



Michael Stewart, PhD

Environmental Chemistry Specialist

Education

PhD in Chemistry – University of Canterbury, 1997

M.Sc. (Hons) – in Chemistry, University of Canterbury, 1994

B.Sc. – University of Canterbury, 1992

Dr Stewart has broad professional experience in many aspects of chemistry, having worked in pharmaceutical/biotech (UK), academia (Australia), and government and consulting (New Zealand) environments.

He has research and commercial experience in environmental chemistry, including the design and implementation of monitoring programmes on legacy and emerging organic contaminants, reviews of emerging contaminants in the aquatic receiving environment from SoE and RMA perspectives, monitoring programme reviews for council, water quality trend analysis, human health risk assessments of contaminants in mahinga kai species and assessments of ecological effects. His current research also encompasses chemical ecology, allowing development of previously acquired skills in mass spectrometry and natural products chemistry to find novel solutions to address degradation of ecological values. Applications of this research have been in biosecurity and conservation.

Specialty areas:

Environmental Chemistry

Aquatic Passive Samplers

Assessment of Ecological Effects

Chemical Ecology

Risk assessment

Natural Products Chemistry

Experience Highlights

- Director, Streamlined Environmental Ltd, since December 2015
- 20 years professional experience as a chemist, having worked in the pharmaceutical /biotech (UK), academia (Australia), CRI and consulting (New Zealand) environments.
- 8 years, Environmental Chemistry Scientist (Level 3), NIWA, Hamilton, New Zealand.
- 3 years, Senior Research Officer (Level B), Institute for Molecular Bioscience, The University of Queensland, Brisbane, Australia.
- 2 years, Research Fellow (Level A), Marine Natural Products Research Group, The University of Melbourne, Melbourne, Australia.
- 3 years, Senior Natural Products Chemist, Institute of Grassland & Environmental Research, Aberystwyth, UK.

Selected recent examples of experience

Environmental Chemistry/Water Quality

Assessment of ecological effects on the receiving environment associated with the discharge from the proposed membrane bioreactor wastewater treatment system for Lakeside development near Te Kauwhata, Lakeside Developments 2017 Ltd, 2017-current. Led the preparation of two AEEs from the discharge of wastewater to support the proposed development of Lakeside near Te Kauwhata. The first AEE incorporates wastewater from the development and Te Kauwhata WWTP, while the second assesses wastewater from the development only. Assessments incorporated aspects of fieldwork, laboratory analyses, wetland modelling and desktop risk assessments on water quality (nutrient, metals, emerging organic contaminants, QMRA). As a landuse change is required to rezone from dairy farm to residential presented evidence as a key witness in the March 2018 hearing. The private plan change was subsequently approved.

Assessment of ecological effects from discharge of wastewater and stormwater on the receiving environment associated with the development of Whitford Manor Estate, Le Coz Ltd, 2017. Fieldwork, laboratory analyses, modelling and desktop risk assessments on water quality (nutrient, metals, emerging organic contaminants, QMRA) of proposed wastewater and stormwater treatment facilities to provide an AEE to support Le Coz Ltd to seek a variation of their consent to discharge contaminants via wastewater and stormwater to Turanga Creek.

Literature review of the risks and adverse effects from discharges of stormwater, wastewater, industrial and trade waste, and other hazardous substances in Otago, Otago Regional Council, 2017. Undertook a review of existing information to identify contaminants present in discharges from stormwater, human wastewater, industrial and trade waste, and other potentially hazardous activities (such as agricultural and mining practices) in the Otago Region. This was a collaborative effort between SEL, Freeman Environmental (Trade Wastes), and ORC staff, to provide this first step in a risk assessment process to assess the potential impact these discharges may have on sensitive receiving environments in the Otago region and inform future changes to Regional Plans (Water, and Coast).

Contaminant monitoring programme critical reviews, Waikato Regional Council, 2016. Critical assessment of WRC estuarine sediment contaminant monitoring programme to ensure it is fit for purpose and a review of emerging organic contaminants of relevance to the Waikato region for potential inclusion in future estuarine monitoring programmes.

Assessment of effects of nutrients and emerging contaminants from WWTP discharges for reconsenting applications, Watercare Services Ltd, 2015-2016. Fieldwork, laboratory analyses and desktop risk assessment on nutrient and emerging contaminant aspects of WWTP discharges. This is providing an assessment of environmental effects to advise Watercare in their application for reconsenting wastewater treatment plants (Omaha, Snells/Warkworth, Waiuku/Clarks) in the Auckland region.

An update on emerging organic contaminants of relevance for regional council marine sediment contaminant monitoring, Auckland Council, Environment Canterbury and Greater Wellington Regional Council, 2016. Lead author on report for NZ's three largest regional councils on an update of international and national research and legislative aspects of emerging organic contaminants. Includes recommendations on which emerging organic contaminants to include in future state of the environment marine sediment monitoring programmes.

Review of chemical tracers to differentiate WWTP sources from other faecal sources to the environment, Watercare Services Ltd, 2015. Desktop review to provide Watercare with practical information on chemical markers and methods to distinguish various sources of faecal contamination to marine receiving environments.

Emerging contaminants, Regional Councils, NIWA Core Funding, Royal Society of New Zealand, 2009-2014. Lead investigator on a NZ first field study of emerging contaminants within Auckland's marine receiving environment in 2008. This was supplemented by a RSNZ funded collaboration with a Spanish research group (2010) to expand the dataset to include pharmaceuticals. Second author on subsequent review for HBRC (2011).

Broad scale water quality assessment to inform the Rotokauri Integrated Catchment Monitoring Plan, Hamilton City Council, 2015. Field and desktop analysis of heavy metals and current and emerging organic contaminants as baseline information for Rotokauri urban development. This involved the analysis of sediment and water contaminants. Passive samplers were installed in existing lake inlets and outlets to measure "averaged" water concentrations of emerging contaminants and metals. The results provided baseline data for proposed monitoring programmes during the urbanization process.

Review of polychlorinated biphenyls (PCBs) for Bream Bay Aquaculture Park, NIWA, 2014-15. Assessment of PCB data from aquaculture fish species, fish feed and the surrounding environment to assist aquaculture scientist at Bream Bay in enhancing aquaculture productivity and survival.

Rotorua District Council stormwater consent, Rotorua District Council, 2014. Project Manager assisting RDC in the preparation of a comprehensive stormwater consent for Rotorua city. Carried out a study to assess long-term water quality impacts arising from the cumulative effects of the quality and quantity of stormwater. The assessment strategy incorporated the characterisation of stream, drain and lake sediments, stream biological surveys, and heavy metal concentrations in freshwater mussels in Lake Rotorua.

Shellfish Contaminant Monitoring Programme (SCMP), Auckland Council, 2013. Project Manager on a status and trends assessment and programme review of Auckland Council's SCMP. AC incorporated the recommendations from the review into their work programme, including collaboration with Dr Stewart on alternative monitoring technologies to replace the SCMP (see development of passive sampling devices example above).

Aquatic Passive Samplers

Managing the risk to New Zealand of emerging organic contaminants research programme, MBE, Cawthron Institute, 2017-2022. Key researcher in a multidisciplinary team of National and International researchers assessing environmental and economic risks to New Zealand from emerging organic contaminants. Brings expertise in aquatic passive samplers to design suitable devices that will sample a wide variety of disparate chemical entities from the environment.

Development of passive sampling devices for analysis of bioavailable contaminants of current and emerging concern in the Waitemata Harbour, Streamlined Environmental, NIWA, Auckland Council, 2014-16. Lead on research programme to develop passive sampling devices as alternatives to shellfish and water spot sampling environmental contaminant monitoring. Results suggest that passive sampling is a

complementary technique to other water sampling methodologies, but more research and validation is necessary before it will be accepted in the regulatory framework.

Risk assessment

Risk assessment of antiscalant chemicals at Ohaaki, Wairakei and Tauhara Power Stations. Contact Energy, 2017. In order to apply for variations to consent conditions, Contact Energy were reviewing their procedures for use of permanent antiscalant chemicals at their geothermal power stations. They required a comprehensive risk assessment to show that no adverse environmental effects would occur as a result of proposed changes.

Risk assessment of potential human health and ecological effects of spills of on-site chemicals at Huntly Power Station, Genesis Energy, 2014. Developed risk assessment procedures to highlight potential human health concerns and ecological effects of unintended chemical spills from Huntly Power Station into the Waikato River.

Ecological risk assessment for applications of chlorine in the control of boat fouling by Mediterranean Fanworm, Northland Regional Council, 2014. Provided technical advice to NRC on correct methodology, risks and risk elimination for use of chlorine for control of invasive Mediterranean Fanworm on boats.

Mahinga kai human health risk assessment, various funding/lwi organisations, 2009-2014. Initial role within HRC programme (2009-2011) involving design of field studies, overseeing field studies and contaminant analyses and development of human health risk assessment procedures for important mahinga kai species. Included studies in South Canterbury (Arowhenua), Rotorua Lakes (Te Arawa) and Whakatane (Ngati Hokopu). Provided chemical and risk assessment expertise for Lake Omāpere tuna assessment (2012). Lead investigator working with Te Waihora Management Board and ECan on mahing kai biohealth study in Lake Ellesmere (Te Waihora) (2014).

Chemical ecology

Novel method for quantifying lamprey migratory pheromone in NZ streams, MBIE, 2006-current. Development of methods based around Polar Organic Chemical Integrative Samplers (POCIS) and liquid chromatography-tandem mass spectrometry (LC/MS/MS) for detection of a lamprey-specific pheromone in New Zealand streams. The method was used to estimate resident lamprey larval populations in streams, which could be used as a baseline in restoration strategies to enhance this taonga species. To date, the methodology has been utilised by Auckland Council, Department of Conservation and Horizons Regional Council.

Pest species impact and control, NIWA Core Funding, MBIE, 2006-current. Investigation of perch pheromones and semio-chemicals by radioactivity tracing, microchemistry and LC/MS. Lab, flume and lake scale efficacy tests have been undertaken for the development of a putative semio-chemical that attracts perch. The method has applications in pest control and sports fishing.

Chemical control and enhancement of marine crab species, MBIE, 2008-current. It is hypothesized that pheromones involved in sexual reproduction may be useful for control of pest species or enhancement of valued species. In New Zealand, the introduced Asian Paddle Crab (*Charybdis japonicus*) is a marine pest while the native paddle crab (*Ovalipes catharus*) has potential for aquaculture. This project involves the

investigation of pheromones in the urine of female members of these species by iterative bioassay (behaviour) directed fractionation. Identification of putative pheromone candidates has been via high resolution mass spectrometry, in collaboration with Analytica Laboratories.

Tuna (eel) species separation trial, Te Ohu Tiaki o Rangitaane Te Ika a Maui Trust, 2013-current. This project aims to be able to separate tuna species (longfin release and shortfin for aquaculture) at the glass eel stage via their olfactory response. Eel liver and tank holding water has been analysed by mass spectrometry techniques to identify chemical differences between species that could be used to differentiate species at the early life stages.

Natural Products Chemistry

Investigations of toxicity in the Georges Bay catchment, Tasmania, Slater & Gordon Ltd, 2009-2010.

Undertook bioactivity directed fractionation and chemical identification of potential causative sources of toxicity to identify the chemicals implicated in oyster mortality in the Georges Bay catchment.

Selected Recent Peer-Reviewed Publications

Baker, C., Jellyman, D., Reeve, K., Crow, S., Stewart, M., Buchinger, T.J., Li, W. (2017). First observations of spawning nests in the pouched lamprey *Geotria australis*. *Canadian Journal of Fisheries and Aquatic Sciences* 74(10): 1603-1611.

Stewart, M., Cameron, M., McMurtry, M., Sander, S.G., Benedict, B., Graham, L., Hosie, M., Green, T. (2016). Development of passive sampling devices for analysis of bioavailable contaminants of current and emerging concern in the Waitemata Harbour. *New Zealand Journal of Marine and Freshwater Research* 50(4): 526-548.

Tremblay, L., Stewart, M., Northcott, G. (2016). Emerging Contaminants: Should we be worried? *Revolve* August: 19–21.

Morrissey, D., Depree, C., Hickey, C.W., McKenzie, D., Middleton, I., Smith, M., Stewart, M., Thompson, K. (2016). Rapid treatment of vessels fouled with an invasive polychaete, *Sabella spallanzanii*, using a floating dock and chlorine as a biocide. *Biofouling* 32(2): 135-144.

Bleaney, A., Hickey, C.W., Stewart, M., Scammell, M., Senjen, R. (2014). Preliminary investigations of toxicity in the Georges Bay catchment, Tasmania. *International Journal of Environmental Studies* 72(1): 1-23.

Phillips, N.R., Stewart, M., Olsen, G., Hickey, C.W. (2014). Human Health Risks of Geothermally Derived Metals and Other Contaminants in Wild-Caught Food. *Journal of Toxicology and Environmental Health, Part A* 77(6): 346-365.

Stewart, M., Olsen, G., Hickey, C.W., Ferreira, B., Jelic, A., Petrovic, M., Barcelo, D. (2014). A survey of emerging contaminants in the estuarine receiving environment around Auckland, New Zealand. *Science of the Total Environment* 468–469(0): 202-210.

Stewart, M., Miles, W.H., Depree, C. (2014). Antifouling activity of synthetic γ -hydroxybutenolides. *International Biodeterioration & Biodegradation* 88, 176–184.

Stewart, M.; Baker, C.F. (2012). A sensitive analytical method for quantifying petromyzonol sulfate in water as a potential tool for population monitoring of the southern pouched lamprey, *Geotria australis*, in New Zealand streams. *Journal of Chemical Ecology* 38(2): 135-144.

Stewart, M.; Baker, C.F.; Cooney, T. (2011). A rapid, sensitive, and selective method for quantitation of lamprey migratory pheromones in river water. *Journal of Chemical Ecology* 37(11): 1203-1207.

Stewart, M.; Phillips, N.R.; Olsen, G.; Hickey, C.W.; Tipa, G. (2011). Organochlorines and heavy metals in wild caught food as a potential human health risk to the indigenous Maori population of South Canterbury, New Zealand. *Science of The Total Environment* 409(11): 2029-2039.

Selected Recent Reports

Stewart, M., Cooke, J, Dada, C. (2017). Assessment of ecological effects on the receiving environment associated with the discharge from the proposed membrane bioreactor wastewater treatment system. Option 1: Treatment of all wastewater generated by Te Kauwhata (current and future), Springhill prison (current and future) and the Lakeside development. Report LDL1701–FINAL, Streamlined Environmental, Hamilton, 168 pp.

Stewart, M., Dada, C., Cooke, J. (2017). Assessment of ecological effects on the receiving environment associated with the discharge from the proposed membrane bioreactor wastewater treatment system. Option 2: Treatment of all wastewater generated by the Lakeside development only. Report LDL1702–FINAL, Streamlined Environmental, Hamilton, 167 pp.

Dada, C., Stewart, M. (2017). Assessment of ecological effects from discharge of wastewater and stormwater on the receiving environment associated with the development of Whitford Manor Estate. Report LCL1701–FINAL, Streamlined Environmental, Hamilton, 142 pp.

Stewart, M., Phillips, N. (2017). Risk assessment of antiscalant chemicals at Ohaaki, Wairakei and Tauhara Power Stations. Prepared for Contact Energy, CON1601-FINAL, Streamlined Environmental, Hamilton, 49 pp.

Stewart, M., Cooke, J., Phillips, N., Freeman, M. (2017). Literature review of the risks and adverse effects from discharges of stormwater, wastewater, industrial and trade waste, and other hazardous substances in Otago. Prepared for Otago Regional Council, Report ORC1601-FINAL-v2. 153 pp.

Stewart, M. (2016). Review of Waikato Regional Council Estuarine Sediment Contaminant Monitoring Programme. Report WRC1601-1, Streamlined Environmental, Hamilton, 61 pp.

Stewart, M. (2016). Emerging organic contaminants in the Waikato region's coastal marine area compared to other New Zealand regions. Waikato Regional Council Internal Series 2017/16. Document #:6541681. 36 pp.

Stewart, M., Northcott, G., Gaw, S., Tremblay, L. (2016). An Update on Emerging Organic Contaminants of Concern for New Zealand with Guidance on Monitoring Approaches for Councils. *Auckland Council Technical Report 2016/006*. 120 p.

Stewart, M., Cooke, J. (2016). Assessment of effects of the discharge of treated wastewater from Clarks Beach WWTP on water and sediment quality in the Southern part of the Manukau Harbour and Waiuku Channel. Prepared for Watercare Services Ltd. 64 p.

- Stewart, M., Cooke, J. (2016). Nutrient yields for the Mahurangi catchment and Warkworth Wastewater Treatment Plant. Prepared for Watercare Services Ltd. 27 p.
- Stewart, M. (2016). Assessment of contaminants of emerging concern in the context of the proposed South-West Manukau wastewater servicing consent project. Prepared for Watercare Services Ltd. 18 p.
- Stewart, M. (2016). Assessment of emerging contaminants in the discharge from the Waiuku WWTP – Technical Report. Prepared for Watercare Services Ltd. 13 p.
- Stewart, M. (2016). Assessment of emerging contaminants in the discharge from the Omaha WWTP – Technical Report. Prepared for Watercare Services Ltd. 12 p.
- James, M., Stewart, M., Phillips, N., Cooke, J., Kelly, S., Goldwater, N. (2016). Assessment of Ecological Effects on the receiving environments from a discharge of treated wastewater from a combined Snells Beach and Warkworth WWTP. Prepared for Watercare Services Ltd. 148 p.
- James, M., Stewart, M., Phillips, N., Cooke, J. (2016). Assessment of Ecological Effects on the receiving environment from the discharge of treated wastewater from the Omaha WWTP. Prepared for Watercare Services Ltd. 109 p.
- James, M., Stewart, M., Phillips, N., Cooke, J. (2016). Assessment of Ecological Effects on the receiving environment from the discharge of treated wastewater from a combined Clarks Beach, Waiuku and Kingseat WWTP. Prepared for Watercare Services Ltd. 109 p.
- Baker, C., Stewart, M., Reeve, K. (2016). Lamprey Pheromones in the Whanganui Catchment. Prepared for Horizons Regional Council. NIWA Client Report No: HAM2016-069.
- Baker, C., Stewart, M., Reeve, K. (2016). Lamprey Pheromones in the Clutha/Mata-Au Catchment. Prepared for Department of Conservation. NIWA Client Report No: HAM2016-068.
- Stewart, M. (2015). Review of chemical tracers for differentiating wastewater treatment plant effluent from septic tank leachate and other faecal sources in the environment. Prepared for Watercare Services Ltd, 24 p.
- Cooke, J., Cox, T., Stewart, M., Phillips, N. (2015). Rotokauri ICMP – Broad scale Water Quality Assessment. 95 p.
- Depree, C., Stewart, M., Palliser, C. (2015). Assessment of environmental effects of Rotorua City stormwater. Prepared for Rotorua District Council. *NIWA Client Report No. HAM2014-111*. 198 p.
- Stewart, M. (2015). Assessment of PCB data from hapūku eggs, fish and feed samples. Prepared for NIWA Bream Bay Aquaculture Park. 6 p.
- Stewart, M.; Tipa, G.; Williams, E.; Home, M.; Olsen, G.; Hickey, C. (2014). Impacts of Bioaccumulative Contaminants in the Te Waihora Catchment on Mahinga Kai Gatherers: Data Report and Risk Assessment. Prepared for Te Waihora Management Board & Environment Canterbury Regional Council. *NIWA Client Report No: HAM2014-012*. 146 p.
- Stewart, M. (2014). Literature Review: PCBs. Prepared for NIWA Bream Bay Aquaculture Park. 19 p.

Stewart, M.; Olsen, G.; Gadd, J. (2013). Shellfish contaminant monitoring programme review. Prepared by NIWA for Auckland Council. *Auckland Council technical report, TR2013/055*. 95 p.

Stewart, M.; Gadd, J.; Ballantine, D.; Olsen, G. (2013). Shellfish contaminant monitoring programme: status and trends analysis 1987 - 2011. Prepared by NIWA for Auckland Council. *Auckland Council technical report TR2013/054*. 203 p.

Stewart, M. (2013). Assessment of potential effects of the Kuratau power station on river water quality. Prepared for King Country Energy. *NIWA Report HAM2013-019*. 33 p.

Stewart, M. (2013). Pharmaceutical residues in the Auckland estuarine environment. Prepared by NIWA for Auckland Council. *Auckland Council Technical Report, TR2013/002*. 51 p.

Olsen, G.; Stewart, M.; Albert, A.; Ovensden, R. (2013). Wellington harbour subtidal sediment quality survey 2011. Sediment chemistry & particle size data. Prepared for Greater Wellington Regional Council. *NIWA Report HAM2012-090*. 225 p.

Tremblay, L.A.; Stewart, M.; Peake, B.M.; Gadd, J.B.; Northcott, G.L. (2011). Review of the Risks of Emerging Organic Contaminants and Potential Impacts to Hawke's Bay. Prepared for Hawke's Bay Regional Council. *Cawthron Report No. 1973*. 39 p.

Hickey, C.; Stewart, M. (2010). Ecotoxicity investigations of the Georges Bay catchment, Tasmania: Phase II – Foam and *Eucalyptus nitens* leaf characterisation. *NIWA Report HAM2010-131*. 115 p.

Stewart, M.; Ahrens, M.; Olsen, G. (2009). Field Analysis of Chemicals of Emerging Environmental Concern in Auckland's Aquatic Sediments. Prepared by NIWA for Auckland Regional Council. *Auckland Regional Council Technical Report 2009/021*. 59 p.

Stewart, M. (2008). A Risk Assessment of Potential Contamination of Surface Water by Agrichemicals in Northland. Prepared for Northland Regional Council. *NIWA Report HAM2008-10*. 40 p.

Recent conference presentations

Stewart, M. Emerging organic contaminants in a predominantly rural aquatic environment – what do we know and should we be worried? *New Zealand Freshwater Sciences Society Conference*, Hamilton, 20-24 November 2017.

Stewart, M., Baker, C. POCIS: A novel tool for biodiversity and biosecurity applications? *New Zealand Freshwater Sciences Society Conference*, Invercargill, 5-8 December 2016.

Stewart, M., Cameron, M., McMurtry, M., Sander, S.G., Benedict, B., Graham, L., Hosie, M. (2015). Development of passive sampling devices for bioavailable contaminants in State of the Environment Monitoring: Waitemata Harbour Case Study. *New Zealand Marine Sciences Conference*, Auckland, 6-9 July 2015.

Stewart, M., Olsen, G., Hickey, C.W., Ferreira, B., Jelić, A., Petrović, M., Barcelo, D. Emerging contaminant issues in New Zealand: An urban case study from the estuarine receiving environment around Auckland. *The 1st International Conference on Emerging Contaminants*, Kaohsiung, Taiwan, 13-15 October 2013.

Stewart, M.; Baker, C.; Cooney, T. A rapid, sensitive, and selective method for quantitation of lamprey migratory pheromones in river water and an application in population monitoring of the southern pouched lamprey, *Geotria australis*, in New Zealand streams. Bioactive Water Borne Chemicals, Faro, Portugal, September 2011.

Stewart, M.; Baker, C.; Cooney, T. The Development of a Highly Sensitive and Selective Method for Detection of Lamprey Migratory Pheromones in Rivers. *New Zealand Freshwater Sciences Society Conference*, Christchurch, November 2010.

Stewart, M.; Olsen, G. Chemicals of Emerging Environmental Concern in the Auckland Marine Environment. *Water & Industry 2009 Conference*, Palmerston North, November 2009.