FH Wetland Systems

Dry Toilets

Background information

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1.0 Introduction

Féidhlim Harty Wetland Systems (FHWS) was established in 1996 to provide a design, consultancy and planting service for constructed wetlands and to increase public awareness of constructed wetlands, wetland habitats and water quality. Since then, FHWS has expanded to include other services to meet the growing awareness on environmental sustainability. Now nearly twenty years in business, FHWS continues to offer a professional yet personal service to home-owners, developers, industry and councils around the country.

This document is a background information document explaining some of the different types of dry toilets that may be used in Ireland to provide excellent protection of groundwater and surface water quality, recycling of nutrients and biomass and sequestration of atmospheric carbon.

The information included here is not site specific and should not be taken as design information for any given project.

2.0 Dry Toilet and Source Separation Systems

In the 2001 report for the Department of Agricultural Engineering in the Swedish University of Agricultural Sciences *Faecal separation and urine diversion for nutrient management of household biodegradable waste and wastewater,* Björn Vinnerås states simply that in order to "create a sustainable society, the nutrients in household biodegradable solid waste and wastewater have to be recycled to agriculture." This basic statement underpins the importance of exploring the options for source separation technologies in Ireland.

Dry toilets are only used by a minority of people in Ireland, and indeed elsewhere in western nations where access to water for flushing is usually plentiful. However, increasingly dry toilets are being included in national guidance documents as a way to both conserve water, recycle nutrients and prevent pollution. The most recent and local example of this trend is the EPA STRIVE Report by Dubber and Gill (2013) *Water saving technologies to reduce water consumption and wastewater production in Irish households*.

Over the past few decades, many environmental organisations and sewage treatment designers with an emphasis on sustainability have begun to question the ubiquitous use of flush toilets, in many cultures around the world. Many different "eco-toilet" designs have evolved to address the limitations of conventional systems. The most recent high-profile development in this area was the Gates Foundation *Reinvent the Toilet Challenge*, where a solution was sought for safe, affordable sanitation solutions for countries without the means to provide vast volumes of water for flushing away faeces.

Eco-designed outdoor dry toilet by P. Dillon.
Photo: Féidhlim Harty.

There are two distinct elements to wastewater generated in domestic dwellings, namely grey water and black water. The black water, from the toilets, is high in organic matter, nutrients and pathogenic micro-organisms. The grey water, from sinks, wash hand basins, showers, baths and washing machines can have elevated nutrient levels due to detergents, but is essentially free of the pathogenic bacteria usually associated with sewage effluent.

The problems typically associated with conventional sewage treatment methods and the associated alternatives can be summarised as follows:

1. Over-consumption of treated, potable water for use as flush water and the associated issues of over extraction from surface water reservoirs and groundwater aquifers. Water conservation using dry toilets has been cited by Dubber and Gill in the EPA STRIVE report, 2013.

2. Pollution of surface water resources and groundwater aquifers by the contaminants of domestic sewage.

3. Ongoing diversion of biomass and nutrients from agricultural land to water or landfill by way of waste food and human excreta and the associated erosion of both quantity and quality of agricultural soil nationally and globally.

4. The fossil fuel consumption and pollution of the aquatic environment by artificial fertilisers that are used to address the chronic losses of recyclable biomass material back to agricultural land. Vinnerås (2001) notes that by returning human urine, faeces and biodegradable solids (uneaten food waste and the food waste present in grey water) back onto agricultural land, the need for "fossil nutrient supplementation" would drop significantly.

Simple indoor dry toilet serving a single house.
Photo: D Taylor.

There are many different types of eco-toilet. Urine separator toilets, compost toilets and faecal separators, to cite three categories, all developed out of an awareness of the growing problems of wasting both water and nutrients by flush toilets and causing water pollution with sewage effluent. Many different sewage management technologies have been developed and researched to meet our need for greater sustainability. Scandinavia has been particularly advanced in this regard, and is a European leader in urine separation for both domestic and municipal scale applications; compost toilet development; and faecal separation for use with flush toilet infrastructure.

Aquatron faecal separator with rotating carousel for compost.
Photo: Féidhlim Harty

3.0 Different Types of Dry Toilets

There are a number of different basic approaches to what has been termed DT-technology. The most basic dry toilet type is the out-door pit toilet, the outdoor privy. At its most elaborate, there are American models which are self-contained composting systems which have electrically powered mixing/aeration bars that turn the organic matter within a plastic chamber; the resulting compost moves through the unit over time until it is ready for removing to the garden for use as mulch or nutrient rich compost.

The different types of dry toilet systems are differentiated by the following characteristics:

- Indoor or outdoor. Indoor systems have an obvious advantage that they are within easy access for regular use, particularly if they are the main toilet within the house. Outdoor systems have the advantage that they can be less costly to construct and less regular in their maintenance requirements. The potential for odour generation is less problematic in outdoor systems.

- Self-contained composting types or remote composting types. Self contained systems compost the faecal matter within the toilet itself, with the obvious advantage that by the time comes for emptying, the organic matter is well composted. The advantage of the remote composting systems is that the composting location is not fixed, and greater space can be found in an outside composting location. Whichever one is chosen, the compost use must be considered and the composting method appropriate to the needs of the users; taking into account both hygiene and physical abilities.

- Electrically powered aeration, manual rotary aeration or stationary. Electrically powered mixers or fans have the advantage of minimising or eliminating odour nuisance and increasing composting speed and efficiency. They have the drawback of introducing an energy consumption element into the equation.

- Electric drying or not. Toilets such as the Lectrolav work by drying out the faecal matter and urine completely, greatly reducing its volume and making emptying a much easier and more pleasant job. Such units tend to use a lot of electricity compared to others, and this must be considered in the context of rising fuel costs and environmental impact.

- Urine separation or mixed. Since urine is basically bacteria free and very nutrient rich it makes a valuable liquid fertiliser, so keeping it separate from the faecal matter is an advantage for ease of use in farming or gardening. Generally the drier the compost in a dry toilet system, the easier it is to maintain, so separation of urine is typically recommended. However some self-contained composting units specifically require the liquid input from urine to create the appropriate composting environment.

- Compost chamber size. Larger units generally need more strenuous maintenance at less frequent intervals than smaller storage units. However, with a good self contained composting system, the longer maintenance interval does not necessarily mean a proportionally greater volume, since the composting process reduces the overall weight and volume of the organic matter. Space within the house is also a factor to consider when deciding upon system type in this context.

- Maintenance input. All the systems require emptying in some form or another. Self contained composting types require emptying of the compost; remote composting types require removal of faecal matter to a good outdoor composting system and then emptying of finished compost from there. Urine separation tanks require emptying when full. The urine tank capacity and frequency of use will clearly dictate the frequency of emptying and volume of each empty. Remote urine separator toilets such as the Nonolet require emptying every couple of days if in constant full family use, whereas piped urine separation tanks can have capacities sufficient for an entire development, emptied at the required interval by farmers for the fertilizer value of the liquid. Each system type has a different set of maintenance requirements and these must be carefully considered in the selection of a dry toilet system.

- Fully Dry Toilet or Hybrid System. Some of the advantages of DT Technology can be employed in conjunction with a flush toilet system where appropriate. Aquatron separators for example separate flush water from solids to allow remote composting of faecal matter while at the same time enjoying the advantages of flush toilets within the house such as ease and familiarity of use. Urine separator toilets divert urine to an external urine storage tank while flushing away faecal matter and paper to an Aquatron, septic tank or sewer. Thus the urine can be reused on the garden or in agriculture, keeping about 50% of the nutrients out of the sewer system relatively easily.

- Cost. There is a large variation in costs, varying from inexpensive DIY out-door pit systems to the most elaborate systems with associated price tags. Each person has a different budget and different set of priorities.

A further consideration is the availability of public facilities for maintenance/composting. For example in Holland the use of dry toilets is commonplace on the canal house-boats. In this instance a urine-separating remote-composting toilet model (Nonolet Recreatie) is used and the resulting dry material is simply lifted out in a purpose made bag and placed in the local authority “greens” bins for removal and municipal composting. This is only appropriate where it is acceptable to the local authority, and where the composting set-up is sufficiently controlled for adequate break-down of pathogens.

Self-contained, outdoor composting toilet, showing rear access for removal of finished matured compost from either left or right chamber, depending on maintenance year.
Photo: Féidhlim Harty

4.0 Regulatory Authorities and Source Separation Systems

Increasingly public authorities are taking a more proactive approach towards compost toilets. In some countries their use is so taken for granted that specific infrastructure is available. For example in Holland the use of dry toilets is relatively commonplace on the canal house-boats. In this instance a urine-separating remote-composting toilet model (Nonolet Recreatie) is sometimes used and the resulting dry solids material is simply lifted out in a purpose-made biodegradable bag and placed in the local authority “greens” bins for removal and municipal composting. This practice would only be appropriate where it is specifically accepted by the local authority, as it is in Holland, and where the composting set-up is sufficiently controlled for adequate break-down of pathogens.

Although compost toilets have not been described in detail in the EPA Code of practice (2021) in Ireland, they are mentioned in the document as an option, and readers referred to the STRIVE report mentioned below. They have also been detailed in other EPA and government documents both in Ireland and elsewhere. Some examples of relevant guidance documents or government reports include the following:

- Dubber, D and L Gill (2015) EPA STRIVE programme 2007-2013. *Water Saving technologies to reduce water consumption and wastewater production in Irish households*. EPA, Wexford.

- EcoSanRes (2008) Guidelines for the Safe Use of Urine and Faeces in Ecological Sanitation Systems. EcoSanRes and Stockholm Environment Institute, Sweden. The EcoSanRes programme is funded by the government agency SIDA (Swedish International Development Cooperation Agency).

- EcoSanRes (2008) Guidelines on the Use of Urine and Faeces in Crop Production. EcoSanRes and Stockholm Environment Institute, Sweden.

- Environment Agency (2008) *Regulatory considerations for disposal of solid and liquid wastes from composting toilets.* Environment Agency, UK.

- Environment Alliance (2006) *Pollution Prevention Guideline No. 4 - Treatment and disposal of sewage where no foul sewer is available*. Environment Alliance (Environment and Heritage Service, Scottish EPA, UK Environment Agency), UK.

- EPA Victoria (2013) *Guidelines for Environmental Management: Code of Practice - Onsite* Wastewater Management. EPA Victoria, Australia.

- Ormiston AW and RE Floyd (2004) Auckland Regional Council Technical Publication No. 58 (TP58) *Onsite Wastewater Systems: Third Edition. ARC Technical Publication 2004*, Auckland Regional Council/Te Rauhitanga Taiao, New Zealand.

- US EPA (1999) *Water Efficiency Technology Fact Sheet - Composting Toilets*. USEPA, Washington DC.

- US EPA (1980) *Design Manual - Onsite Wastewater Treatment and Disposal Systems*. US EPA, Office of Water Program Operations and Office of Research and Development Municipal Environmental Research Laboratory. USA

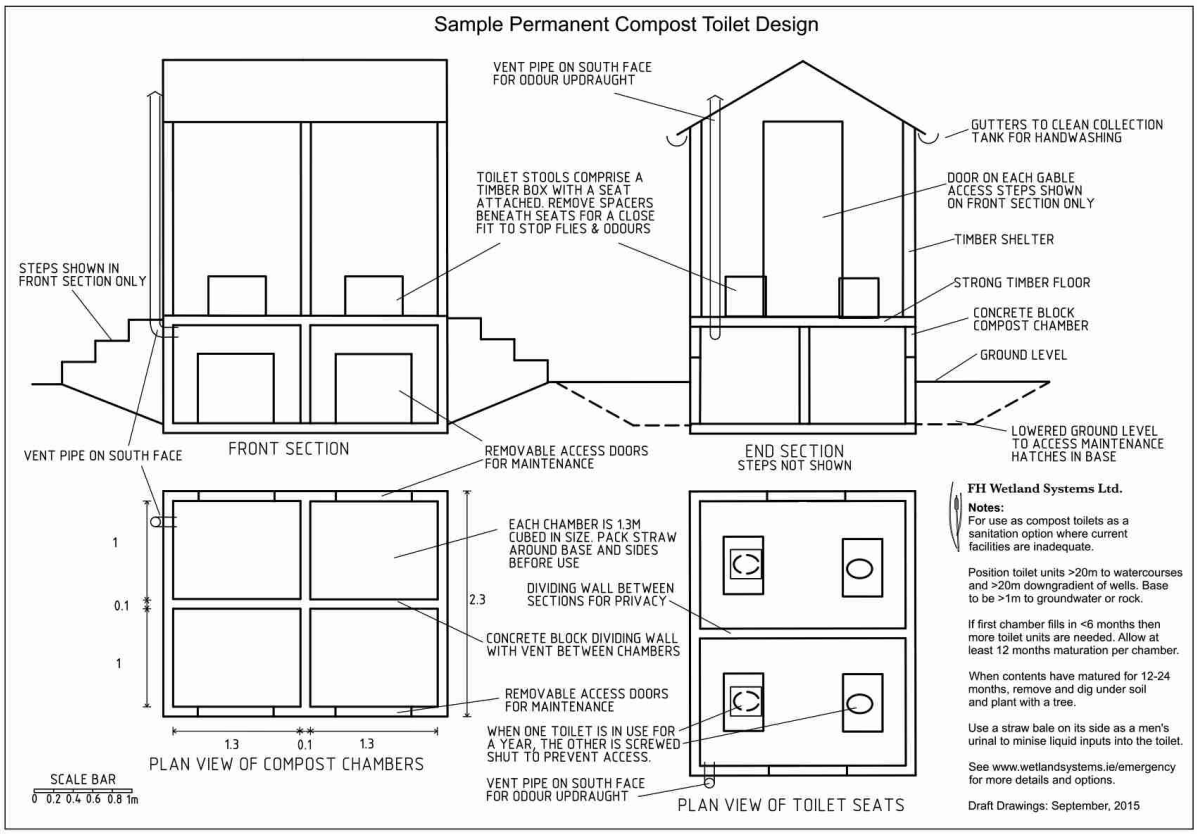
- Waitakere City Council (2008) *Waitakere City Council's Sustainable Home Guidelines - Wastewater.* Waitakere City Council, Wellington, New Zealand.

- West SM (2003) *Innovative On-site and Decentralised Sewage Treatment Reuse and Management Systems in Northern Europe & the USA*. Report prepared to benefit the Sydney Water Corporation, Australia. (Sarah West is also the author of the Victoria EPA Code of Practice)

It's clear from this sample of international government agency documentation that compost toilets are a widely accepted form of sanitation that offer much in terms of water conservation, water pollution prevention and sustainability. Specifically in the Irish context, the EPA Code of Practice (2021) requires local authorities to consider new technologies and innovative products on a case-by-case basis (Section 1.3), which allows the way for well designed compost toilet and source separation systems to be submitted and approved under existing Irish guidance.

FH Wetland Systems have worked with many clients over the years in the area of dry toilet or source separation advice and planning consultancy. The majority of clients are homeowners or owners of eco-camp sites and glamping sites with an ecological focus.

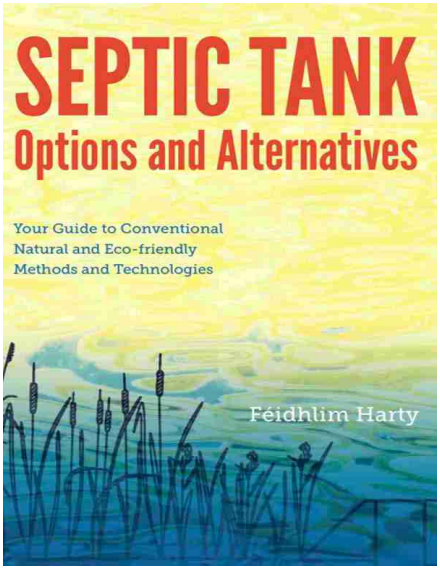
Front and rear photographs of low-tech domestic system. Remote composting semi-indoor use toilet, with large chamber which can be easily removed for maturation and then further composting as needed.
Photo: Féidhlim Harty

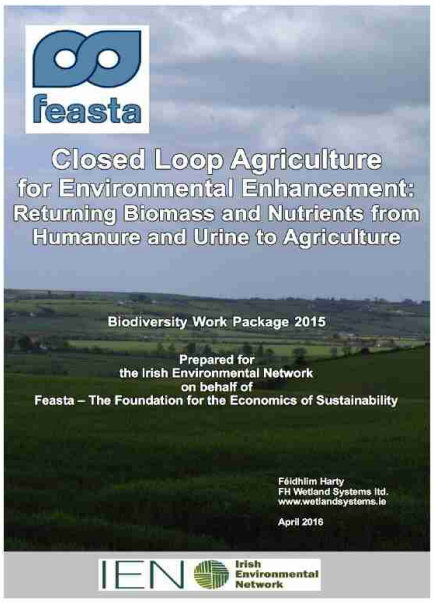


Sample designs for self contained double twin-chamber system, designs made available under Creative Commons Licence for ease of use by refugee supports in Calais and elsewhere in 2015.

5.0 Further Resources from FH Wetland Systems

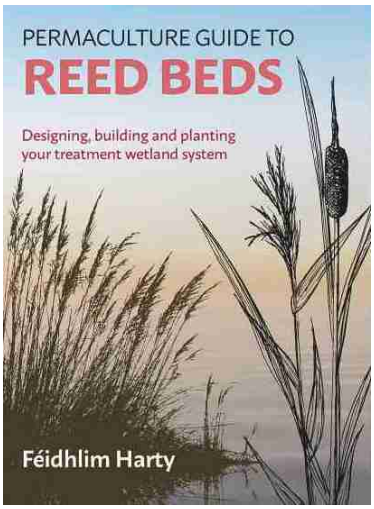
Septic Tank Options and Alternatives - Your Guide to Conventional, Natural and Eco-friendly Methods and Technologies was published by Permanent Publications in 2014 to address the many questions surrounding options for septic tank upgrades and new sewage treatment options on both green-field sites and existing homes.

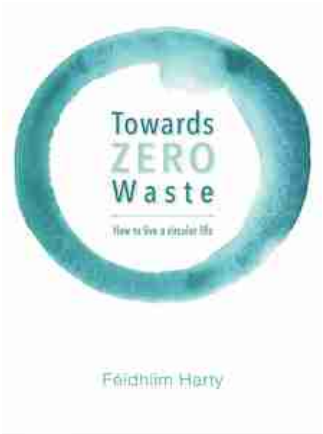




Closed Loop Agriculture for Environmental Enhancement: Returning Biomass and Nutrients from Humanure and Urine to Agriculture was published by Feasta – the Foundation for the Economics of Sustainability in 2016. This document addresses the many benefits to a dry toilet infrastructure for the environment, water quality, climate change, Irish agriculture, and soil biodiversity and vitality. (free to download from www.wetlandsystems.ie)

Permaculture Guide to Reed Beds looks at the A-Z of reed bed and treatment wetland selection, design, construction and planting for domestic systems. Published by Permanent Publications in 2017.





Towards Zero Waste – How to Live a Circular Life explores the many and varied ways to step back from excessive plastic, waste and environmental impacts. Permanent Publications, 2019.

https://www.wetlandsystems.ie/Bookshop.html

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Environment Agency (2008) Regulatory considerations for disposal of solid and liquid wastes from composting toilets. Environment Agency, UK.

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Vinnerås B, H Jönsson and J Weglin (2001) The composition of biodegradable solid household water and wastewater – flow of nutrients and heavy metals. Submitted to Bioresource Technology.

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