Dealing with Glenorchy's faeces urine and greywater - grasping the potential by thinking differently

The Glenorchy sewerage debate so far has avoided attempting to grasp the potential that is available to us. Let us look at this potential through the lens of solving the nitrogen (N) issue with a different way of thinking; one that acknowledges that sewage is a mixture of faeces, urine and greywater.

Using the fact that 81% of the nitrogen is in the urine to explore this potential (Table 1) then, if we fitted urine separating toilet bowls and captured this 81% at source, this is sufficient for our septic tanks to generate discharge quality effluent (better than an AWTS system - Figure 1). Indeed, our septic tanks would perform even better if the faeces were also captured (faeces + urine account for 92% of the N in the sewage – and roughly half of the sludge). In addition, as some of these urine + faeces capturing technologies do not need a water flush we could also reduce water and energy consumption and be even more sustainable. With this combination of technologies the septic tank is an OK technology.

Yet septic tanks are portrayed as a problem technology within the current discussion; but with the above evidence they are only a problem if the toilet wastes are mixed with the greywater. The assumption that the three waste streams have to be mixed to form sewage is the current debate's starting assumption that needs to be challenged - the potential inherent in encouraging different toilet technologies is absent so we cannot even begin to grasp it.

Table 1 – The amount of nitrogen in each of the 3 waste streams that form sewage. Note: 1/ 92.5% of the N originates from the toilet; 2/ Most of the *volume* is in the greywater (120 L/p/d – 98.89% if there is no toilet flush); 3/ The toilet flush (80 L/p/d) is technology dependent.

	Urine (%)	**Faeces** (%)	**Greywater** (%)	**Total**
Nitrogen g/p/d	10.9 (81.3%)	1.5 (11.2%)	1 (7.5%)	13.4
Volume L/p/d	1.2 (0.99%)	0.14 (0.12%)	120 (98.89%)	121.34
With flush	80 (40%)		120 (60%)	200

In addition, most of us are culturally wedded to the flush toilet and this cultural preference is deeply embedded in the technologies that are developed, and also the laws that our councils operate under (they call it waste water, when faeces are not water and could be considered a nutrient-rich resource). Therefore in order to grasp the potential that is before us, our main issue is social rather than technological.

In contrast, the debate could have begun with measureable parameters (volume is a good one that is easily measured) and a technology's performance based on N in the water exiting the technology. With these starting assumptions then **all** technologies can be considered without prejudice as they only need their measured performance to be known and this performance will be influenced by capturing N at source.

Beginning the discussion without a technology prejudice means we can also rate all technologies against other socially important issues, such as:

- Local issues
    - Current and future residents.
    - Commerce and domestic.
    - Holiday homes.
    - Tourists.
    - Affordability/cost
- Resilience – yes we do live close to the alpine fault and should consider the consequences of this rupturing.
    - Modularity to manage the risk of total failure.
    - Ease of repair.
    - With this spring's dryness perhaps we should also consider incentives to use greywater to keep our grass alive.

And while we have a different way of thinking, why not consider how the intent of the community plan can be included. The recent community visioning process found *sustainability* to be the most frequently occurring word that residents wanted in their vision statement. Under this sustainability constraint the best technology would: use zero water, need zero energy and recycle all nutrients. Zero is a useful measure to enable listing of all technologies from best to worst. These prioritised lists are eminently suited for a high quality public debate - where nutrient recycle can be viewed as zero nutrients to receiving waters (Figure 1).

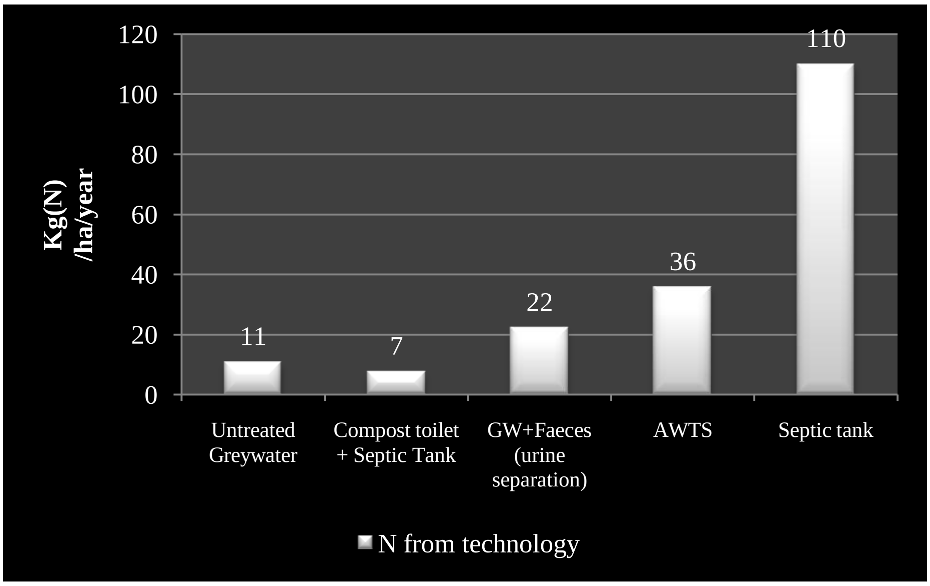

Figure 1 – Nitrogen in the wastewater from different combinations of technologies. Data based on 2.6 people/dwelling on an 800 m^2 section and a 30% N reduction within a septic tank. The collected urine and faeces are assumed to have zero N discharges to the lake.

However, grasping the potential involves a technology change that is beyond the cultural mores of most people. This technology change therefore requires consideration of the social conditions that trigger change. More particularly we need to create space for individuals who are able to step beyond these cultural mores and want to choose differently. These are the primary adopters (or early adopters if you are into marketing) that are an important component of social change.

Our sewerage debate therefore needs to include how these highly motivated individuals can be accommodated within a community scheme – and perhaps acknowledge that the proportion of these individuals may increase over time.

However, these individuals need to be influenced by the measurements based on volume and N if we are to avoid the technology prejudice mentioned above.

There is a role here for the council to internalise to the decision maker the consequences of technology choice on the amount of N entering receiving waters by consideration of:

- The scale necessitated by the N being mainly sourced from the toilet.
    - For community considerations, the dwelling is a useful scale as this can interface with the council rating system due to it being on a legal title and dwelling construction is a time of technology choice.
- Using the council rating system to internalise the environmental consequences of N in receiving waters to the owners of the dwelling. This provides councils with a tool by which they can satisfy their legal responsibility for wastewater; as *responsibility for* is not necessarily the same as *possession of*.
    - Using the rating system necessitates an interface with the economic system for which manufactured (and operating) cost divided by a technology's measured performance is a useful measure.
    - It includes the potential inherent in polluter pays and using this revenue for cross subsidisation to encourage choice of more sustainable technologies. N improvement can be fiscally neutral and avoid the expense of polluters needing to be prosecuted.

The dwelling scale is therefore very important for this different way of thinking as it enables all of:

- Construction of a dwelling is a period of technology choice therefore:
    - Information can encourage desirable technology choices.
    - Acknowledgment of the contribution of those who choose technologies that capture their N at the toilet.
- Incremental improvement in N entering the lake as each dwelling decides to reduce their N output.
    - Incremental improvement also optimises the affordability issue by minimising the interest payments that arise from the large up-front cost of a conventional sewerage system and simplifies cross subsidisation.
- Is consistent with social change mechanisms that are necessary to move away from an embedded technology that is underperforming.

The council can manage the information flow by a range of possible tools (such as polluter pays, cross subsidisation and simplified information charts such as those of Figure 1). However, there are two useful points for this council influence:

- Consent stage for new houses; and
- Annual rates (useful for excessive N discharge).

With this way of thinking, Glenorchy can begin with the intention of reducing its nitrogen load to Lake Wakatipu; then encourage adoption of those technologies that best achieve this from the full suite of available technologies. In addition, with the administrative framework based on volume and N, any debate on a community system reduces to: "is it fair that cost proportions are based on $\$/m^3$ and $/g(N)?"; and this debate avoids any technology bias.

The public debate is further enhanced by the relevant information being in a visual form (Figure 1).

It may be that a centralised sewerage system is the ‘best’ for our purpose but if that is the case then the evidence will support this as centralised sewerage is included in the potential as one of the technology possibilities.

So what about future generations, those not yet born who will have to live with the consequences of our decisions? Encouraging the capture of N from urine and faeces results in a technology system that can be easily adapted by future generations so, if the fertiliser value of these nutrients becomes more important for growing food and biofuels, they can be easily recovered. The potential remains alive for these future generations. Consequently, they can have a voice in current decisions as it is reasonably predictable that water, nutrients and energy will become increasingly important.

There is considerable potential before us in terms of the way our technologies are chosen. However, accessing this potential is best achieved by paying attention to the organisational framework that surrounds the choice of technology, rather than being swamped by the technical details of particular technologies. The community debate does not need any detailed knowledge of the technologies as the detail impacts a technology’s relative position in the graph of Figure 1 – an informed debate that includes the details becomes possible. This potential extends to identifying alternatives to rules and discharge limits for councils to satisfy the intent of their governing Act. Potential creativity is also released in other areas such as why put your greywater into a septic tank when it can keep your lawn nice and green and further reduce your demand for potable water. This creates an incentive for commerce to develop better N recovery technologies that will satisfy our cultural mores.

In Glenorchy’s case, using the legal title (which includes commerce, public toilets and private dwellings) and the nitrogen in the wastewater discharged from this title is sufficient to tap into this potential. Sending incentives to the decision maker (usually the title owner) to choose technologies that decrease the N in the wastewater means we can take responsibility for our N discharges. Those who don’t want to take responsibility for their own N can pay an annual fee which generates a funding source to assist those who do, as a part of this continuum is polluter pays. With this way of thinking, the legal responsibility of councils can be made explicit by the mix of incentives/disincentives which can be set to effect the *rate* at which *community* N discharges decrease. This can all be done in a manner that contains no technology preference and taps into the natural variability in humans, some of whom will be comfortable choosing those technologies that capture N at source. These change agents may be a minority but their value is such that their contribution should not be swamped by a simple majority vote.

For our proposed centralised sewerage system debate, having each dwelling knowing its nitrogen load in its wastewater and all technologies available to deal with this nitrogen means the value of a community wide collection system can be assessed against all possibilities. Indeed, individual dwellings who wish to collect the N at the toilet can be fairly accommodated within a centralised collection system – but this is discussed elsewhere.

For those who wish to see my submission to Council on this way of thinking you can down load it from my website: paulchapman.nz/papers/Design-optimisation-for-Glenorchy.pdf.

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