

Structured Internal Project Application 2024-2025

Project Overview

Field	Details
Project name:	Development of QMRA Workflow Engine
Staff:	Reza Moghaddam (Lead Developer)
Project Manager:	[To be assigned - Group Manager]
Region:	Hamilton
Centre:	FRESHWATER
Type:	Science (Applied Research & Development)
Budget:	\$27,500
Project objective:	Develop a Python-based QMRA workflow engine to reduce project delivery time by 60-70% and capture greater market share in the expanding regulatory compliance sector.

Project Outline

Quantitative microbial risk assessment (QMRA) represents the gold standard for evidence-based decision-making in water and food safety. With national wastewater performance standards becoming mandatory in August 2025 and approximately 60% of treatment plants requiring consent renewals, there is urgent market demand for efficient QMRA delivery capabilities.

This project will develop a comprehensive Python-based QMRA workflow engine from the ground up. Current QMRA projects require 60-80 hours of manual work: 20 hours building dose-response models, 25 hours on treatment calculations, 15 hours for simulation setup, and 20 hours for reporting. Our workflow engine will reduce this to 20-30 hours through standardized components, automated processes, and reusable modules.

The technical approach leverages Python's full ecosystem including NumPy/SciPy for numerical computations, pandas for data management, and specialized libraries for statistical modeling. This native Python implementation ensures optimal performance, maintainability, and integration with modern data science workflows. The system will incorporate advanced methodologies including Bayesian approaches for parameter uncertainty quantification, validated through recent applications in dairy product safety, respiratory pathogen policy, and wastewater treatment risk assessment.

Recent New Zealand-specific research validates the critical need for localized QMRA approaches, particularly for recreational and drinking water contamination assessment and emerging pathogen identification. Our workflow engine will position NIWA as the premier provider of regulatory-grade QMRA services in this expanding market.

**Expected outcomes:** 60-70% reduction in project delivery time, improved competitive win rate from 60% to 80-85%, and strategic positioning for the \$25-50M regulatory compliance market opportunity. Investment recovery is projected through 2-3 projects, with \$100-200K additional annual revenue from enhanced competitive positioning.

## System Architecture

The QMRA Workflow Engine will be built as a comprehensive Python application featuring automated processing modules and standardized outputs for regulatory compliance. The modular architecture enables:

- **Pathogen Database Module:** Standardized dose-response relationships using Python statistical libraries
- **Treatment Assessment Module:** Automated log-reduction calculations with NumPy/SciPy
- **Risk Simulation Engine:** Monte Carlo analysis with uncertainty quantification using native Python implementations
- **Regulatory Reporting Module:** Automated compliance documentation and visualization
- **Data Management Layer:** Robust data handling using pandas and modern Python data structures

## WORK PROGRAMME AND TIMELINE

Task	Specific Activity	Responsible	Timeline	Hours
Requirements & Design	System architecture definition, QMRA methodology analysis, stakeholder consultation	Reza	Month 1	40
Core Development	Pathogen database creation, dose-response model implementation, Python framework development	Reza	Months 2-3	80
Advanced Features	Monte Carlo simulation engine, Bayesian uncertainty quantification, statistical modeling	Reza	Month 4	40
Testing & Validation	Performance testing, regulatory benchmark validation, quality assurance protocols	Reza	Month 5	25
Documentation & Training	User guides, technical documentation, training materials development	Reza	Month 6	15

Task	Specific Activity	Responsible	Timeline	Hours
Deployment & Transfer	System deployment, staff training, knowledge transfer protocols	Reza	Month 6	10

Total Project Duration: 6 months

Total Effort: 210 hours

BUDGET BREAKDOWN

Item	Rate/Cost	Hours	Total
Reza Moghaddam (Senior Developer)	\$125/hour	210	\$26,250
Computing resources & software licenses	Fixed cost	-	\$750
Documentation & training materials	Fixed cost	-	\$500
TOTAL PROJECT COST:			\$27,500

PROJECT JUSTIFICATION

Market Opportunity & Business Case

The August 2025 regulatory deadline creates an immediate \$25-50M market opportunity for QMRA services. Current inefficiencies are causing direct business losses through failed competitive bids, with recent project losses to competitors highlighting the urgent need for operational improvements.

Quantified Benefits:

- **Efficiency Gains:** 60-70% reduction in project delivery time (60-80 hours → 20-30 hours)
- **Revenue Recovery:** Full investment recovered through time savings on 2-3 typical projects (\$15-50K each)
- **Competitive Advantage:** Projected win rate improvement from 60% to 80-85%
- **Annual Revenue Impact:** \$100-200K additional revenue from enhanced competitiveness

Technical Foundation & Risk Assessment

Technical Strengths:

- Pure Python implementation ensures optimal performance and maintainability
- Comprehensive use of mature Python scientific libraries (NumPy, SciPy, pandas)

- Modern software architecture enabling easy extension and customization
- No dependency on external statistical software reducing licensing costs and complexity

#### **Risk Mitigation:**

- **Technical Risk:** LOW - leveraging mature, well-supported Python ecosystem
- **Implementation Risk:** MINIMAL - single developer approach ensures consistent architecture and design
- **Deployment Risk:** LOW - modular Python design allows phased rollout and validation

**Research Foundation:** Advanced QMRA methodologies including Bayesian hierarchical modeling for parameter uncertainty reduction provide proven approaches for systematic risk assessment. New Zealand-specific pathogen research validates the critical need for localized analytical tools.

#### **Strategic Alignment**

This project directly supports NIWA's Impact Strategy through:

- **Competitive Positioning:** Establishing NIWA as the market leader in regulatory compliance QMRA services
- **Regulatory Engagement:** Enhanced capability to support national wastewater performance standards
- **Technical Innovation:** Modern Python-based solution providing superior performance and maintainability
- **Revenue Growth:** Capturing disproportionate market share in the expanding regulatory compliance sector

The workflow engine represents a strategic investment in NIWA's long-term competitive position, transforming current operational inefficiencies into market-leading capabilities that directly support regulatory compliance objectives across New Zealand.