with the Client (WASA) and other bodies to finalise the design requirements. Field investigations were undertaken to finalise the scope of works. Local Consultants were engaged and managed to produce tender documents. Planning Permission required liaison with a wide range of engineering disciplines in order to ensure the objectives were co-

ordinated. Haswell and the local consultants jointly produced the D&C tender documents. The Conditions of Contract were based on modifying the IChemE Red Book and FIDIC.

Hampton Ozonation WRW, London, UK (Design & Build) (1996): Miller Construction, Bid Manager. Responsible for preparing and presenting the civil design to Thames Water Utilities for the 4No. stream 800 ML/d WTW fed by the London water ring main subject to surcharge pressures. Proposed the original engineering foundation solution for the 4No. stream that saved 20% of the foundation costs. Nominated as Design Co-ordinator. Scheme awarded to in-house Designers – Taylor Woodrow

Ladybower and Ashopton Viaducts and associated Pipebridge Refurbishment, Midlands (UK) (1995-1996): Severn Trent Water Ltd, Project Manager. Responsible for the detailed design, drawings, contract documents, sub-consultant management, and co-ordination of design team. A Severn Trent Water Millennium Project located in the Derbyshire Peak District.

Wombourne Sewage Treatment Works, Wolverhampton, UK (1995-1996): Severn Trent Water Ltd, Project Manager. Managed the site investigation, structural survey, feasibility study and design work for Severn Trent Water. The hydraulic modelling included the provision of a new humus tank as well as renewing bacteria bed media to conform with consent requirements.

Barby Service Reservoir Refurbishment, Midlands, UK (1995-1996): Severn Trent Water Ltd, Project Manager. Prepared the Feasibility Study and recommended a new 15 mega-litre reservoir due to operational and demand requirements for Severn Trent Water. Permanent chlorination and new pipework were also provided along with internal remedial works.

Ilkestone Croft Yard Reservoir Refurbishment (1995): Severn Trent Water Ltd, Project Manager. Managed the detailed design which involved reviewing internal lining alternatives and cost estimates.

Gas Main Bridge Crossing, Barry, Wales (1995): TransCo. Ltd, Project Manager. Managed the design of the bridge that spanned twin Railtrack lines and required maintenance access to the 300mm diameter pipelines.

Armitage Sewage Treatment Works, Midlands, UK (1995-1996): Severn Trent Water Ltd, Project Manager. Responsible for the design of all civil renewal works. The feasibility study revealed hydraulic and pumping constraints that were optimised during the detailed design.

CrossRail redevelopment at Liverpool Street Station, London, UK (1994-1996): Transport for London (London Underground Ltd and British Rail), Tunnel and Cavern Designer. Sub-consultant to W.A. Fairhurst. Detailed structural and geometrical NATM design of underground caverns, ventilation shafts, escalator shafts, station tunnels, running tunnels. Checked design from first principles for caverns (dome shaped circulation concourses). Resolved the cut and cover design where the tunnels interfaced with the Station box. Designed the escalator shafts in S.G.I. where NATM was not feasible in the Woolwich and Reading gravel beds. Rescheduled the overall programme using Power Project to achieve the optimum construction sequence in London Clay, Lambeth Group, Thanet Sands and Chalk.

Northern Line Tunnels, London Bridge, UK (1992-1994): City of London, Specialist Tunnelling Advisor. Advised the City of London during reconstruction of the Northern Line tunnels beneath London Bridge for the Jubilee Line Extension. Particular attention was given to the close proximity of the River Thames and London Bridge when reviewing tunnelling construction methodology on site. Arranged to issue an injunction order as the Contractor refused to comply with man lock specification requirements.

Clacton Foul Water Sewer Relief project, Essex, UK (1993-1995): AMEC, Tender Design (Design and Build). Prepared the successful tender design and drawings. This included segmental reinforced concrete shaft and tunnel linings and modifications to the existing sea outfall chamber.

Railtrack Southern, UK (1994): Railtrack, Tender Design – Consultancy Services. Prepared Tender designs for the Railtrack Southern and North East Zones inspection and maintenance management of railway under and over bridges, retaining walls, embankments, and structures. PICOW and PTS qualified.

Drainage Tunnel, Malta (1994-1995): Gruppo Dipenta Construzioni, Tender Design (Design and Build). Prepared the tender stage drainage tunnel lining design in Pwales, Malta for Gruppo Dipenta Construzioni.

The proposed lining considered earthquake loadings and in soft ground utilised steel fibre reinforced shotcrete.

Storm Relief Tunnel, Hastings, Sussex, UK (1995): Southern Water Ltd, Tunnelling Advisor. Developed cost and programme estimates based on construction options for a 6.5m ID storm relief tunnel.

Heathrow Express Tunnels, London, UK (1995): London Underground Limited, Specialist Tunnelling Advisor. Advised London Underground Limited on site with respect to the stability of their Piccadilly Line running tunnels and station during the construction of the Heathrow Express tunnels after the well documented NATM collapse. NEC form of contract.

East London Line, London, UK (1995): London Underground Ltd (LUL), Feasibility Study. Feasibility design of escape tunnels and flood gates at Rotherhithe and Wapping Stations on the East London Line for LUL.

Tipton - Granular Activated Carbon Regeneration Plant – West Midlands, UK (Design & Build) (1993-1995): Grafham Carbons Ltd (Severn Trent Water and Anglian Water – JV), Engineer's Representative (Seconded from Haswell). Engineer's Representative responsible for the civil, mechanical and electrical construction, commissioning, performance tests and final account. The scheme included a kiln, acid bath, water retaining structures, extensive pumping, pipework, gas and chemical treatment, and full operational control by SCADA. Vibro-compaction piles and pad footings provided support to the 20m high main building. Additional delegated powers include supervising and approving design checks. The programme, delays and extensions of time were analysed using the "Time Slice" approach on the Powerproject software package. Responsible for Civil, Mechanical and Electrical Inspectors as well as the Plant Manager during construction, commissioning and the performance tests. IChemE (lump sum) Contract. Tender value £8.25 million. Further advice during the maintenance period, included a lining investigation report. Attended Board meetings and advised on progress, commercial, safety and technical aspects. Critically evaluated all the Geotechnical, Civil, and Structural variations, extensions of time and claims to achieve a final project cost of £8.55m.

Northern Line Tunnels, London, UK (1992-1994): London Underground Ltd, Tunnel Designer. Design Engineer responsible for the detailed design of permanent and temporary works including tunnels, shafts, openings and track support system integral within specialist Tunnel Shield for the Northern Line tunnel lining replacement project. Two existing 150m lengths of SGI running tunnel linings were replaced with a larger stainless-steel lining (with a 400-year design life) due to naturally occurring sulphuric acid in London Clay. The running tunnels were relined during night-time possessions to maintain normal tube-train commuting during operational hours. Construction options (GRP, SGI, RFC, SS) were interrogated during the design process. Settlement was estimated based on O'Reilly and New. Responsible for preparing detailed designs, Specifications, Bills of Quantities, cost estimates and Construction programme options.

Jubilee Line, London, UK (1994): London Underground Ltd, Tunnel Designer. Responsible to London Underground Limited for structural advice requested during the Waterloo International escalator tunnel construction that interfaced with the Jubilee Line. Advice related to the resolution of over stressed temporary supports under load from compensation grouting.

Black Country Sewerage and Drainage Project, West Midlands, UK (1993-1994): Miller Construction, Detailed Designer (Design and Build). Detailed design of tunnel intersections, manhole shafts, base slabs and reinforced concrete chambers for the Black Country sewerage and drainage project.

Hinstock STW, UK (1994): Severn Trent Water Ltd, Structural Designer. Designed all structures including tanks, flow chambers and buildings for the Hinstock STW.

River Seven, Yorkshire, UK, (1992): North York Moors National Park, Structural Designer. Detailed design of a footbridge spanning 21m across the River Seven in the North Yorkshire Moors. Arched steel beams with stainless steel pins and teak decking and hand railing. Prepared the Contract Documents and supervised drawing production. Modelled the 3-pin arch snap-through failure mechanism using the LUSAS-FEA software package.

Gallion's Reach Docks, London, UK (1991): London Dockland Development Corporation, Design Engineer. Preliminary design of lock gates at Gallion's Reach on the river Thames. Detailed structural and preponderance design check of lock gates at the King George V Docks on the Thames.

Kingston upon Hull Docks, Humberside, UK (1991-1992): London Dockland Development Corporation, Design Engineer. Preliminary design of lock gates at Kingston upon Hull. Detailed structural and preponderance design check of lock gates.

Replacement Coastal Defence Scheme, Littlehampton, UK (1991-1992): Littlehampton Council, Design Engineer. Detailed design and preparation of tender documents and drawings for a replacement coastal defence scheme in Sussex. Research work involved Hydrographic surveying to obtain seabed levels and tidal currents for the Bathometric computer model. Physically modelled at Hydraulics Research in Wallingford, UK.

Timber Framed Jetty, Greenhithe, UK (1991): Port of London Authority, Maritime and Structural Designer. Structural survey, structural check and redesign of a timber framed jetty on the river Thames.

Trident Submarine Channel and Beacon Structures, Barrow-in Furness, UK (1991): Ministry of Defence, Maritime and Structural Designer. Jim designed the Barrow-in-Furness navigation channel, dredging requirements, leading lights, beacon structures, piled foundations and confidential constraints for Trident submarines.

Darenth Valley WTW, Kent, UK (1990): Binnie & Partners, Design Engineer. Jim designed all water retaining structures in accordance with BS 8007 including reinforced concrete for full displacement rafts, semi rigid rafts, and tanks. Advised on cement content, PFA, GGBS so that concrete mix was optimised for heat of hydration and thermal cracking.

Bridges, Highways, Drainage and Retaining Walls, UK (1989-1990): Leeds City Council, Road and Drainage Designer. Designed the highway alignments, retaining wall, and drainage design for 2km of dual carriageway at Pudsey, Leeds. The highway alignments, slope stability and drainage networks were all verified using the MROAD-3, SLOPE and CADS-DRAINAGE software packages.

King George V Dock Bascule Bridge and Lock Gates, London Docklands, UK (1989-1992): London Dockland Development Corporation Ltd, Resident Engineer. Supervised the final civil works, Mechanical and Electrical commissioning of the Bascule Bridge and Lock gates. Taylor Woodrow was Contractor. Construction value £2M. In addition, prepared the Specification and supervised all aspects of the final civil works during the three-month construction period. The London Docklands Development Corporation was the client, and the Geoffrey Osborne Builders were the Civil Contractor.

Lake Coleridge Power Station, Canterbury, New Zealand, Undergraduate Engineer, summer placement (1987): Ministry of Works, Construction Labourer. Internal repairs to the Lake Coleridge Hydroelectric Power Station intake tunnel. Construction labouring, shuttering and fixing reinforcement to penstock foundations and bridge abutments that supported pre-stressed concrete beams.

Bay of Plenty Harbour Board, New Zealand – Summer Placement (1986): Bay of Plenty Harbour Board, Undergraduate Engineer. Site Supervision of mooring dolphin construction and pile driving on a major wharf extension at the Port of Tauranga. Hydrographic surveying and preparation of structural designs and drawings for the Harbourmaster's building extension.

PROFESSIONAL HISTORY

Lombardi Engineering – Australia – Tunnelling Expert	2024 - present
WSP (Formally WSP Opus), Auckland, - Project Director	2016 - 2024
Benson Consultancy (HK) Ltd, Hong Kong – Managing Director	2014 - 2016
Jacobs-SKM – Global Manager Tunnelling	2012 - 2014
SMEC Asia - Managing Director, Regional Man., North Asia	2007 – 2012
Director SMEC China & Mongolia, Chair SMEC ECCL	2010 - 2012
Mott Connell, Hong Kong, Singapore – Associate	2003 - 2007
Haswell Consulting Engineers, London, Singapore	1992 - 2003
Robert West & Partners, London - Design Engineer	1989 - 1992
Ministry of Works, Lake Coleridge, Canterbury – Summer intern	1987
Bay of Plenty Harbour Board – Tauranga – Summer intern	1986

PUBLICATIONS

Benson J.F. (2003) Design Considerations for Small Diameter Tunnels in Singapore. Proceedings of Underground Singapore, Updating the Engineering Geology of Singapore 27th - 29th November 2003, NTU, Singapore

Wightman, N.R. & Benson J.F. (2014). Impact of changing geological conditions for foundation design and construction in Tung Chung New Town Area. Proceedings of HKIE 34th Geotechnical Division Annual Seminar, 30th May 2014, pp135-141

Benson, J.F., Wightman, N.R. and Mackay, A.D. (2014). Cost comparisons for metro tunnelling projects in 4No. major world cities. Proceedings of World Tunnel Congress - WTC2014 & 40th ITA-AITES General Assembly, at Iguassu Falls, Brazil, 9th - 15th May 2014

Benson, J.F. Bsaibes, N, Sit, J. (2020) – Cross passage design and construction on metro tunnelling projects in major world cities, Melbourne, 10th - 12th May 2021