

Resumé:

NIGEL GOULDING

Over the past 16 years, Mr. Goulding has been working in the fields of environmental site assessments and remediation. He has acted as Senior Project Manager and Project Engineer on the investigation, assessment, and remediation of over four hundred hydrocarbon, solvent, metal, and radionuclide contaminated sites throughout Australia, New Zealand, South East Asia, and the United States.

Mr. Goulding has been responsible for the direction of over \$50MM per year in remediation projects for petroleum, petrochemical, and explosives companies. He provided technical direction on projects, resourcing and working with client managers in developing technical approaches, and determined project schedules and budgets.

Mr. Goulding also maintains an active role in the Remedial Technologies Development Forum, ITRC and API steering groups for NAPL mobility and recovery.

Education

- BA, Geography, Auckland University, 1991
- M. Phil., Environmental Science, 1993; First Class Honors

Registrations and Certifications

- National Groundwater Association
- Australian and New Zealand Association of Environmental Professionals
- Fire Service Advanced Compressed Breathing Apparatus (CABA) Certificate
- 40 – OSHA Advanced Confined Space Entry Certificate
- Advanced Fire Fighting Training

Fields of Competence

- LNAPL and DNAPL mobility and recoverability.
- Investigation and remediation of chlorinated solvents in porous and fractured media
- Risk based remediation techniques and cost forecasting.
- Investigation and remediation in complex and low permeability environments
- Deep air sparging (50-100 m below the water table)
- In-situ and ex-situ bioremediation
- Chlorinated Solvent Remediation

Key Projects

Mr. Goulding has extensive experience in remediation design and operation and site

assessments and environmental audits. Most recently Mr. Goulding has worked on major remediation projects in Australia.

Remediation Design and Operation

LNAPL Technical Director for the Avon Refinery Remediation project in Martinez, California. The facility comprises 2200 acres of refinery in the San Francisco Bay area surrounded by sensitive aquatic environments. LNAPL remedial approaches and strategies were developed to optimize LNAPL recovery, better integrate LNAPL, groundwater and Waste Management Unit remedial activities and develop end points for closure of remedial operations in select areas of the refinery.

Technical Lead for the Mc Cooks Metals project in Cook County Illinois, Nigel was responsible for directing the LNAPL investigation, regulatory strategy development and remedial approach for LNAPL at the site. A combination of mobility and recoverability assessments combined with dissolution assessments and fate transport modeling were used to develop a “maximum extent practical” argument for leaving LNAPL in place. Through extensive negotiations and technical demonstrations to the agency the majority of the LNAPL impacted areas were closed as either “deminimus areas” or areas where the “maximum extent practical”

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end point had already been achieved. Acceptance of the technical and remedial approach prevented Alcoa from having to embark on site wide soil excavation and is estimated to have saved the client over \$US20MM.

Technical Director for remediation projects being conducted on 15 chemical distribution terminals throughout the US. Remediation systems designed, installed and operated under my oversight have included, air sparging, soil vapor extraction, pump and treat (included UV, perozone, activated carbon, slurry phase bioreactors, air stripping, ion exchange resin, metals precipitation, nano-filtration, reverse osmosis), dual phase and multi-phase extraction, in-situ and exsitu chemical oxidation and biological degradation, capping and vertical barrier systems Total expenditures on these remedial projects average approximately \$US5MM per year.

Technical Director for the Piccillo and Davis Superfund projects in Rhode Island. Projects involve investigation and remedial of 2 solvent disposal sites where a combination of BTEX, halogenated hydrocarbons, blended industrial wastes were disposed in the 1980s. Remediation activities have comprised soil excavation, ex-situ thermal desorption, dual phase extraction, and pump and treat. Sequential treatment of the groundwater at the Piccillo site comprised, filtration, chemical precipitation, air stripping, liquid phase carbon and ion exchange resin treatment steps. Of late complex fate transport modeling has been completed at the site to facilitate development of new remedial goals and end points. This has resulted in USEPA approval of shutdown of the dual phase extraction system and conversion of the remedial approach to hydraulic containment only.

Technical Director and Ashland Project Manager for the Filtrol remediation projects.

These sites were large industrial facilities where DDT and refinery catalyst were manufactured and investigation and remediation was undertaken. Contaminants treated/managed included heavy metals, petroleum hydrocarbons, chlorinated solvents, DDT and associated Isomers and radioactive Thorium and Uranium wastes. A combination of remedial technologies were utilized at the site included excavation, insitu treatment and capping with total remediation expenditures of approximately \$US8.5MM.

Technical Director and Ashland Project Manager for the European and US Composite Polymer Production site remediation projects. Sites ranged in size from 10 to 50 acres and were located in Finland, Germany, France, Spain, the UK and 6 states within the US. A combination of diverse geologic setting and operational histories (some utilized in WWII as chemical weapons manufacturing facilities) added to the complexity associated with investigation and remediation of the facilities. Investigation and remediation activities are currently ongoing at these facilities. Senior Project Engineer for NAPL strategy development on the Chevron El Paso, El Segundo and Cincinnati refinery projects. Nigel has been responsible for managing the direction of the engineering technical team in developing and review options for long-term NAPL management, NAPL system optimization and NAPL high grading strategies. In conjunction with this role Nigel has been working on the Chevron NAPL Technical Steering Committee evaluating the mobility and recoverability of NAPL, development of practical endpoints, regulatory negotiation strategies and innovative techniques of immobilizing NAPL (smearing technologies).

Senior Project Manager for the Marathon Ashland St Paul, Louisville and Canton Refinery LNAPL projects. Nigel is responsible

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for direction of the engineering and hydro geologist teams in characterizing NAPL distribution, mobility and recovery at the sites, optimization of the existing recovery systems, review of long-term NAPL management options and regulatory liaison. Remedial technologies being implemented at the site include air sparging, soil vapor extraction, pump and treat, monitored natural attenuation, vacuum enhanced fluid recovery and water flood techniques.

Senior Technical Lead for the BP Wood River and Whiting Refinery Projects. Nigels role on these projects were twofold: facilitate the development of a comprehensive and integrated approach for the investigation and characterization of LNAPL, dissolved and vapor phase impacts at the site. Utilizing this data develop a site conceptual model that can be utilized to demonstrate the relate mobility/immobility of the various NAPL pools and on this basis develop a comprehensive management/remediation plan for NAPL, dissolved phase and vapor impacts.

Senior Project Manager for the Chevron Bakersfield project. Work included development expansion of the existing SVE system and pilot testing and development of a deep air sparge system to address saturated zone NAPL and dissolved phase impacts. Testing and installation of the air sparge system was conducted approximately 150 feet below the water table to address a NAPL smear zone that extended approximately 130 feet below the water table. In conjunction with this system a gaseous phase nutrient injection system is being installed to stimulate biodegradation of saturated zone impacts Project Engineer for the design, installation and operation of a hydraulic containment and groundwater treatment system at a site within the Charnock well field in Santa Monica, California. The groundwater treatment system comprised a

combination of activated carbon and blended media to treat TPHg, BTEX, MTBE and TBA impacted groundwater. The hydraulic containment systems utilized computer controlled variable speed pumps to maintain constant flows and draw down in the pumping wells and therefore maintain 'hydraulic containment'.

Project Engineer for the Lockheed Martin perchlorate pilot test design and construction project. Nigel managed an in-house design and construction team to develop and build a prototypic custom built pilot testing system. The system comprised seven independent fixed bed ion exchange units fully automated and controlled to undergo repeated adsorption and regeneration cycles under different adsorption and regeneration regimes. Both conventional and advanced resins were evaluated using either brine or acid regeneration steps. The pilot test is currently ongoing.

Project Engineer for a feasibility study, and design of a caustic waste water treatment system at Siemens Solars Camarillo, California facility. Treatment system compared a combination of vibrating reverse osmosis, conceptual reverse osmosis and ion exchange resin. The System design saved the client around \$300,000 per year in waste disposal costs.

Senior Project Manager for the Ashland PVO project in Boonton New Jersey. The site a 25 acre industrial facility that was in operation for approximately 80 years is heavily impacted with NAPL, dichlorobenzene and heavy metals. A range of remedial options are being undertaken in conjunction with redevelopment of the site for commercial landuse. To address groundwater issues and biosparging treatment system is being installed over 10 acres of the site to address groundwater impacts. In conjunction with this design a gaseous phase nutrient injection system will be installed to

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stimulate biological degradation.

Senior Project Manager for the Ashland Santa Fe Springs hydraulic containment and source removal remediation project. A pump and treat system has been designed and installed and is currently operating at approximately 120 gpm. Groundwater is treated through a series of treatment steps including biological degradation (for removal of alcohol and ketones), air stripping (for removal of BTEX and chlorinated solvents) and a final GAC polish of the effluent, prior to discharge. In conjunction with pump and treat activities a vapor extraction system has been installed to remove sources from the unsaturated zone.

Senior Project Manager for the Coltech Burbank hydraulic containment and source removal remediation project. A pump and treat system has been designed and installed at the site. Groundwater is treated via GAC (for chlorinated solvents), reverse osmosis and chemical precipitation (for hexavalent chromium). Vapor extraction is currently being undertaken to remove source areas of chlorinated solvent impacts.

Senior Project Engineer for the St Paul Refinery and Park Penta Remediation projects. Activities included development of alternative remedial strategies for NAPL recoverability, wastewater treatment and PCP removal from the subsurface. As part of these activities, Nigel was responsible for development of a successful regulatory education and negotiation program which resulted in over \$1 million in short term cost savings.

Senior Project Manager for the Ashland Newark DSO facility project, Oakland California. A pump and treat system is currently operating at the site to maintain hydraulic containment over VOC impacted groundwater within the shallow aquifer at the site. Treatment technologies employed included biological degradation and carbon adsorption. In addition, to these activities

a program of activities was developed with agency approval for Environmental Indicator closure and development of alternative clean-up levels (ACLs). Closure on the environmental indicators survey has been achieved and ACLs are currently being developed for submittal to the regulatory agency.

Project Manager for the design and implementation of remedial works at the Caltex Napier Bulk Storage Facility. Remedial works included hydraulic containment, groundwater extraction and treatment through air stripping, separate phase hydrocarbon recovery and landfarming of contaminated soils. Remedial works were designed to complement de-watering and subsurface excavation works associated with the construction of new storage tank foundations. The groundwater treatment system was designed to treat approximately 25,000 gallons/minute of BTEX contaminated groundwater extracted from the de-watering area with 98% removal efficiencies achieved over the period of the project. All equipment (including the air stripper) were designed and constructed on-site by the Caltex construction team under Nigel's supervision.

Project Manager for the design and installation of a product recovery system at the Caltex Palmerston North Depot. A floating layer which comprised approximately 600,000 gallons of petrol and diesel was present at the site and was found to be discharging off-site through preferential conduits. A fully automated product recovery and groundwater treatment system was designed and installed at the site and is currently recovering around 20,000 gallons of product a week.

Senior Project Manager for the remediation of the former Hamilton gasworks site. The site was heavily contaminated with BTEX, PAHs cyanide, phenols and other residual hydrocarbons. Remedial works comprised excavation and off-site treatment of

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approximately 14,000 tons of contaminated soil, 100,000 gallons of coal tar liquid and capping of the site with clean fill materials. In addition large-scale geotechnical stabilization works were undertaken at the site to allow redevelopment. A demonstration was made to the agency that the DNALP at the site was immobile and posed limited risks to groundwater. Theoretical removal of DNAPL was demonstrated to result no changes in the dissolved phase plume and only small incremental changes in plume longevity.

Project Engineer for reconfiguration and optimization of an SVE system at the ARCO Burnett Street Valve Box property, Long Beach, California. Works involved optimization of an existing SVE system to enable removal of approximately 1,500 gallons of product per month from the subsurface (works ongoing).

Project Engineer for the investigation, assessment and remediation of the Southdown Power Plant Site. The site, formerly asbestos waste dump, was remediated to allow construction of a new power plant. Works involved management of the excavation and removal of approximately 500 tons of friable asbestos contaminated material, capping of a 22.5-acre site and development of a long-term management plan.

Project Engineer for the investigation, assessment and remediation of the former Shell Block 3 Bulk Storage Facility. Approximately 1 million gallons of Jet A1 and 0.4 million gallons of AVGAS were known to have been spilt at the site and had resulted in the formation of an extensive floating layer of separate phase hydrocarbons and groundwater and soil contamination. A dual phase extraction system has been designed to remediate the site, with remedial construction works currently in progress.

Project Engineer for the investigation, assessment and remediation of the Waihi

Gasworks. Soils at the site were contaminated with BTEX and PAHs. Remedial works comprised excavation and off-site treatment of approximately 7,500 tons of contaminated soils, geotechnical stabilization and capping of the site. A long-term management plan was established for the site to mitigate long-term risks and ensure the capping integrity was not compromised.

Project Manager for the investigation, assessment and remediation of 50 Caltex service station sites. Sites were predominantly contaminated with BTEX and light molecular weight aliphatic compounds with remediation generally comprising a combination of in-situ soil vapor extraction and air sparging.

Project Engineer for the design and operation of a remedial system at the former Caltex Timaru Terminal. The remedial system comprised a 2000 scfm vapor extraction system and 1200 scfm air sparge system which was designed to remediate both soil, groundwater and separate phase contamination at the site.

Project Manager for the investigation and remediation of the Caltex Nelson Bulk Storage Facility. Following notification of free product discharges from the site to the harbor an emergency response team was dispatched to investigate and prevent further off-site discharges. Over a two (2) week period the site was characterized, remedial designs formulated and a cutoff wall and product recovery trench system installed along the downgradient site boundary. The systems have been activated and are currently recovering 2,000 gallons of product per week.

Project Manager for the investigation and remediation of the former Caltex Murupara bulk storage depot. URS Greiner Woodward Clyde performed assessments of soil and groundwater at the site, followed by evaluation of remedial options, design and installation of an in-situ/ex-situ bioremediation system. The system was

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designed to treat in-situ 17,500 tons of contaminated soil and remove a floating layer of separate phase hydrocarbons, which covered a 1-acre area of the site. Project Engineer for the investigation, assessment and remediation of former paint manufacturing sites (4 total). All sites were contaminated with heavy metal and solvents (toluene and xylene), with extensive soil and groundwater contamination. Detailed semi-quantitative risk assessments were conducted for each site, with remedial works comprising soil vapor extraction, lime stabilization and solidification, thermal desorption and bioremediation.

Project Engineer for the investigation, assessment and remediation of two former vehicle assembly plants. The sites were potentially contaminated with heavy metals, TCE and aromatic solvents. A multilayer groundwater monitoring well network was developed for the site to monitor TCE and aromatic solvent concentrations within surficial deposits and a basalt aquifer. Remedial options were developed for each site with a vapor extraction system currently in operation at one of the sites.

Project Manager for the investigation, assessment and remediation of a former Agrichemical Storage Depot. Remedial works comprised the soil washing of residual DDT/DDE/PCP and toxic metal contamination and offsite electrostatic precipitation and oxidation of the resulting effluent. A semi-quantitative risk assessment was conducted to determine acceptable clean-up levels.

Project Engineer for the Shell Five Cross Roads Remediation. The site, an operational service station, had a spillage of approximately 8,000 gallons of gasoline into a potable aquifer system. Remedial works were implemented at the site within a 48-hour period and comprised product recovery, soil vapor extraction and air sparging. The system is still operational, with

contamination confined to the site.

Project Engineer for the investigation and assessment of a chemical manufacturing site. The site, a large chemical manufacturer, was heavily contaminated with styrene, toluene, butanol, formaldehyde and MEK. Based on the clients budget constraints remedial works have been staged with an in-situ air sparging and vapor extraction remedial system currently installed for treatment of contaminated groundwater migrating from the site.

Project Engineer for the investigation, assessment and remediation of ammonia groundwater contamination at an operational Urea manufacturing plant. Remedial works comprised a pump and treat remedial system utilizing vegetated spray irrigation treatment cells.

Project Engineer for the investigation assessment and remediation of the Caltex Lyttelton No 2 Terminal. The site comprised a former bulk oil and fuel storage facility, an oil blend plant and associated tanker and railcar loading facilities. A floating layer of separate phase hydrocarbons was found to extend over a 1.5- acre portion of the site and was discharging to the harbor. Design and trial of a vacuum enhanced product recovery system and a sheetpile cut off wall, which are about to be installed at the site. (Work ongoing).

Project Engineer for the investigation, assessment and remediation of twenty (20) Shell service station sites throughout New Zealand. URS Greiner Woodward Clyde was commissioned to undertake detailed assessments of soil, groundwater and soil gas contamination at each site. Based on the results of these investigation works remedial options for each site were evaluated. Remedial works comprised active and passive product recovery, air sparging, soil vapor extraction and insitu and ex-situ bioremediation.

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Project Engineer for the investigation, assessment and remediation of the former Caltex Lyttleton No 1 Bulk Storage Facility. The site comprised a large bulk storage facility and associated rail and tanker truck loading facilities. Remedial works comprised excavation and ex-situ bioremediation of over 20,000 tons of contaminated material prior to disposal.

Project Engineer for the design and implementation of insitu bioremediation systems for treatment of petrol, diesel and waste oil contamination at 30 Shell New Zealand Ltd bulk storage and commercial sites.

Remedial systems were designed to treat between 1,000 tons and 60,000 tons of contaminated soil.

Project Engineer for the investigation, assessment and remediation of the Caltex supplied Smith and Davies Depot. The site comprised a former service station and operational truck depot site. Remedial works comprised separate phase hydrocarbon recovery works and excavation and removal of contaminated soil for off-site treatment and disposal. A risk assessment was conducted to characterize the long-term human health and environmental risks posed by residual contamination.

Project Manager for the assessment and remediation of the Feltex Textile factory. Soils at the site were contaminated with heavy metals and hydrocarbons. Based on the results of a semi-quantitative risk assessment, remedial works consisted of the excavation and off-site stabilization and disposal of approximately 10,000 tons of contaminated soil.

Site Assessments and Environmental Audits

Project Engineer for the investigation and assessment of a natural gas treatment plant. The soil and groundwater contamination at the site comprised light end distillates (BTEX compounds) and heavy metal catalysts (vanadium, manganese and lead). Project

Manager for an environmental risk survey of 550 BP underground storage tank (UST) sites throughout New Zealand. Works involved resistivity surveys and desk study reviews of geotechnical and environmental data in order to define potential environmental liabilities.

Project Manager for the environmental risk assessment of approximately 400 service station and 1200 commercial sites for Caltex throughout New Zealand and Asia Pacific. Works were designed to prioritize environmental and facility upgrade works and identify site closures. Based on these works a program of site investigation works and site closures was designed and implemented. These works have been extended to additional sites within the Asia – Pacific region.

Project Manager for the investigation and assessment of ten potentially contaminated sites within the Otago region. The sites comprised five (5) timber treatment sites, three service stations, one former landfill and the former Dunedin City gasworks site. Detailed risk assessments were conducted for each site and remedial approaches were developed for the high-risk sites.

Project Engineer for the Wiri Hazardous Waste Treatment Facility feasibility and design program. Works involved site selection and evaluation for the development of a hazardous liquids treatment and disposal facility. A detailed hydrogeological investigation and assessment was conducted on the preferred site and recommendations regarding site design were presented.

Project Engineer for the investigation and assessment of the Caltex owned Auckland Manawatu and Wanganui Asphalt Plants. The sites all comprised operational asphalt batching plants, with one constructed on a former bulk storage terminal and one on a former gasworks site. Preliminary remedial evaluations and designed were presented for each site, with

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detailed remediation design works currently in progress.

Project Engineer for the investigation and assessment of the former Caltex Wanganui Terminal, Westport Depot, Whangarei Terminal, Gore and Invercargill Depots. Remedial options are currently being evaluated for each of these sites.

Project Engineer and/or Project Manager for the environmental investigation and assessment of over one hundred (100) Caltex service stations and diesel stops associated with redevelopment and operational leaks and spillages. Investigation works included detailed characterization of soil, vapor, dissolved and separate phase contamination at each site. Sites were ranked according to risk to allow prioritization of remedial works.

Project Manager for the investigation and assessment of ten (10) Mobil service station sites associated with redevelopment and operational leaks and spillages. Remedial options were evaluated for each site and are currently being conducted in conjunction with site redevelopment works.

Project Manager for the investigation and assessment of twenty (20) Shell service station sites associated with redevelopment and operational leaks and spillages. Remedial options were evaluated for each site and are currently being conducted in conjunction with site redevelopment works.

Project Manager for pre-purchase assessments on 20 sites to be redeveloped by Caltex as service station sites.

Project Engineer for the hydraulic and geotechnical testing of the Caltex Nelson Terminal compound liner. The assessment included, hydraulic testing, trial pits, and laboratory analyses of collected soils. Based on this review, a new compound liner was designed and installed at the site.

Project Engineer for the investigation and assessment of two former gasification plants active at the Dargaville and Whangarei sites from the late 1800's to approximately 1950. Works included detailed characterization of soil and groundwater contamination.

Project Engineer for the investigation and assessment of a battery manufacturing plant and recycling operation. Remedial options were evaluated for the remediation of lead contaminated soils, with materials stabilized and solidified on-site prior to being landfilled.

Project Engineer for the investigation and Assessment of Ciba Giegy (NZ) Ltd former pesticide (including DDT/DDE) manufacturing site. The investigation included detailed characterization of soil and groundwater contamination at the site. Remedial options are currently being evaluated for the site.

Recent Australian Projects

Project Director for the Mobil Colmslie Terminal Investigation and Remediation Project. This site a 75 acre former bulk fuel storage and lubricant blending manufacturing facility located adjacent to the Brisbane River has undergone investigation and remediation to facilitate sale and redevelopment. A comprehensive environment investigation has been completed at the site comprising 300 soil bores, 200 test pits and 100 groundwater monitoring wells. On the basis of the investigation results a Phase 2 Investigation, Detailed Human Health Risk Assessment and Remedial Approach have been developed for the site. On the basis of these documents and comments received from the TPR remedial works commenced in October 2007. To date around 55,000 y3 of impacted soil has been removed and is undergoing land farm treatment.

Validation sampling and reporting has been completed for the remedial excavations and treated soil and submitted to the TPR as technical memos. These Technical Memos will

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be integrated into a final validation report. In conjunction with the soil remediation activities pilot testing of LNAPL remedial technologies has been conducted at the site and a full scale system has been designed and is currently being installed at the site. This full scale system will treat LNAPL impacts over a 4 ha area of the former Terminal. To date approximately \$10MM has been spent on investigation and remediation of this site.

Project Director for the Mobil Yarraville Terminal and Lubricants Plant. This is a 50 acre operational bulk storage and lubricants blending plant adjacent to the Yarra River and surrounded by the Yarraville industrial area. The site is impacted by a combination of petroleum hydrocarbons, chlorinated solvents, pesticides and metals associated with both the Terminals operations and adjacent sites. A comprehensive investigation was conducted within 3 aquifers (sands, basalt and silts and clays) at the site, consisting of over 200 wells and 100 soil borings. This project most recently involved the submission of a comprehensive Stage 2 Audit report which included 14 Technical appendices including a QRA, Hydrogeologic Model, LNAPL Conceptual Model, DNAPL Conceptual Model, Geochemical Model of Inorganics in groundwater, fate and transport modeling, remedial options assessment, groundwater flow modeling of remedial options and development of a comprehensive site wide remedial strategy and approach. Concurrent with these activities pilot testing of various remedial technologies has been conducted at the site and LNAPL recovery activities have continued. To date around \$15MM has been spent on investigation and remediation activities.

Project Director for the Mobil Spotwood Terminal. This is a 40 acre former bulk storage terminal and lubricants blending. The facility stored and distributed fuels, solvents and lube

oils and was operational for over 80 years. The site is impacted with a combination of petroleum hydrocarbons, solvents and metals within numerous aquifers and a remediation has comprised multiphase extraction and groundwater pump and treat. A comprehensive investigation is being conducted in conjunction with demolition activities to develop a remedial approach for redevelopment of the property.

Project Director for Santos Pipeline Spills in Queensland. Three major pipeline releases up to 1,000,000 gallons of crude oil occurred at three sites along the Moonie to Brisbane pipeline. A range of settings were encountered during the investigation and remediations include agricultural areas, wetlands, residential areas and public roads and infrastructure. The project involved emergency response including construction of coffer dams within creeks and streams, pumping of accumulated oil, excavation and removal of impacted soils, and installation of groundwater remediation systems. The investigation and soil remediation is complete at all three sites and groundwater remediation is ongoing. To date around \$35MM has been spent on the emergency response, investigation and management under the direct oversight of URS.

Project Director for the Santos Port Boynton remediation project. This is a coastal crude oil Terminal in Wyalla in South Australia. Historical releases of crude oil have resulted in soil and groundwater impacts at the facility with LNAPL migrating from operational areas up to and discharging to the adjacent marine environment. A comprehensive program of investigations and pilot testing was conducted at the site culminating in the project team designing and constructing a 1 km long barrier wall along half of the facility perimeter and installing a groundwater and LNAPL recovery system behind the wall and remaining areas of the site. The total project value was \$9MM.

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Technical Director for the Shell White Oil Pipeline release. This release around 3,000,000 gallons occurred from a 100 km long pipeline from the Terminal to a main distribution terminal. The release occurred within farmland and impacted an underlying basalt aquifer which is utilized for agricultural water supply. The project involved investigation and installation and operation of a large scale 2,700 scfm MPE system on part of the impacted area with skimming and LNAPL recovery conducted on remaining areas. The remediation works are ongoing at the site with expenditure to date totally around \$15MM.

Project Director for the Shell Mackay Terminal. This is a 7 ha bulk fuel distribution Terminal in Mackay. URS took over the project from Coffey's and have been responsible for ongoing monitoring, supplemental investigations and development of a new remedial strategy. The revised remedial strategy for the Terminal was integrated into a revised EMP which has subsequently been approved. This new EMP will consist of implementation of bioventing and biosparging of residual LNAPL impacts in the area of the former release and the abandonment of LNAPL recovery activities. Total Project expenditures \$3MM.

Project Director for the Mobil Kedron Service Station. Activities at this site have included groundwater monitoring and operation and maintenance on an MPE remediation system. This site has been extensively investigated by URS with a remediation system installed in May 2007. Since this time the system has been operational, with systems optimized during this period to maximize mass removal. All LNAPL has been successfully removed by the system and remedial activities are now focused on treatment of impacted groundwater through a combination of pump and treat and operation of the sparging wells. Project Expenditures of \$1.7MM.

Technical Director for the Ford Rolling Meadows Car assembly plant investigation and remediation project. This involved a comprehensive Phase 1 and Phase 2 Investigation of all facility operations and the implementation of active remediation of groundwater in three areas of the site. A combination of remedial technologies were implemented at the site including, pump and treat, air sparging and soil vapour extraction and vacuum enhanced LNAPL recovery. All systems have been installed and commissioned and operations are continuing.

Technical Director for the Altona Refinery Investigation and Remediation Project. This active refinery covers around 500 acres within a coastal environment and has been in operation for around 80 years. The scope of work included a comprehensive investigation of soil and groundwater at the site and sediment in adjacent water ways. Supplemental work included installation of groundwater and LNAPL recovery systems within the fractured rock. All remediation systems are operational at the site.

Technical Director for the Mobil Oil Australia and Mobil Chemical Australia Pty Ltd remediation projects. This portfolio of refineries, chemical manufacturing sites and petroleum and chemical distribution sites comprises around \$30MM in remediation expenditures per year with the majority of sites being demolished, remediation and redeveloped for a combination of commercial industrial and residential land-use. An integrated risk based remedial and property redevelopment approach has been developed and implemented on these sites, reducing remediation costs, expediting sale and in some cases integrating the remedial approach and systems into the final redevelopment.