Michael Stewart, PhD

Environmental Chemist

Education

PhD in Chemistry – University of Canterbury, 1997

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

B.Sc. – University of Canterbury, 1992

Experience Highlights

- Director, Streamlined Environmental Ltd, since December 2015
- More than 19 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.

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.

Dr Stewart has applied research and commercial experience in environmental chemistry, including: assessments of ecological effects; reviews of emerging contaminants in the aquatic receiving environment from SoE and RMA perspectives; review, design and implementation of monitoring programmes on legacy and emerging organic contaminants, water quality trend analysis; human health and ecological risk assessments; and development of chemical ecology tools for biodiversity and biosecurity applications.

Dr Stewart has recently attained certification as an RMA Independent Commissioner (May 2017). Recent environmental science expertise in the RMA space includes studies to support consent applications and a variation of consent, plan changes, and expert witness services. Recent projects have included: determining water quality effects (nutrients, metals and emerging organic contaminants) from 3 wastewater treatment plants to support consent applications to Auckland Council; a literature review of the risks and adverse effects from discharges in Otago as a first step in a plan change for ORC; a risk assessment on antiscalant chemicals used at Contact Energy owned geothermal power stations to assist Contact in preparation of variation on consent conditions.

Specialty areas:

RMA Science Support

Risk Assessments (Human and Ecological)

Environmental Chemistry/Water Quality

Chemical Ecology

Selected recent examples of experience

RMA Science and Policy Support

Assessment of effects of nutrients and emerging contaminants from WWTP discharges for reconsenting applications, expert witness, *Watercare Services Ltd*, 2015-current. Fieldwork, laboratory analyses and desktop risk assessments on water quality (nutrient, metals and emerging organic contaminant) aspects of wastewater treatment plant discharges. Incorporation of information into assessment of ecological effects reports for inclusion in consent applications. This has/is providing scientific support to advise Watercare in their application for reconsenting wastewater treatment plants (Omaha, Snells/Warkworth, Waiuku/Clarks) in the Auckland region. Prepared summary of evidence for Snells/Warkworth (not required to attend hearing). Jim Cooke represented SEL as expert witness for Omaha. Long term (35 year) consents have been granted for both WWTPs. Dr Stewart is earmarked to present and appear as the expert water quality witness for Watercare in the upcoming hearing for Waiuku/Clarks scheduled for September.

Literature review of the risks and adverse effects from waterborne contaminants in Otago, *Otago Regional Council*, 2016-17. Lead author on 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. Worked collaboratively with 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).

Risk assessment of antiscalant chemicals at Ohaaki, Wairakei and Tauhara Power Stations, *Contact Energy*, 2016-current. Contact Energy were interested in modifying resource consent conditions to allow for increased use of antiscalant formulations at their geothermal power stations. Developed site-specific risk assessments to provide robust scientific evidence to support Contact Energy to seek modifications to consent conditions.

Review of Waikato Regional Council Estuarine Sediment Contaminant Monitoring Programme, *Waikato Regional Council*, 2016. WRC required a review of their estuarine sediment contaminant monitoring programme to ensure it is relevant and providing the information necessary for WRC to fulfil its obligations

for environmental protection. Provided a critical assessment of technical issues which could impact on Council's ability to satisfy relevant policy directives and recommendations on measures required to address these issues.

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.

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. This was in response to concerns raised by submissions to a resource consent application by NRC.

Assessment of potential effects of the Kuratau Power Station on river water quality, King Country Energy, 2013. Provided an assessment of water quality data (status and trends) for King Country Energy to assess water quality impacts of the Kuratau Power Station on Kuratau River as part of King Country Energy's consent monitoring obligations under the RMA.

Broad scale water quality assessment to inform the Rotokauri Integrated Catchment Monitoring Plan, Hamilton City Council, 2015. As part of a study assessing the water quality impacts of the Rotokauri structure plan implementation to support an integrated catchment management plan for the scheme, led field and desktop analysis of heavy metals and current and emerging organic contaminants. This involved analysis of sediment and water contaminants and installation of passive samplers to measure "averaged" water concentrations of emerging contaminants and metals and comparison of results with relevant guidelines to assess potential ecological effects.

Risk assessment

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.

Mahinga kai human health risk assessment, ***Health Research Council*** **2009-2011.** Involved in a project aimed at characterising the risks to Māori associated with consuming mahinga kai collected from rivers, lakes and coastlines in South Canterbury (Arowhenua), Rotorua Lakes (Te Arawa) and Whakatane (Ngati Hokopu). My role was to lead the design and supervision of field studies, contaminant analyses and develop human health risk assessment procedures for important mahinga kai species within each region. Project website.

Metals in tuna (eels) from the Lake Ōmāpere catchment, *Te Roopū Taiao o Utakura*, 2012. Tuna are an important source of kai to the local community of Lake Ōmāpere catchment. There were concerns that metals from a nearby geothermal field could be providing an increase consumptive risk to tuna from the catchment. My role was as scientific lead, using methods developed as part of the HRC programme to inform local community that tuna were safe to eat.

Te Waihora Mahinga kai biohealth study, *Te Waihora Management Board and Environment Canterbury*, 2013-2014. Lead investigator on a project to assess potential human health risks to local iwi from consumption of mahinga kai in the Te Waihora catchment. Developed risk assessment methods further from previous work. Communication of results with Te Waihora Management Board, Regional Council scientists, iwi and the larger community.

Environmental Chemistry/Water Quality

Emerging organic contaminants (EOCs) in the Waikato region's coastal marine area, *Waikato Regional Council*, 2016. Most research on risks from EOCs in New Zealand has been related to the urban environment (for example, see report below). WRC required a review of EOCs relevant to a predominantly rural region. Carried out a review of likely EOC profile in Waikato (based on predominant industries) and recommendations for future monitoring programmes.

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.

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.

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.

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).

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, Horizons Regional Council and MfE.

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 crap (*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.

Selected Recent Reports

Statement of Michael Stewart for Watercare Services Limited in the matter of the Resource Management Act 1991 and in the matter of an application for resource consent for the Warkworth and Snells Wastewater Treatment Plant ("WWTP") under the Auckland Unitary Plan – Operative in Part. 21 February 2017.

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. 153 pp. See ORC website for report.

Stewart, M. and 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. (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.

Stewart, M. (2016). Emerging organic contaminants in the Waikato region's coastal marine area compared to other New Zealand regions. Report WRC1604–1, Streamlined Environmental, Hamilton. 36 pp.

Stewart, M. (2016). Review of Waikato Regional Council Estuarine Sediment Contaminant Monitoring Programme. Report WRC1601-1, Streamlined Environmental, Hamilton, 61 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. (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). Analysis and comment on organochlorine pesticide and arsenic data from Lake Opuha. Prepared for Te Runanga o Arowhenua. 14 pp.

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., Hickey, C., 2014. Risk assessment of potential human health and ecological effects of spills of on-site chemicals at Huntly Power Station.

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, TR2013/00*2. 51 p.

Olsen, G.; Stewart, M.; Albert, A.; Ovenden, 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.

Williams, E.K.; Stewart, M.; Boubée, J.A.T.; Dalton, W. (2012). Metals in tuna from the Lake Ōmāpere catchment. A preliminary assessment. Prepared for Te Roopū Taiao o Utakura. *NIWA Report HAM2012-011.* 47 p.

Baker, C.; Aldridge, B.; Stewart, M. (2011). Pond-scale tests of a semio-chemical attractant for perch control. *NIWA Report HAM2011-28.* 25 p.

Stewart, M.; Olsen, G.; Phillips, N.; Hickey, C. (2011). Contaminants in kai – Arowhenua rohe. Part 1: Data Report. *NIWA Report HAM2010-105.* 79 p.

Stewart, M.; Hickey, C.; Phillips, N.; Olsen, G. (2011). Contaminants in kai – Arowhenua rohe. Part 2: Risk Assessment. *NIWA Report HAM2010-116.* 82 p.

Phillips, N.; Stewart, M.; Olsen, G.; Hickey, C. (2011). Contaminants in kai – Te Arawa rohe. Part 1: Data Report. *NIWA Report HAM2010-21.* 69 p.

Phillips, N.; Stewart, M.; Olsen, G.; Hickey, C. (2011). Contaminants in kai – Te Arawa rohe. Part 2: Risk Assessment. *NIWA Report HAM2010-23.* 82 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.

Olsen, G.; Stewart, M. (2009). Organic Contaminants in Sentinel Shellfish: 2008 Data. *NIWA Report HAM2009-115.* 36 p.

Olsen, G.; Stewart, M. (2009). Organic Contaminants in Sentinel Shellfish: 2007 Data. *NIWA Report HAM2009-022.* 36 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.

Peer-Reviewed Publications and Book Chapters

22 in peer-reviewed scientific journals (12 as first author), and 3 book chapters. Available on request.