Structured internal project application 2025-2026

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| **Project Overview** |  |
| **Project name: (Short title)** | Development of QMRA Assessment Toolkit |
| **Staff: (who will be completing the work?)** | Reza Moghaddam (Lead Developer - 120 hrs), David Wood (Model Review & Support - 30 hrs) |
| **Project Manager:** | Andrew Hughes |
| **Region:** | Hamilton |
| **Centre:** | Freshwater |
| **Type: (science, operations activity, or other - explain)** | Science (Applied Research & Development) |
| **Budget: (attach costing prepared by your project coordinator)** |  |
| **Project objective: (30 words max)** | Develop a Python-based Quantitative Microbial Risk Assessment (QMRA) assessment toolkit to standardise processes, improve reproducibility and auditability, and reduce manual work for regulatory compliance assessments. |
| **Project outline: (150-300 words max)** | Earth Sciences New Zealand currently undertakes Quantitative Microbial Risk Assessment (QMRA) projects using @Risk Excel add-in, which has proven problematic and costly. @Risk relies on error-prone Excel-based workflows with extensive manual processes that could be automated. Recent projects have lost up to 80 hours due to security system conflicts within NIWA's firewall environment, requiring client extensions and budget overruns. Based on our project experience, typical QMRA projects involve 40-60 hours of manual work using @Risk's cumbersome Excel interface.  This project will develop a Python-based QMRA assessment toolkit following a Minimum Viable Product (MVP) approach. The toolkit will replace @Risk dependency, eliminate manual Excel-based processes through automation, incorporate ESI's dilution modelling capabilities (our key differentiator), and work with engineer-provided log reduction values rather than attempting complex treatment calculations.  The project delivers: (1) a Python QMRA toolkit replacing Excel-based workflows, (2) technical documentation via NIWA Technical Report, and (3) stakeholder engagement through webinar rollout. |
| **Project outputs: (e.g., a journal paper or an App, or a safe operating procedure or guidance document for operations activities)** | 1. **Python-based QMRA toolkit** providing:  * Norovirus exposure models for primary contact and shellfish consumption * Dilution modelling integration module (NIWA's key differentiator) * Validated dose-response database with engineer-provided LRV inputs * Standardised reporting templates for regulatory compliance * User-friendly interface with automated calculations  1. **NIWA Technical Report** documenting:  * QMRA methodology and theoretical foundation * Python implementation details and architecture * Validation procedures and benchmark comparisons * User guidance for operational deployment * Worked examples demonstrating toolkit application  1. **Stakeholder engagement deliverables:**  * ESI web page outlining toolkit capabilities and contacts * Professional webinar for consultants, councils, and regulatory bodies * Demonstration materials showcasing enhanced functionality |
| **Project impact: (choose an SCI impact area that the project aligns with, see graphic below)** | Protecting our diversity Improved environmental health |
| **Alignment: (with a programme and/or National Centre outcomes or KPIs)** | This project aligns with Earth Sciences New Zealand's analytical capabilities development and supports regulatory compliance services. It develops our technical capacity for water quality risk assessment and supports our role in environmental protection. The improved reproducibility and auditability will strengthen our credibility with regulatory bodies. |
| **Outcomes for Māori: (may include partnerships, resourcing, alignment with aspirations)** | Supporting improved water quality assessment capabilities that contribute to protecting water bodies important for cultural values and mahinga kai. The developed QMRA capabilities will support decision-making that considers cultural significance of water resources and traditional food gathering practices. |
| **Operations alignment: (for non-science projects, how does this work contribute to inputs or enablers from the graphic below)** | Not applicable |

The QMRA Assessment Toolkit processes multiple data inputs through a modular Python-based system. Input data includes water quality measurements, pathogen concentrations, user-defined log reduction values, population demographics, and exposure scenarios. The core processing engine integrates a norovirus pathogen database as the initial proof-of-concept, applies Monte Carlo simulation for uncertainty analysis, and implements validated dose-response models. The system generates comprehensive outputs including risk assessment results, regulatory compliance reports, health risk estimates, and decision support documentation for environmental health protection, while integrating Earth Sciences New Zealand's dilution modelling capabilities.

# WORK PROGRAMME AND TIMELINE

Outline the tasks to be done, who will do what and by when. Be as specific as possible.

**Table 1:** Work Programme and Timeline for QMRA Assessment Toolkit Development with Regular Review Meetings

| **Task** | **Specific Activity** | **Hours** |
| --- | --- | --- |
| **Requirements Assessment** | Review Charlotte Jones-Todd's R package, assess current Excel application, define conversion requirements and enhanced functionality scope (Reza) | 10 |
| **Review Meeting 1** | Requirements and scope review (David & Reza) | 2 |
| **Python Conversion & Core Development** | Convert Excel application to Python framework, implement norovirus exposure models (primary contact and shellfish consumption), develop user interface (Reza) | 15 |
| **Dilution Modelling Integration** | Integrate Earth Sciences NZ's dilution modelling capabilities, implement automated workflows (Reza) | 10 |
| **Review Meeting 2** | Implementation progress and technical review (David & Reza) | 2 |
| **Monte Carlo & Advanced Features** | Implement Monte Carlo simulation replacing @Risk functionality, uncertainty quantification, automated reporting (Reza) | 10 |
| **Testing & Validation** | Validate against Excel benchmarks, test functionality across exposure scenarios, ensure regulatory compliance outputs (Reza) | 8 |
| **Technical Model Review** | Review of implementation, validation of dose-response relationships and dilution integration (David) | 18 |
| **Technical Report Preparation** | Prepare NIWA Technical Report as user guide documenting methodology, step-by-step instructions, validation, worked examples, and practical operational guidance (Reza) | 35 |
| **Report Review & Finalization** | Technical review, feedback, and finalization of Technical Report (David) | 10 |
| **Webinar Development** | Develop webinar content, presentation materials, demonstration examples for stakeholder rollout (Reza) | 18 |
| **Stakeholder Webinar Delivery** | Deliver professional webinar to consultants, councils, and regulatory bodies; demonstrate toolkit capabilities and answer technical questions (Reza) | 3 |
| **Web Page & Documentation** | Prepare ESI web page content, user documentation, quick-start guides (Reza) | 7 |
| **Project Closeout** | Final review meeting and handover (David, Reza & Andrew) | 2 |
| **Total Hours - Reza** |  | **120** |
| **Total Hours - David** |  | **30** |
| **Net Hours** |  | **150** |

**Strategic Investment in QMRA Capability**

**Market Opportunity:** The QMRA market is evolving with tightening regulatory requirements. Proposed wastewater standards will require QMRAs for discharges impacting shellfish gathering areas. The number of QMRA providers is contracting as key practitioners retire or exit the market.

**NIWA's Position:** David Wood and Public Health & Freshwater Science have been invited to collaborate with Taumata Arowai on developing national QMRA guidance, demonstrating regulatory trust and influence.

**Technical Advantage:** Converting to Python improves scalability, reproducibility, and audit trails while positioning ESI as a leader in modern QMRA methodology. Integration of dilution modelling capabilities represents our key market differentiator.

**Stakeholder Engagement:** The webinar rollout ensures rapid market awareness of enhanced capabilities, positioning NIWA to capture emerging regulatory-driven demand.

### Chief Scientist support

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| Chief Scientist comment: (For example - If agreement that project required, indicate why SIP mechanism versus Centre Funds; What is/are the key output(s) and how will NIWA/National Centre/programme/individual benefit from that; note that there must be an output at the end of the project)  I have liaised with Reza and Andrew over the last week to help shape the strategic direction of this proposal. Based on the case that has been made to me, I agree that this would be a valuable project that should contribute to generating future work. | |
| Signature  A signature on a white background  AI-generated content may be incorrect. |