Environmental Sustainability and Waste Management at Ella Bay

Introduction

Ella Bay is being designed to set new benchmarks in the sustainable use of energy and water in a residential development. In line with their integrated Master plan, the proponents, P3, intend Ella Bay to be independent of water supply and sewerage infrastructure. P3 will build a 6000 e.p. onsite treatment plant, with tertiary treated water used for toilet flushing and irrigation of the golf course and gardens.

A consortium of UQ researchers is interested in involvement with the project, and the range of innovations that are possible if a relationship can be established at the planning stage. Extending the theme of onsite waste treatment, the UQ consortium proposes a range of studies to support an overall nutrient balance for the site. From a systems perspective, minimizing the import of nutrients to the site and the inventory of nutrients within the site will reduce the risk of emissions to protected areas. The preferred treatment system can be selected on the basis of these criteria.

Proposed Scope

The system assessment will be encapsulated in an analysis of nutrient fluxes through Ella Bay. Nutrient inventories within the system will include the treatment plant, vegetation, harvested vegetative matter, fertilizer, food, detergents, surface water, lowland marshes and groundwater. Further delineation of inventories will be beneficial for optimizing particular activities. e.g., nutrient fluxes through hotels might be significantly different to that through residential areas.

A dynamic model can be used to simulate fluxes between these inventories. A range of expertise will be required for different facets of the systems model. e.g.,

- wastewater design and control expertise for the treatment plant and overall optimization of nutrient management in Ella Bay.
- nutrient uptake in natural systems such as wetlands
- nutrient release from the degradation of organic solid wastes
- percolation of nutrients through soil and with groundwater
- transformation of nutrients within the subterranean tidal mixing zone.

The treatment system will be the key process in the nutrient model. The model will indicate the required performance of the treatment system. It may be more sustainable to opt for a lower energy system that relies on uptake by other inventories to meet discharge requirements (e.g., the golf course, wetlands), thereby recycling nutrient and reducing nutrient influx to the site.

The Team

The UQ team consists of researchers with established international reputations in their respective fields. The following personnel have expressed interest in this proposal.

Process Engineering: UQ has leading research and development engineers and scientists in the treatment of wastewater and solid waste, particularly focusing on nutrient and energy recovery. The UQ team has the track record to meet the stringent environmental standards required of the site. The personnel will include **Professor Jurg Keller**

(Director, AWMC, expertise on nutrient removal and recovery and energy recovery from wastewater), **Dr Damien Batstone** (Chair, IWA AD Modeling group, Assoc editor *Wat Res*, expertise on anaerobic digestion and bioengineering); **A/Prof Bill Clarke** (Director, Env Eng program, expertise in solid waste digestion and composting); **Dr Lydia Kavanagh** (Senior Design Lecturer, expertise in ecologically sustainable treatment of wastewater).
Groundwater modeling: UQ has Australia's leading group of groundwater modelers. This includes **A/Prof David Lockington** (Director, Centre for Water Studies, Assoc editor *Wat Resour Res* and *Adv Wat Resour*, expertise in groundwater and nutrient percolation), **Prof Ling Li** (Assoc editor *Adv Wat Resour* and *Hydrogeology J*, expertise in tidally induced groundwater-ocean interactions); **Dr Kate O'Brien** (Lecturer, Chemical and Env Engineering, expertise in surface water quality modeling, esp. algal dynamics); **A/Prof Bill Clarke** (expertise in geochemistry).
Estuarine ecology and water quality analysis: **Dr James Udy** (Adjunct Professor, expertise in estuarine ecology, water quality analysis and monitoring).

Two of the researchers, **A/Prof Clarke** and **Prof Keller**, have an established relationship through an ARC Linkage project and Community Water Grant with **Econova**, government licenced water and wastewater service provider. EcoNova have successfully designed, built and operated independent water infrastructure for similar projects. Our consortium can therefore provide design, optimization and installation of infrastructure, either in the form of a trial system within the development, or as more central system for the entire development.

This consortium is strongly supported by a number of postdoctoral fellows with further specializations, including microbial ecology, nutrient transport through soils, biofilm modeling and energy recovery from waste.

Schedule and Terms
Preliminary work is required to define subprojects within the broader goal of system optimization to minimize nutrient impacts. A suggested progression might be:

- *Baseline studies* to determine surface and subsurface baseflows and nutrient fluxes;
- *Development of a systems model framework* to obtain an initial estimate of nutrient inventories and fluxes.
- *Ongoing refinement of model* with subprojects focused on speculative aspects of the model. e.g., groundwater fluxes; treatment system performance; releases of nutrients from decaying vegetation.

The consortium is happy to proceed in smaller stages with decision branch-points at the end of each stage. The work will be costed on a commercial basis. Inkind commitments will only be considered if they contribute to part ownership by UQ of IP or a commercial venture. In either case, UQ will require a clear exit strategy.

As an indication of the level of involvement we believe necessary to provide the nutrient balancing/modelling, treatment systems concept design, testing and support during procurement and commissioning of the onsite system, a budget of $300-400K p.a. would

be required during the initial 3 year phase of the project, followed by a reduced ongoing involvement of $100-200K p.a.