ZERO WASTE ALLIANCE IRELAND

Towards Sustainable Resource Management

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Joint Submission by Zero Waste Alliance Ireland and Herr Limited to the Environmental Protection Agency

in Response to the Agency's Public Consultation on the Draft Code of Practice for Wastewater Treatment and Disposal Systems Serving Single Houses

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19 March 2019

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Domestic Wastewater Treatment Consultation,
EPA,
McCumiskey House,
Richview,
Clonskeagh Road,
Dublin 14.

By email to: *d.inspections@epa.ie*

Dear Sir,

Joint Submission by Zero Waste Alliance Ireland and Herr Limited to the Environmental Protection Agency on the Draft Code of Practice for Wastewater Treatment and Disposal Systems Serving Single Houses

On behalf of Zero Waste Alliance Ireland (ZWAI) and Herr Limited, and in response to the invitation on the Agency's website, we are attaching an electronic copy of our observations on the draft Code of Practice for Wastewater Treatment and Disposal Systems Serving Single Houses.

Our observations express concern that the draft Code of Practice (CoP) addresses only one aspect of the treatment and disposal of wastewater from single houses, and is exclusively concerned with houses in rural areas where soil conditions are not suitable for the standard septic tank and percolation field treatment system. That issue is the prevention of pollution of groundwater and surface water; and, while we agree that this is a very important matter, the draft Code of Practice fails to address the need to conserve and recover dissolved nitrogen and phosphorus from the wastewater.

No attention is paid to the possibility of re-using treated grey water, and there is nothing in the draft Code of Practice about the old Irish tradition of saving rainwater which can be used in homes and gardens. In our opinion, rainwater should be considered as a valuable resource, available to augment our existing water supplies which we abstract from surface waters and groundwater.

We also consider that the draft CoP misses the opportunity to advise builders, architects and home owners of the recent advances in water-free or no-flush toilet designs, which eliminate the need for a water supply and for wastewater treatment and disposal. The Agency will be aware that our present system of water-flush toilets and wastewater treatment dates from the nineteenth century (though with some improvements in efficiency), requires a water supply and treatment of the resulting wastewater, while up-to-date systems now developed for "third world" countries (but which can also be applied in Ireland) require far less infrastructure and are equally effective in protecting human health.

Finally, ZWAI welcomes this public consultation being carried out by the Agency, and we are pleased to have the opportunity to present our observations.

Yours sincerely,

Ollan Herr — Jack O'Sullivan

Herr Limited — **Zero Waste Alliance Ireland**

ZWAI-EPA-SHWWTCOP-10 Submission cover letter, 19-Mar-19.doc

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1. INTRODUCTION AND PRELIMINARY COMMENTS

1.1 Purpose and Structure of Our Submission

The purpose of our submission to the Environmental Protection Agency on the draft Code of Practice is to provide evidence-based and robust reasons why the proposed new Code of Practice should achieve the following goals:

- To prevent the wasting of key strategically important mineral and nutrient resources in wastewater that are known to be economically finite, and on which human societies are dependent for their long term survival;
- To demonstrate that wastewater treatment and disposal systems serving single houses (DWWTSs) can and should play their part in the wider range of solutions to prevent future world food security threats;
- To demonstrate that every new DWWTS needs to play a part in reducing and preventing the emission of avoidable greenhouse gases, and thereby help to mitigate the damaging effects of climate change;
- To show why, and for what reasons, all new DWWTSs should comply with the Circular Economy principles, as advocated by the European Union; and should also comply with the UN Sustainability Goals;
- To show why, and for what reasons, single house wastewater treatment systems should serve as effective measures to prevent medicines and ingested pharmaceuticals from entering groundwater, surface waters and the aquatic environment generally;

- To agree with and strengthen the purpose of the proposed Code of Practice, that DWWTSs must effectively prevent and avoid pollution by discharges of treated or partially treated wastewater, particularly where the percolation soils are unsuitable for septic tank systems;
- To advocate that, instead of entering groundwater or nearby surface waters, nitrates and phosphates from single house wastewater treatment and disposal systems should be recycled to grow food crops and/or other beneficial plants;
- To demonstrate that such recycling of nitrates and phosphates is possible, practicable, and can be undertaken effectively at a reasonable cost; and,
- To describe practical solutions that can be implemented – assuming that there is enough political will and positive interest by the EPA and the relevant Government departments to do so.

The outline of the report is as follows:

1) Introduction and preliminary comments (section 1);
2) Purpose and structure of our submission (section 1.1);
3) Brief historical background and limitations of the current EPA Code of Practice (section 1.2);
4) Some legal background – the European Court of Justice ruling in Case C –188/08, and the Irish legislation implementing the findings of the Court (section 1.3);
5) Zero Waste Alliance Ireland (ZWAI) (section 2); our origin and activities (section 2.1); our basic principles (section 2.2); what ZWAI is doing – our policy submissions, and our status as an NGO and a registered charity (section 2.3);
6) Herr Limited (section 3);
7) The origin of the urban and rural wastewater problem, or how human societies learned to turn fertiliser into waste (section 4);
8) Addressing the problem of why and how wastewater should be transformed from a difficult waste into a source of nutrients for plant growth (section 5);
9) Legal support for wastewater re-use and recycling; the importance of the Urban Waste Water Treatment Directive (section 5.1);
10) Limitations of the present and the proposed CoP, and why these limitations need to be addressed (section 6);
11) The need to conserve and re-use water to the maximum extent (section 6.1);
12) Inadequacy of the current wastewater treatment systems; loss of dissolved phosphorus and nitrogen (section 6.2);
13) Water pollution and eutrophication (section 6.3);

14) The phosphorus question; why should phosphorus be conserved and not wasted; whether or not peak phosphorus production has passed; future shortages of phosphorus; and problems with existing sources of rock phosphate as a raw material for fertiliser production (section 6.4);

15) Synthetic nitrogenous fertilisers; raw materials for their production are fossil fuels; fertiliser production consumes large amounts of energy; relationship between nitrogenous fertilisers, agriculture and climate change mitigation (section 6.5);

16) Impacts of future fertiliser shortage on world food prices (section 6.6);

17) Problem of pharmaceuticals in current wastewater discharges, despite existing treatment methods (section 6.7);

18) Organic nutrients and the Circular Economy (section 6.8);

19) Compliance with the UN Sustainable Development Goals (section 6.9);

20) Our proposed solutions (section 7);

21) Urine separation and composting toilets (section 7.1);

22) Health issues – safe removal of pathogens, parasites and pharmaceutically active substances (section 7.2);

23) Utilisation of separated and collected human urine to grow non-food plants (section 7.3);

24) Removal of nitrates and phosphates by growing trees or plants and making compost (section 7.4);

25) Reuse of grey water (section 7.5); and,

26) Awareness raising and implementation (section 7.6).

1.2 Brief Historical Background and Limitations of the Current EPA Code of Practice

The problem of surface water and groundwater contamination from domestic wastewater systems currently treating wastewater from single houses not connected to a public sewer has a lengthy history in Ireland. According to the Central Statistics Office[1], approximately one-third of the total number of houses in the Republic of Ireland are served by septic tanks and other single-house wastewater treatment systems. Data from the 2011 Census (the most recent available on the CSO website) shows that some 437,652 households are served by individual septic tanks while 50,259 households use other individual sewerage systems. And of course these figures do not include the estimated 83,000 septic tanks in the North of Ireland.[2] The total number of single-house wastewater treatment systems in all of Ireland is therefore approximately 571,000.

This is a relatively high proportion of houses unconnected to public sewerage systems, and probably reflects the dispersed nature of rural houses in Ireland. In Sweden, for example, approximately 90% of the population is connected to centralized wastewater treatment plants, while only 10% rely on on-site wastewater treatment systems.[3] Nevertheless, it is estimated that sanitary systems serving individual households in rural areas contribute approximately 20% of the Swedish anthropogenic load of phosphorus to the Baltic Sea.[4]

In Ireland, as far back as 1975, the Institute for Industrial Research and Standards (long since closed down by a previous Government) published the "*Recommendation for Septic Tank Drainage Systems Suitable for Single Houses*" (SR6, 1975), the first guideline document outlining best practice for the installation and operation of septic tank systems in Ireland.[5]

This publication was followed 16 years later by an updated guidance document, the "*Recommendations for Domestic Effluent Treatment and Disposal from a Single House*" (SR6, 1991) published by the National Standards Authority of

1 Central Statistics Office, 2012. Profile 4 – The Roof over our Heads; results of Census 2011; page 26; Urban and rural sewerage. Central Statistics Office, Information Section, Skehard Road, Cork

2 Tim Clifford, 2011. Septic Tank Inspections are here; Site Assessor, 30 June 2011. http://www.siteassessor.com/blog/making-sense-of-septic-tank-inspections-and-ecj-ruling-against-ireland-76.html

3 Elisabeth Kvarnström, Karin Emilsson, Anna Richert Stintzing, Mats Johansson, Håkan Jönsson, Ebba af Petersens, Caroline Schönning, Jonas Christensen, Daniel Hellström, Lennart Qvarnström, Peter Ridderstolpe, Jan-Olof Drangert, 2006. *Urine Diversion: One Step Towards Sustainable Sanitation*. Stockholm Environment Institute, Stockholm, Sweden.

4 Höglund, Caroline, 2001. Evaluation of microbial health risks associated with the reuse of source-separated human urine. Royal Institute of Technology (KTH), Department of Biotechnology, Applied Microbiology Swedish Institute for Infectious Disease Control (SMI) Department of Water and Environmental Microbiology, Stockholm 2001.

5 Institute for Industrial Research and Standards, 1975. *Recommendation for Septic Tank Drainage Systems Suitable for Single Houses* (SR6:1975). IIRS, Dublin.

Ireland (NSAI) in 1991.[6] This document required a site suitability assessment to be carried out before the installation of a Domestic Wastewater Treatment System (DWWTS), and it provided instructions for carrying out the site assessment and for constructing percolation areas. The recommendations also suggested remedial measures for situations where locations were considered to be unsuitable for septic tanks.

In 2000, the EPA published a revised guidance manual, "*Wastewater Treatment Manual: Treatment Systems for Single Houses"* [7], which further defined the site assessment process and provided detailed descriptions of the types of secondary treatment systems available in Ireland at that time. Acceptable limit values for the results of percolation tests were set out in this document, together with the advice that if a site failed the percolation test, it was not suitable for the installation of a septic tank for the treatment of wastewater. From the year 2000 onwards, the site assessment process became a more complex procedure.

In late 2009, the EPA again revised and extended the guidelines, publishing a manual entitled "*Code of Practice: Wastewater Treatment and Disposal Systems Serving Single Houses (p.e. ≤ 10)".* [8] This is the currently applicable document for all houses constructed since 2009; and is to be replaced by a new Code of Practice, the draft version of which is the subject of the current public consultation, and the subject of our observations.

Firstly, the Code of Practice will apply only to site characterisation and assessment works (and associated installations) carried out on or after the date on which the current CoP will be replaced by the new CoP. Therefore the CoP will apply only to newly built dwellings or extensions to houses constructed in unsewered areas, where wastewater from a single house has to be treated on-site, and where planning permission is required. However, it will provide guidance from the assessment stage to the design, installation and maintenance stages of a DWWTS, with the aim of preventing water pollution and protecting public health.

The most significant weakness of the draft CoP is that it does not address any of the problems connected with many older houses served by existing DWWTSs which pre-date the application of the new Code of Practice when issued. In addition, it does not address the waste of two valuable resources – the nitrogen and especially the phosphorus contained in domestic wastewater (see sections 6.2 to 6.7 below). While this may not have been important from the 1970s to the 1990s, the global shortage of phosphorus has become a matter of increasing concern in the 21st century.

[6] National Standards Authority of Ireland, 1991. *Septic Tank Systems – Recommendations for Domestic Effluent Disposal from a Single Dwelling House, SR 6: 1991*. Eolas, Dublin.

[7] EPA, 2000. *Wastewater Treatment Manual: Treatment Systems for Single Houses*. EPA, Wexford.

[8] EPA, 2009. *Code of Practice: Wastewater Treatment and Disposal Systems Serving Single Houses* (p.e. ≤ 10). EPA, Wexford.

All modern agricultural systems are highly dependent on continual inputs of phosphate fertilisers derived from phosphate rock, a finite resource which could be depleted in a couple of decades (see section 6.4 below).[9] However, long before depletion is reached, we will see a global peak in phosphate fertilizer production, estimated to occur in the next 30 years. There is therefore a strong case for including long-term phosphorus scarcity on the priority agenda for global food security, but the more immediate effect of this scarcity is likely to be a further significant rise in the price of fertilizer, with damaging consequences for agriculture and food production (see section 6.7 below).

The key differences between peak oil and peak phosphorus are:

i) oil can be replaced by other forms of energy as it becomes too scarce;

ii) there is no substitute for phosphorus in food production, as phosphorus cannot be produced or synthesized commercially;

iii) oil is consumed as it is used, but phosphorus is an element which can be captured after use and recycled for further use within economic and technical limits.[10,11]

It is of strategic importance that phosphorus should not be wasted, existing and well-tried methods should be implemented to conserve and recycle it (sections 7.1 and 7.2 below); and this is one of the principal reasons why Zero Waste Alliance Ireland and Herr Limited are making this submission to the EPA. If waste of phosphorus can be avoided, and phosphorus recycled as much as possible, this will be a "win-win" outcome, coinciding with our policy of reducing and eliminating waste, including wastewater (see sections 1.3 and 2.2 below).

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9 Cordell, D., Drangert, J-O., and White, S., 2009. The story of phosphorus: Global food security and food for thought. *Global Environmental Change*, Volume 19, Issue 2, May 2009, Pages 292–305.

10 White, S., and Cordell, D., undated. Peak Phosphorus: the sequel to Peak Oil. Published in Sustainable Phosphorus Futures, Global Phosphorus Research Initiative. http://phosphorusfutures.net/peak-phosphorus.html

11 Cordell, D. and Kerschner, C., 2007. Governing Global Resource Peaks: the case of peak oil and peak phosphorus, 1st version prepared for the Institutional Analysis of Sustainability Problems proceedings book, June 2007, Marie Curie Emerging Theories and Methods in Sustainability Research series, Bratislava.

1.3 Legal Background – the European Court of Justice Ruling in Case C –188/08, and Irish Legislation to Implement the Findings of the Court

On 29 October 2009, in Case C –188/08, the ECJ ruled against Ireland in relation to the treatment of wastewaters from septic tanks and other on-site wastewater treatment systems.[12] The Court found that by failing to adopt the legislation necessary to ensure compliance with Articles 4 and 8 of European Council Directive 75/442/EEC (the Waste Directive) as regards domestic waste waters disposed of through septic tanks and other individual waste water treatment systems, Ireland had failed to fulfil its obligations under that Directive.

The Irish Government in its defence referred to the existing legislation at that time, and to a circular issued to local authorities in 2003 about the assessment of sites, and the design, installation and maintenance of septic tanks; and the defence referred also to the 2005 Sustainable Rural Housing Guidelines.[13] The Government indicated during the case that it intended to make both the 2005 Sustainable Rural Housing Guidelines and the 2007 Development Planing Guidelines[14] and Development Management Guidelines for planning authorities mandatory.[15] The Government also cited the provisions of the Water Services Act 2007 in connection with rural water services, but the Court dismissed this as a defence, given that the relevant provisions had not been enacted before the case had been referred to the Court. The Irish Government also argued that the Commission had not proved a link between the use of septic tanks (and other domestic wastewater treatment systems) and groundwater pollution.

The Court noted that the relevant EU legislation covered all septic tanks and individual waste water treatment systems, both old and new; but that the Irish legislation was significantly deficient in this respect. Even though the Local Government (Water Pollution) Acts 1977 and 1990 prohibited water pollution from all sources, the exemptions under those Acts for discharges of domestic sewage of less than 5 cubic metres per day excluded a large number of septic tanks (paragraph 65 of the judgment). The Court also found that the Building Control Acts 1990 to 2007 applied only to septic tanks and private waste water treatment systems constructed after 1992, and that the Planning and Development Acts 2000 to 2006 applied only to septic tanks and private waste water treatment systems constructed after 2000.

The Court also noted that the requirements of SR:6 of 1991 (see section 1.1 above), referred to in Technical Guidance Document H of the Building Control

[12] European Court of Justice, Judgment in Case C 188/08. Failure of a Member State to fulfil obligations; Directive 75/442/EEC; Waste; Domestic waste waters discharged through septic tanks in the countryside; Waste not covered by other legislation; Failure to transpose. 29 October 2009. http://curia.europa.eu/juris/liste.jsf?language=en&num=C-188/08.

[13] Department of the Environment, Heritage and Local Government, 2005. Sustainable Rural Housing: Guidelines for Planning Authorities. Dublin, Stationery Office, April 2005.

[14] Department of the Environment, Heritage and Local Government, 2007. Development Plans: Guidelines for Planning Authorities. Dublin, Stationery Office, June 2007.

[15] Department of the Environment, Heritage and Local Government, 2007. Development Management: Guidelines for Planning Authorities. Dublin, Stationery Office, June 2007.

Standards[16], are not suited to the geological and soil characteristics generally found in Ireland (judgment, paragraph 70). It therefore found that planning permissions granted on the basis of these standards did not ensure a level of environmental and human health protection that was required under EU law.

The Court also concluded that monitoring systems must include regular inspections by local authorities of the functioning and maintenance of septic tanks and individual waste water treatment systems. While local authorities have powers of inspection under the relevant Irish legislation, and minimum standards of inspection are also required, the Court found that these powers are not exercised within a framework of regular checks and inspections at appropriate intervals. The Court rejected the argument made by Ireland that an absence of regular inspections could be justified because of the high number of septic tanks in Ireland (paragraphs 77 to 82 of the judgment).

One very relevant matter raised in Ireland's submission to the Court was that wastewaters covered by the case against Ireland were not 'waste' within the meaning of EU Directive 75/442[17] because they were not in the "*list of wastes belonging to the categories listed in Annex I*" adopted by the Commission under Article 1(a) in accordance with the procedure referred to in Article 18 of that Directive. The Court concluded that Annex I to Directive 75/442 is very broad in scope, that case-law confirmed the inclusion, in certain circumstances, of waste waters in its scope, and it was the Community legislature's intention **not to exclude waste waters from the scope of Directive 75/442** (paragraph 35 of the judgment).

This is a finding with which **ZWAI** would agree completely, as it is our view (and a key point in our submission) that wastewaters are waste within the normal meaning of the term "waste"; and they may be classed as "liquid wastes" in contrast to "solid wastes". Therefore it is our submission that these "wastes" should be eliminated or reduced as far as meaningfully possible, by re-use or recycling.

In order to comply with the findings of the European Court in the above case, the *Water Services (Amendment) Act, 2012* (No. 2 of 2012) was brought into force, requiring homeowners connected to a domestic wastewater treatment system (DWWTS) to register their wastewater treatment systems and ensure that these systems did not constitute a risk to human health or the environment. Prevention or elimination of this risk was to be ensured through compliance with standards for the performance and operation of DWWTSs.

The Act also required Water Services Authorities (WSAs) (local authorities) to maintain a register of DWWTSs and to undertake inspections to regulate the discharges from these systems. The Environmental Protection Agency (EPA)

[16] Department of the Environment, Heritage and Local Government, 2010. Building Regulations 2010: Technical Guidance Document H; Drainage and Waste Water Disposal. Dublin, Stationery Office, 2010.

[17] Commission of the European Communities, 1975. Council Directive of 15 July 1975 on waste (75/442/EEC). Brussels, Official Journal of the European Communities No L 194/39-41.

was made responsible for the development of the National Inspection Plan (NIP), for the appointment of inspectors, for the establishment and maintenance of a register of inspectors; and Agency was given the authority to supervise the WSAs in the performance of their functions under the Act.

The new legislation was also intended to assist Ireland in meeting the relevant objectives of the Water Framework Directive (2000/60/EC).

Subsequent to the passing of the Water Services (Amendment) Act, 2012, a number of Statutory Instruments were brought into force:

1. The *Water Services Acts 2007 and 2012 (Domestic Waste Water Treatment Systems) Regulations, 2012* (S.I. No. 223 of 2012), which prescribes the actions to be taken by owners of domestic wastewater treatment systems to ensure compliance with their obligations under Section 70(C)(1) of the Water Services (Amendment) Act 2012;

2. The *Domestic Wastewater Treatment Systems (Registration) (Amendment) Regulations, 2013* (S.I. No. 180 of 2013), to provide for the registration of newly constructed or installed domestic wastewater treatment systems;

3. The *Domestic Waste Water Treatment Systems (Financial Assistance) Regulations, 2013* (S.I. No. 222 of 2013), to provide financial assistance to owners of domestic wastewater treatment systems which require remediation or upgrading following an inspection and the subsequent issue of an advisory notice under Part 4A of the Water Services Act 2007; and,

4. The *Planning and Development (Amendment) Regulations, 2013* (S.I. No. 219 of 2013) which introduced a planning exemption for remedial works to an on-site domestic wastewater treatment system which had to be carried out in order to comply with an advisory notice from a water services authority in cases where septic tanks or other on-site waste water treatment systems have been assessed by the Water Services Authority as causing or likely to cause a risk to human health or the environment.

While this legislation has undoubtedly brought septic tanks and other on-site domestic wastewater treatment systems under improved control, and it applies to all systems of whatever age (thereby addressing the problem of older septic tanks and percolation areas which may have ceased to work properly, or may have been poorly located in the first place), it addresses only the problems of surface water and groundwater pollution, and does not consider wastewater as "waste" to be prevented, re-used or recycled. As we will describe in sections 7.1 and 7.2 *et seq* below, human urine and domestic wastewater contain significant amounts of phosphates which can be, and should be, recovered for subsequent use; and this is a key policy area for Zero Waste Alliance Ireland.

2. ZERO WASTE ALLIANCE IRELAND (ZWAI)

At this point we consider that it is appropriate to mention the background to our submission, especially the policy and strategy of ZWAI, given that our previous submissions to Government Departments and to the EPA have primarily addressed the issues of solid wastes, their origin, prevention, minimisation, re-use, recycling, treatment and disposal.

2.1 Origin and Early Activities of ZWAI

Zero Waste Alliance Ireland (ZWAI) was established in May 1999 as an alliance of anti-landfill and anti-incineration groups from many locations in Ireland, and has subsequently developed into a national confederation of local residents' groups, supported by all of Ireland's principal environmental organisations, with the objectives of:

i) sharing information, ideas and contacts,

ii) finding and recommending environmentally sustainable and practical solutions to the growing domestic, municipal, industrial and agricultural waste management crisis in Ireland;

iii) lobbying Government and local authorities to implement environmentally sustainable waste management practices, including clean production, elimination of toxic substances from products, re-use, recycling, segregation of discarded materials at source, and other beneficial practices;

iv) lobbying Government to follow the best international practice (for example, the policies and practices of countries such as New Zealand, Australia and many other countries, regions and cities which have adopted the policy of Zero Waste) and EU recommendations by introducing fiscal and economic measures designed to penalise the manufacturers of products which cannot be re-used, recycled or composted at the end of their useful lives, and to financially support companies making products which can be re-used, recycled or are made from recycled materials;

v) raising public awareness about the long-term damaging human and animal health and economic consequences of landfilling and of the destruction of materials by incineration; and,

vi) maintaining contact and exchanging information with similar national networks in other countries, and with international zero waste organisations.

ZWAI initially had nearly 50 affiliated organisations and groups throughout Ireland, including all the principal environmental NGOs (An Taisce, Voice, Friends of the Earth Ireland, Earthwatch Leitrim, Earthwatch Sligo, Friends of the Irish Environment, Cork Harbour for a Safe Environment (CHASE), Kinsale Environment Watch, the Irish Doctors Environmental Association (IDEA)), and more than 40 active local groups developing and implementing new ways to address Ireland's waste problems.

2.2 Our Basic Principles

Human communities must behave like natural ones, living comfortably within the natural flow of energy from the sun and plants, producing no wastes which cannot be recycled back into the earth's systems, and guided by new economic values which are in harmony with personal and ecological values.

In nature, the waste products of every living organism serve as raw materials to be transformed by other living creatures, or benefit the planet in other ways. Instead of organising systems that efficiently dispose of or recycle our waste, we need to design systems of production that have little or no waste to begin with.

There are no technical barriers to achieving a "*zero waste society*", only our habits, our greed as a society, and the current economic structures and policies which have led us to the present environmental, social and economic difficulties.

"Zero Waste" is a realistic whole-system approach to addressing the problem of society's unsustainable resource flows – it encompasses waste elimination at source through product design and producer responsibility, together with waste reduction strategies further down the supply chain, such as cleaner production, product repairing, dismantling, recycling, re-use and composting.

2.3 What We are Doing

Zero Waste Alliance Ireland (ZWAI) was formed as a limited liability company, and our memorandum and articles of association state that we promote the goal of a sustainable zero-waste society and the circular economy. Our board of directors believe that the present consumerist and wasteful economy cannot continue much longer, that we must change. We believe that an economy that recovers and reuses all its waste resources is the only way to support 7 billion people to live with an acceptable quality of life, in the long term.

Zero Waste Alliance Ireland has prepared detailed policy documents on waste management, we hold regular meetings, and we continue to lobby Government on the issue of sustainable resource management, and to express our concern at the failure to address Ireland's waste problems at a fundamental level.

In recent years, as many older landfills were closed or became better managed (primarily as a consequence of the implementation of European Directives, Irish legislation transposing these Directives, the development of a waste licensing regime by the Environmental Protection Agency, and the establishment of the Office of Environmental Enforcement in 2003), the number of affiliated groups concerned about the adverse environmental and public health effects of landfills decreased considerably in number, and ZWAI has concentrated more on the objective of ensuring Ireland's compliance with the Stockholm Convention, and on promoting the concepts of waste reduction or elimination at source, repair, re-use, recycling, and implementation of "the circular economy" as steps towards zero waste.

ZWAI strongly believes that Ireland, as an EU Member State, has a binding obligation under the Stockholm Convention to significantly reduce emissions of persistent organic pollutants (POPs). Merely holding our submissions at present levels, or preventing an increase in either toxicity or volume, is not an adequate response to the aims of the Stockholm Convention. Instead, Irish State organizations, including the Department of the Environment and the EPA, should implement policies aimed at ensuring very significant reductions in the emissions of POPs; and, in some situations, reducing such emissions to zero.

ZWAI further believes that Ireland should have a policy of not sending our wastes for further treatment or recycling in other countries, particularly in developing countries where local populations are being exposed to dioxins and other very toxic POPs. Relying on other countries' infrastructure to achieve our "recycling" targets is not acceptable from a global ecological and societal perspective.

Zero Waste Alliance Ireland has made the following submissions in response to public consultations:

a) in September 2011, to the Department of the Environment, Community and Local Government, on waste policy;

b) in September 2012, to the Environmental Protection Agency, on the Agency's draft National Implementation Plan (NIP) for the Stockholm Convention;

c) in December 2013, to Dublin City Council Regional Waste Coordinator in response to a notice of intention to commence preparation of regional waste management plans;

d) in January and February 2014, to the Department of the Environment, Community and Local Government, on proposals for the regulation of household waste collection and for dealing with used or end-of-life tyres;

e) in January 2015, to the Eastern & Midlands Regional Waste Coordinator, Dublin, on the Eastern and Midlands Draft Regional Waste Management Plan 2015 – 2021 (proposed reduction of regional waste management areas from 10 to 3);

f) in March 2015, to the Environmental Protection Agency in response to the Agency's public consultation on the National Inspection Plan 2015-2017 for Domestic Wastewater Treatment Systems;

g) in April 2015, to Irish Water, on the Draft Water Services Strategic Plan;

h) in February 2016, a submission proposing amendments to the Building Regulations;

i) in March 2016, to An Bord Pleanála, observations on the planning application by Indaver Ireland Ltd for a proposed incinerator at Ringaskiddy, County Cork;

j) during 2016, undertaking a research project on the Circular Economy;

k) in October 2017, to An Bord Pleanála, observations in response to the planning application by Irish Cement Ltd for permission to burn or utilise a greatly increased annual tonnage of non-hazardous and hazardous wastes as alternative fuels and raw materials in the company's cement production plant at Platin, County Meath; and,

l) in April 2018, to the Department of Housing, Planning and Local Government, observations on the Draft Water Services Policy Statement, in response to the Public Consultation launched on 04 April 2018.

ZWAI is represented on the Government's Waste Forum, is a member of the Irish Environmental Network (IEN), the Environmental Pillar, and the European Environmental Bureau (EEB); and ZWAI is funded by the Department of Communications, Climate Action and the Environment (and previously by the Department of the Environment, Community and Local Government) through the Irish Environmental Network.

ZWAI continues to maintain active working relationships with Zero Waste Europe, Zero Waste New Zealand Trust, with the Grass Roots Recycling Network in the United States, the Community Resources Network Scotland (CRNS), with the Global Anti-Incinerator Alliance (Global Alliance for Incinerator Alternatives), and with other international environmental organisations.

It will be clear that ZWAI is primarily concerned with the very serious issue of discarded materials and goods, whether from domestic, commercial or industrial sources, how these become "waste", and how such "waste" may be prevented by re-design along ecological principles. But these same ecological principles can also be applied to liquid wastes, including wastewater from domestic sources, especially in rural areas where the lack of municipal or communal sewerage systems requires each dwelling to install and maintain an individual or isolated wastewater treatment system. On the other hand, we would suggest that, for most rural homes, there is adequate land around most houses to enable a more ecological system to be installed, so that the nutrients contained in the wastewater from that house can be re-used.

Zero Waste Alliance Ireland (ZWAI) is a limited liability company and a registered charity. Our memorandum and articles of association state that we promote the goal of a sustainable zero-waste society and the circular economy. Our board of directors believe that the present consumerist and wasteful economy cannot continue much longer, that we must change. We believe that an economy that recovers and reuses all its waste resources is the only way to support 7 billion people to live with an acceptable quality of life, in the long term.

Our directors are:

- Ollan Herr
- Sean Cronin
- Richard Auler
- Jack O'Sullivan

3. HERR LIMITED

Herr Ltd is a private company owned by Mary and Ollan Herr. It was originally established in 1992 for the manufacture of plastic and stainless steel penstocks, sluice gates, valves, adjustable bell-mouths, adjustable overflow weirs, flap valves and hand-stops; principally for municipal waste water treatment systems. Over the past 15 years the business has moved more towards the innovative development and supply of domestic wastewater treatment systems using reed beds and willow wetlands.

More recently the company also designs and supplies essential components for domestic reed beds to treat grey water for recycling for flush toilets. Herr Ltd has now become primarily active in promoting the concept of sustainable water systems and the circular economy for the nutrients present in domestic waste water.

Examples of our systems are zero-energy rain-water harvesting, the treatment and recycling of grey water and using water-less composting toilets to respond to increasing future water shortages as a result of summer droughts in Ireland.

The business also promotes natural composting and plant based treatment systems to treat, recover and recycle phosphorus and nitrates from separated human urine and toilet solids. This is done to ensure an adequate supply of recycled phosphates and nitrates for future generations so that single families can sustainably and safely grow garden vegetables.

On many occasions the company has collaborated with the environmental NGO charity “Zero Waste Alliance Ireland”,

4. THE ORIGIN OF THE PROBLEM, OR HOW WE LEARNED TO TURN FERTILISER INTO WASTE

For most of humanity's existence on this planet, our excreta and food wastes served as nourishment for other animals, or were returned directly to the soil in rural areas. The cycle was closed, though imperfectly, and the nutrients which we removed in the form of cereals, vegetable crops and cattle were put back as biodegradable organic wastes.

In cities, most homes had no designated space for bodily relief, and the street was assumed to be the proper place for the disposal of all domestic wastes.[18] Medieval cities were cleaned by pigs; while ravens, kites and vultures were protected as sacred scavengers. By the mid 19th century in London, the houses of the wealthy usually contained one "privy", from which "nightsoil" was removed several times each week for spreading on land.

The invention of the water flush changed this practice. The water closet (or WC) was first used by the English upper classes in the late eighteenth century; it was placed in a closed cupboard and drained by an unventilated pipe to a cesspool in the cellar. The device became common in London, partly because of the social status it conferred on its owner. By law, the contents had to be retained in cesspools on the premises (which produced a more evil-smelling gas than the privvies they had replaced !); but, in spite of the law, an increasing number became connected to the sewers.

Towards the end of the 19th century, when piped water and the WC became common in both Britain and the United States, the capacity of domestic cesspools became quickly overwhelmed, the surrounding soil could no longer absorb the water, and major health problems resulted. Personal hygiene had progressed at the expense of public health, and the technology of sewerage systems and large-scale sewage treatment had to be developed.

The cost of getting rid of water from households proved to be many times more costly than getting it there in the first place. This disproportion was increased when many European and American cities decided to combine the sewers for domestic wastewater with storm sewers for rainwater. Engineers relied on the ability of natural bodies of water to dilute, disperse and breakdown the wastes from sewers and treatment plants; and therefore by the end of the 19th century, the spread of faecal-borne infection via tap-water had become common, and recycling of water became an agent in the spread of disease.

Resources had to be applied either to the further treatment of sewage before disposal, or to the treatment of water supplies for domestic use. For the first half of the 20th century, public authorities chose to sterilise water supplies, using filters and chemical treatment (mainly by chlorine). In more recent decades of the last century, the emphasis has been shifted towards more complete treatment of sewage (for example, tertiary treatment and "polishing")

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[18] Illich, Ivan, 1985. *H_2O and the Waters of Forgetfulness: Reflections on the Historicity of Stuff*; p. 46. Published 01 January 1985 by the Dallas Institute of Humanities and Culture, Dallas, Texas; and published subsequently by Heyday Books, Berkeley, California, USA.

in order to prevent increasing pollution; and the legislation described in section 1.2 above was the result of this policy and practice being applied in Ireland to rural houses not connected to municipal sewerage systems.

It is relevant to note that the spread of the WC was resisted at first, even in cities where its need might be considered greatest. The contents of dry toilets in the cities were considered to be "*a mine of wealth*".[19]

In Sweden, for example, the first "official" WC was installed in 1883 but its more widespread use was very slow because of a prohibition against using water for toilet flushing purposes.[20] There was also an intense debate ongoing at that time in which health authorities and physicians argued for WCs, whereas those against flush toilets were concerned about the resulting water pollution, and they also argued that the introduction of this type of toilet would end recycling and utilisation of plant nutrients from urine and faeces in agriculture.[21] Representatives of the farmers' organisations in Sweden therefore argued against the implementation of WCs.

It would be interesting to discover whether farmers' organisations in Ireland had made similar arguments around the same period; but such further historical research is outside the scope of this submission.

France was equally slow to adopt the flush toilet, and it took over a century for Paris to follow the example of London. A report from *L'Institut de France* in 1835 rejected a proposal to adopt the WC and to channel the sewage into the River Seine. The decision was based neither on anti-British sentiment nor on concern for the water quality in the river, but on calculating the enormous economic value that would be washed down the drain with the excrement of people and horses.[22]

During the middle of the 19th century, a sixth of the area of Paris produced approximately 50 Kg per capita of fresh salads, fruit and vegetables, more than the 1980 level of per capita consumption of these foods. Some 6.5 persons per

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[19] Goddard, N. 1996. A mine of wealth? The Victorians and the agricultural value of sewage. *Journal of Historical Geography* **3**:274-290 (from the abstract only).

[20] Cronström, A. 1986. The technical history of Stockholm - Water provision and sewerage. (Stockholms tekniska historia -Vattenförsörjning och avlopp). Liber Förlag, Stockholm, Sweden.

[21] Höglund, Caroline, 2001. Evaluation of microbial health risks associated with the reuse of source-separated human urine. Royal Institute of Technology (KTH), Department of Biotechnology, Applied Microbiology Swedish Institute for Infectious Disease Control (SMI) Department of Water and Environmental Microbiology, Stockholm 2001.

[22] Illich, Ivan, 1985. *H_2O and the Waters of Forgetfulness: Reflections on the Historicity of Stuff*; p. 67. Published 01 January 1985 by the Dallas Institute of Humanities and Culture, Dallas, Texas; and published subsequently by Heyday Books, Berkeley, California, USA. Quoted in "*The Re-Imagination Of Water -- Dealing with the Threats to Groundwater, Drinking Water, Rivers and Lakes*"; a paper presented by Jack O'Sullivan at a Seminar on Public Participation and Water Quality, held at the Environmental Change Institute, NUI Galway, on 23 June 2007. Also quoted in "*Restorative Commons: Creating Health and Well-being through Urban Landscapes*", Edited by Lindsay Campbell and Anne Wiesen, United States Department of Agriculture, General Technical Report NRS-P-39; U.S. Government Printing Office, 2011; 278 pp.

hectare were employed full time, with others engaged in sales; and over a period of four decades enough "soil" was produced to enable the growing area to be expanded by 6 % annually. The growing techniques reached maximum sophistication in the 1880s, with inter-cropping and succession-cropping giving as many as six, and never less than three, harvests per year. Winter crops were made possible by the heat of fermenting manure, bell-shaped glass cloches, straw mats and high walls surrounding the inner-city small-holdings.[23]

According to Ivan Illich, Kropotkin's 1899 claim that the city of Paris could supply London with green vegetables, was not unreasonable.[24] It may also be surprising for us to learn that a proposal was made more than 100 years ago to export by rail from Paris the excess quantities of rich humic soil so as to fertilise the surrounding countryside. The efficiency of the re-cycling system was all the more remarkable by today's standards when the almost total absence of imported energy (in the form of fossil fuels and fertilisers) is taken into account.

Unfortunately, instead of exporting soil to fertilise the countryside, present-day cities export waste-water and the flush-toilet; while a very significant number of rural houses are served by wastewater treatment systems which contaminate groundwater and surface water ! Between 25 % and 50 % of all domestic water goes down the toilet, consuming expensively treated water where its biological cleanliness is irrelevant, and putting further demands on scarce resources.

In a global context, not dissimilar to the situation in rural Ireland at the present time, the use of the flush toilet creates significant problems. A paper entitled "*What is Environmental Sustainability in Sanitation?"*, by Robert Goodland and Abby Rockefeller in *UNEP International Environmental Technology Centre Newsletter,* states that "*for the sake of environmental sustainability, we must stop mixing human excreta with drinking water, then collecting and further worsening this mixture with industrial and non-point source wastes*".[25]

Goodland and Rockefeller based their arguments not only on the waste of resources, but on the economic costs of collecting, treating and disposal of sewage. At the time when their paper was being written, data from cities in OECD countries showed that initial construction costs of sewage disposal were around $50,000 per urban household. Overall, approximately 80-90% of the construction costs of sewage treatment and disposal systems are required for transportation of the wastewater (e.g., laying of pipes) and around 10-20% for the treatment process.

Therefore, as a consequence of the widespread use of the relatively simple technology of the flush toilet and the "water carriage" system, along with the application of other technologies upstream and downstream to mitigate its effects, we now require in Ireland:

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[23] Stanhill, G., 1977. An urban agro-ecosystem: the example of nineteenth-century Paris. Ecosystems, Vol 3, pp 269-284.

[24] Illich, Ivan, 1985. *H_2O and the Waters of Forgetfulness: Reflections on the Historicity of Stuff*; p. 67.

[25] Goodland, Robert, and Rockefeller, Abby, 1996. What is Environmental Sustainability in Sanitation. *Insight*, Newsletter of the UNEP International Environmental Technology Centre, Summer 1996, pp 5-8.

i) larger-scale and more expensive water treatment and distribution systems to supply larger quantities of potable water than would otherwise be necessary;

ii) expensive and complex sewage collection and treatment facilities serving most towns and all major cities;

iii) a means of disposing of the large quantities of sludge remaining after treatment of the sewage;

iv) costly individual on-site treatment of sewage from houses and other buildings in rural areas outside of towns;

v) expensive water treatment facilities to safeguard public health; yet producing, at best, a tasteless water suspected of carrying minute quantities of contaminants; and,

vi) large-scale production and application of chemical fertilisers to restore lost nutrients to agricultural land.

These technological or engineering solutions, while solving some problems, have created others, resulting in:

a) surface water and groundwater pollution by faecal bacteria and sewage-derived nutrients;

b) loss of valuable and increasingly scarce plant nutrients which are required for the growth of crops;

c) a need to replace these nutrients by the manufacture, distribution and application of artificial fertilisers;

d) soil depletion and erosion in cereal growing areas as a result of intensive fertiliser use;

e) rising costs of maintaining the water cycle; and,

f) problems in complying fully with the Water Framework Directive.

5. ADDRESSING THE PROBLEM OF HOW AND WHY WASTEWATER MAY BE TRANSFORMED FROM A DIFFICULT WASTE INTO A SOURCE OF NUTRIENTS FOR PLANT GROWTH

Obviously, there are few (if any) advantages in returning to the way in which cities dealt with their wastes from medieval times through to the 19th century. Yet to the present day in many parts of Central and Eastern Europe, and throughout the Asian, African and Indian continents, rural dwellers continue to deal with their domestic wastes by disposal to soil -- with varying degrees of healthiness or unhealthiness, depending on their knowledge and practices.

Twentieth-century microbiology and our knowledge of parasites and the transmission of diseases allows us to by-pass or avoid all of the sewage-derived problems which made life uncomfortable, unhealthy or difficult for people living in earlier times, while at the same time ensuring that nutrients and organic matter are returned to the soil. The application of ecological principles, waste minimisation at source, modern knowledge of disease transmission, new construction materials and modern technology has opened up a range of domestic wastewater disposal alternatives particularly applicable to rural areas. However, it remains to be seen whether we are willing to adapt culturally and in our habits to using such alternatives.

Improvements to existing water supply, sewage disposal systems and alternative methods of disposal may be grouped into the following principal types:

i) improved percolation area design and location for septic tank systems in rural areas (addressed by the legislation listed above and by the Agency's proposed amendment of the Code of Practice for Wastewater Treatment and Disposal Systems Serving Single Houses);

ii) more common use of small-scale constructed wetlands (reed beds) for single houses or groups of houses where ground conditions permit;

iii) small-scale packaged sewage treatment plants (also addressed by the legislation listed above and by the Agency's Code of Practice);

iv) water saving devices and appliances in the home;

v) non-water-carriage toilets;

vi) urine separation toilets, and use of the separately collected urine as a fertilizer (see section 7.1 below);

vii) wastewater re-cycle and re-use systems; and,

viii) water metering and volume-related charges (very recently the subject of widespread public debate about the scale and method by which metering and related charges were being implemented).

Unfortunately, Irish wastewater policy is focused solely on "*treating wastewater*" in an effort to minimise the detrimental effects of wastewater discharges on the aquatic environment. Our view is that a better policy would be to place equal emphasis on wastewater "*segregation*" as well as on "*the treatment of wastewater*". This would greatly facilitate "*wastewater pollution avoidance", "nutrient resource recovery*", more efficient use of water, and water recycling where appropriate.

The core of this submission from Zero Waste Alliance Ireland is to call for a very radical revision of the EPA Code of Practice.

At this point it is appropriate to draw a parallel between the way in which society has improved the practice of solid waste separation and recycling. In the last decade Ireland has moved from using a single waste bin system to the provision of 3-bin systems. One stream is for waste for disposal by landfilling, one for recycling and the third bin is for material to be composted. Indeed in many towns we now provide public amenity centres where a much wider range of separated resources can be recovered. Sustainable resource recovery and recycling is almost always achieved by keeping things separate.

We are therefore recommending that different domestic wastewater streams should be kept separate. The elements of this recycling concept are already encouraged by EU Directives, and the reuse of treated water and the recycling of sewage sludge are two such examples.

5.1 Legal Support for Wastewater Re-use and Recycling

In addition to the evidence provided in section 1.3 above that wastewater is "waste" within the general meaning of the term "waste" as used in Council Directive 75/442/EEC (the Waste Directive), we would point out that the Urban Waste Water Treatment Directive (91/271/EEC)[26] contains the following two relevant Articles which support the principal aims of our submission:

Article 12 (1): "*Treated waste water shall be reused whenever appropriate*"; and,

Article 14 (1): "*Sludge arising from wastewater treatment shall be re-used whenever appropriate*".

When referring to the re-use of sludge we believe that the reason for doing so is to recycle nutrients of N, P & K in the sludge so that these nutrients can be conserved. The use of the word "shall" in the Directive is important in this context, as it imposes an obligation rather than an option. **ZWAI** fully supports the wording in these EU obligations, and we believe that more action is needed by Ireland to reuse and recycle much more than we are doing at present.

As required by the EU Directive, Part H of Irish Building Regulations provides standards for the treatment of grey water that can be reused for gardens and

[26] EU Council Directive of 21 May 1991 concerning urban waste water treatment; O.J. 30 May 1991; No. L 135/40 – 135/52.

toilet flushing; and the spreading of sludge on agricultural land is regulated by a Statutory Instrument (S.I. No. 267/2001: Waste Management (Use of Sewage Sludge in Agriculture) (Amendment) Regulations, 2001).

The standards for treatment of water intended for reuse and the treatment of sludge for agricultural use are very important, and there are rightly strict limits on the concentration of metals in sewage sludge as well as limits on the concentration of total coliforms in treated wastewater for recycling.

6. Limitations of the Present and the Proposed Amended Code of Practice, and why these Limitations need to be Addressed

6.1 The Need to Conserve and Re-Use Water to the Maximum Extent

One of the major objectives of ZWAI is to promote conservation of resources, on the basis that conservation and efficient use are the opposite of waste; and therefore we welcome the statement in the draft Code of Practice that:

> *"Water conservation measures should be adopted to reduce water consumption and the quantity of waste water generated in a household".*[27]

We also welcomed the statement by Irish Water in that organisation's Water Services Policy Statement, which emphasised the importance of conservation:

> *"The promotion of water conservation and water resource management is an important plank of Irish water policy. This involves multi-facetted programmes, around leak detection, network repair and improvements, cost effective metering, public awareness campaigns and funding to fix customer side leaks".*

Nevertheless, the problem remains that conservation of water appears to be considered only in the narrow context of leakage control and saving of costs; and, the Irish Water Policy completely ignores the wider issue that water is a scarce and valuable resource, and should be treated as such. While the EPA should be more aware of the need for conservation (and hopefully is more aware), it is disappointing that there is nothing further in the draft Code of Practice than the general statement above.

It is therefore our observation that the Code of Practice should be strengthened to include a mandatory requirement that all new rural dwellings, and extended or refurbished rural dwellings in cases where planning permission is required, should include some form of water conservation and re-use of water where possible.

[27] Code of Practice for Domestic Waste Water Treatment Systems (Population Equivalent ≤ 10); Section 3.4 Minimising Waste Water Flow, page 18. EPA, draft 26 November 2018.

Our reasons for the above recommendation are that climate change, population growth and migration, increasing urbanization and ageing infrastructure are imposing significant strains on urban water supplies and water cycle systems in Europe (including Ireland), and will continue to do so over the coming decades. Cities such as Dublin are already beginning to experience increasingly frequent shortfalls in the supply and demand balance, particularly during the summer months. More intense rainfall events are leading to local flooding of properties and to pollution of receiving waters.

Sustainable solutions to these challenges need to be sensitive to increasing energy prices, demands for low carbon intensity solutions, and the need to reduce greenhouse gas emissions from all activities – but none of these issues are addressed in the draft Code of Practice.

If we consider the practical details of water conservation, we find that there is a wide range of measures and appliances which can be used or installed to conserve water, and we have listed some of these in Table 6.1 below.

<table>
<tr><th>ACTIONS</th><th>RESULT</th></tr>
<tr><td>Efficient fittings – flow restrictors on taps, showerheads.</td><td rowspan="5">Reduction of 40 % in water use</td></tr>
<tr><td>Efficient toilets – dual flush, reduced header tank flow.</td></tr>
<tr><td>Water-efficient fittings and appliances, including more efficient washing machines and dishwashers.</td></tr>
<tr><td>Householder behaviour change through education.</td></tr>
<tr><td>More water efficient plant species, better garden layout, with irrigation to be permitted only when water restrictions are not in place (unless the householder has a supply of stored rainwater).</td></tr>
</table>

Table 6.1 Effectiveness of some water conservation measure.

For example, replacing a single-flush toilet with a 4 star dual-flush toilet can save about 23 thousand litres per household per year; and, in section 6.1 below we suggest going a step further and providing for the installation of urine separating toilets, which would result in the conservation and use of human urine.

An important conservation measure, to reduce demand on other water sources, is the use of rainwater which is plentiful in Ireland. It is perhaps surprising that rainwater utilisation is comparatively rare in Ireland, though it has been widespread in Germany since the 1980s; and around 50,000 professional rainwater harvesting systems are being installed every year, mostly in new one-family houses.[28]

Typically, the water is collected from the roof and is filtered, stored and primarily used for toilet flushing, garden watering and household laundry. Research by

[28] Nolde, E., 2007. Possibilities of rainwater utilisation in densely populated areas including precipitation runoffs from traffic surfaces, Desalination, 215, pp. 1–11.

Erwin Nolde at the Technical University of Berlin has suggested a novel approach: instead of using only the water from the roofs, the results shows that rainwater draining from streets and courtyard surfaces could also be reused. This could be a viable option for densely populated urban areas and reduces drinking water consumption and wastewater production. It also minimizes the entry of pollutants into the surface waters, without the need for a sewer connection. He found that 70% of the toilet-flush demand can be replaced by treated stormwater without any comfort loss.[29]

There are numerous positive benefits for harvesting rainwater. The technology is low cost and highly decentralized, empowering individuals and communities to manage their water, and to improve access to water and sanitation at the local level. In agriculture, rainwater harvesting has demonstrated the potential of doubling food production by 100% compared to the 10% increase from irrigation. Rain-fed agriculture is practiced on 80% of the world's agricultural land area, and generates 65-70% of the world's staple foods. The biggest challenge with using rainwater harvesting is that it is not included in water policies in many countries, where water management is based on surface and groundwater with little consideration of rainwater.[30]

According to the Irish Water Treatment Association, studies show that 55 % of domestic treated water could be substituted for rainwater while 85 % of water used for commerce and industry does not need to be of drinking standard. Rainwater harvesting systems have only started to grow in popularity in Ireland during the past couple of years or so, but they have long been popular abroad. For example, they have been used for about 20 years in Germany, which does not have as much rainfall as Ireland. To date, the demand for rainwater harvesting technology in construction projects has been driven by planning decisions, commercial developments and environmentally conscious builders and developers.[31]

While not directly a necessary component of wastewater treatment and disposal for rural houses, we are nevertheless advocating that the Code of Practice should include a requirement for water conservation (see section 6.9 below).

6.2 Inadequacy of Current Wastewater Treatment Systems: Loss of Dissolved Phosphorus and Nitrogen

It is our recommendation that domestic waste water treatment systems need to be redesigned to capture and retain phosphorus and nitrogen, and these new systems should be promoted and adopted.

Our present domestic wastewater treatment systems were never intended to be capable of treating and adequately removing nitrates and phosphates from

[29] Nolde, E., 2007. *Op. cit.*

[30] *Rainwater Harvesting: A Lifeline For Human Well-Being*. A report prepared for UNEP by Stockholm Environment Institute. Published by United Nations Environment Programme and Stockholm Environment Institute in 2009.

[31] http://www.iwta.ie/rainwater-harvesting/3/rainwater-harvesting.aspx

wastewater, and therefore we are forced to rely on percolation and dilution in groundwater to mitigate the impacts of inadequate nutrient retention. We in ZWAI believe that the new EPA CoP should recommend a new approach or a new type of treatment system that can effectively remove and sustainably manage these nutrients.

The draft EPA CoP admits to these inadequacies:

> *"As DWWTSs (Domestic Waste Water Treatment Systems) do not remove significant amounts of nitrogen or phosphorus, a high density of systems in areas of* ***extreme*** *or* ***high*** *groundwater vulnerability may cause plumes of nitrate".*[32]

ZWAI and Herr Ltd contend that failure to remove significant amounts of nitrogen and phosphorus from DWWTSs must be addressed. The consequence of this failure is that nutrient pollution is inevitable when the ground conditions are poor or when the water table is high. In a study into the problem of surface water pollution from septic tanks the following paper explains this issue further:

> *"Where rivers and lakes are impacted by excess nutrients, we need to understand the sources of those nutrients before mitigation measures can be selected. In these areas, modelling can be used in conjunction with knowledge from local authorities and information gained from investigative assessments to identify significant pressures that contribute excessive nutrients to surface waters.*
>
> *Where surface waters (SW's) are impacted by excess nutrients, understanding the sources of those nutrients is key to the development of effective, targeted mitigation measures".*[33]

It is known that the current designs of DWWTSs do not treat or remove nitrates to any great extent. There is irrefutable evidence that, despite the use of EPA approved domestic wastewater aeration treatment systems with optimum or ideal soil percolation conditions, nitrate levels will inevitably rise in local groundwater, and/or in nearby wells and streams. This pollution of groundwater by nitrates from a very high proportion of single house wastewater treatment systems is almost impossible to prevent. Now that there is a full understanding of the sources and the consequences of septic tank nutrient emissions, the EPA must start to implement new mitigation measures and should propose different treatment strategies to address this problem.

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[32] Code of Practice for Domestic Waste Water Treatment Systems (Population Equivalent ≤ 10); Section 4, Standards, page 21 (EPA, draft 26 November 2018); reference: Morrissey, P.J., Johnston, P.M. and Gill, L.W., 2015. The impact of on-site waste water from high density cluster development on groundwater quality. *Journal of Contaminant Hydrology 182: 3.*

[33] What Are The Main Sources Of Nutrient Inputs To Ireland's Aquatic Environment? Eva M. Mockler, Jenny Deakin, Donal Daly, Michael Bruen and Marie Archbold. In: Proceedings of the 37th Annual Groundwater Conference Tullamore, Co. Offaly, Ireland, 25 and 26 April 2017. http://www.iah-ireland.org/conference-proceedings/2017; page 75.

Prof Laurence Gill of Trinity College Dublin gives the following recommendation for the most ideal soil percolation system to treat and remove "some" of the pollution, particularly phosphates and E. coli, but his report goes on to state how most percolation systems fail to have enough organic carbon to de-nitrify, i.e., to remove nitrates.

> *"Nitrate can be removed from the subsoil by denitrification, as discussed in Section 4.2.3. The occurrence of this process requires the presence of an anaerobic zone and an adequate biodegradable carbon source (Jenssen and Siegrist, 1988). However, due to aerobic oxidation the wastewater is usually devoid of sufficient organic C to promote denitrification in properly functioning septic tank treatment systems (Wilhelm et al., 1994a and 1994b)".*[34]

Therefore for septic tank and aerobic treatment systems it is not realistic, even with ideal soil and percolation conditions, to be using or continuously adding organic carbon to remove nitrates from treated waste water. For the approximately 570,900 septic tanks and other individual household wastewater treatment systems in Ireland (see section 1.2 above), it is obvious that, regardless of soil conditions, nitrates will not be treated or removed in the soil, and it is inevitable that the nitrates will pass unimpeded through the ground water to nearby streams and surface water.

We quote from another EPA report that admits to the same problems with the mobility of nitrates through the soil, and the failure of DWWTS to adequately remove nitrogen; and, in some situations, to also remove phosphates:

- *"A substantial proportion of the country is problematical with regard to percolation characteristics;*
- *The risk to human health from DWWTS waste water is significantly higher in areas with a high density of DWWTS's Domestic Waste Water Treatment Systems and inadequate percolation; and in vulnerable areas with private wells;*
- *Phosphorus is the main pollutant posing a threat to the environment, particularly to surface water, either where there is inadequate percolation or where there is inadequate attenuation prior to entry of waste water into bedrock aquifers, particularly karstified (cavernous limestone) aquifers. While the cumulative pollutant load arising from DWWTS's will be insignificant compared to urban waste water treatment systems and agriculture at river basin scale, it can be significant in certain physical settings at small catchment scale";*
- *The threat posed by nitrogen from DWWTSs is low at catchment scale and at the scale of this assessment – 1 km^2 – due to dilution;*

[34] *An investigation into the performance of subsoils and stratified sand filters for the treatment of wastewater from on-site* systems. Literature Review for project 2000-MS-15-M1 (The Hydraulic Performance and Efficiencies of Different Subsoils and the Effectiveness of Stratified Sand Filters); L. Gill, P. Johnston, B. Misstear and C. Ó Súilleabháin; Section 4.4.2 Inorganic Constituents, page 75. EPA Environmental RTDI Programme 2000-2006. Report Prepared for the Environment Protection Agency, June 2004. https://www.epa.ie/pubs/reports/research/water/EPA_literature_review_for_ERTDI27.pdf

> *however, in exceptional circumstances, at site scale (a few hectares), a high density of DWWTSs can cause localised plumes with elevated nitrate concentrations in groundwater.* [35]

The EPA Risk-Based Methodology report further states that:

> *"Phosphorus is the major limiting factor for plant growth in many freshwater ecosystems. The addition of phosphorus encourages algal growth, depletes dissolved oxygen, and causes algal blooms in lakes and fish kills in rivers. Phosphorus is the main cause of eutrophication in rivers and lakes in Ireland. For the purposes of this report,* ***molybdate reactive phosphorus****, or MRP, which is often used as a measure of the soluble reactive inorganic phosphorus in water, is taken as the primary phosphorus pollutant arising from DWWTS's (Domestic Waste Water Treatment Systems).*
>
> *The percolation process converts nitrogen and ammonia from organic matter almost entirely into nitrite and then to nitrate. Nitrate, unlike ammonium, is mobile in the ground and therefore is a good indicator of contamination. Reduction of nitrate concentrations in groundwater occurs primarily through dilution, both by recharge from rainfall and, where background nitrate concentrations are low, by groundwater. In certain hydro geological settings in Ireland, denitrification can occur (see Appendix 2). In this report, nitrate is taken as the main nitrogen pollutant, although in some circumstances ammonium from DWWTS's also causes water pollution.*
>
> *Where only a shallow cover of soil/subsoil over bedrock exists on a site with an existing DWWTS, elevated levels of nitrate, MRP and faecal indicating organisms FIOs/pathogens in the underlying groundwater may result. Such cases occur where bedrock is within 1–2 m of the surface and preferential flow paths in soil and subsoil take the contaminants rapidly towards groundwater below. In these areas, the attenuation processes of filtration, sedimentation, cation exchange, adsorption, precipitation and biological oxidation, which remove contaminants where soil and subsoil treat wastewater effectively, are limited, as there is an insufficient depth of soil and subsoil on sites to allow them to occur effectively".*[36]

There is no doubt that, if we want to improve the existing quality of surface waters in these problem areas, different treatment measures will be needed for new rural houses and for refurbishment of existing houses.

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[35] A Risk-Based Methodology to Assist in the Regulation of Domestic Waste Water Treatment Systems; Executive Summary, Risk Characterisation, page vii; and section 7, Summary and Conclusions, page 37.
https://www.epa.ie/pubs/reports/water/wastewater/EPA_DWWTS_RiskRanking.pdf

[36] A Risk-Based Methodology to Assist in the Regulation of Domestic Waste Water Treatment Systems; section 3, source characteristics, page 9; and section 4.5 Factors Influencing Groundwater Susceptibility to Contamination, page 14.

6.3 Water Pollution and Eutrophication

The Agency will be familiar with the widespread problem of non-point or diffuse sources of water pollution by nutrients, and the resulting eutrophication, reduction in water quality and ecological damage.

STRIVE Report No. 91, funded by the EPA, states that:

> *"The contribution of septic tanks to high phosphorus concentrations in rivers, particularly as constant point sources during low flows in the summer months, was a recurring theme"*.[37]

We know that the nitrogen fraction of domestic waste water (mostly from urine) gets lost and wasted in the ground. This nitrogen inevitably moves through the soil to eventually reach nearby lakes and ponds as per the example below.

Our example is Lough Derg, where single houses may be a small contributor to the levels of nutrient in the lake, but single houses must nevertheless play their part to separate, remove and recycle phosphate and nitrate. It would be a dereliction of duty to let another 30 years to pass while continuing to allow nutrients from septic tanks and other single house wastewater treatment systems to be simply wasted into the ground or nearby lakes.

View 6.3 Warning sign on the shores of Lough Derg, County Clare

37 https://www.epa.ie/pubs/reports/research/water/Summary_Findings_91-Summary_Findings.pdf

6.4 The Phosphorus Question: Why Should Phosphorus be Conserved and Not Wasted

In section 6.2 above, we have shown that the currently acceptable septic tanks, proprietary wastewater treatment systems and filtration through soil, results in phosphorus being wastes, instead of being retained as an essential plant nutrient for the growth of crops and other beneficial plants.

Additional reasons for conserving phosphorus are provided in this section; and they include the global and local importance of phosphorus; whether or not peak phosphorus production has passed; future shortages of phosphorus; and problems with existing sources of rock phosphate as a raw material for fertiliser production.

It is therefore a key point of our submission that the EPA should amend the new CoP for domestic waste water treatment system so as to include “options” for the recovery, separate treatment and reuse of phosphorus and nitrogen in order to prevent groundwater pollution and to sustainably and safely grow food crops. These “options” are described in section 7 of our submission.

6.4.1 High Risk of Phosphorus Shortages in Ireland and Europe

Firstly, it may be appropriate to begin with a statement made in the Dáil on 15 May 2018 by the Minister for Agriculture, Food and the Marine, Mr Michael Creed, TD, on the urgent need to better manage and recycle phosphorus in a more sustainable manner that is currently going to waste. The Minister was replying to a question by Ms Catherine Martin, TD (Green Party) who asked if contingency plans to address future shortages of phosphorus in view of Ireland’s dependence on mined and imported phosphorus to meet commercial fertiliser requirements have been examined.[38] The Minister replied:

> *“Mineral phosphorous is a non-renewable resource and is mined from quarries of igneous and sedimentary rock. Over 95% of the remaining reserves are controlled by five countries, including Morocco, China, USA, South Africa and Jordan. Phosphorus is a limiting nutrient in crop growth and hence can limit global crop yields. It is included in a list of critical raw materials published by the European Commission in 2017. Critical raw materials are those raw materials which are economically and strategically important for the European economy, but have a high-risk associated with their supply.*
>
> *The EU Nitrates Directive, introduced in 2006 set limits for Phosphorous use on farms. A new Nitrates Action Programme was agreed for Ireland for 2018-2021 (S.I. No. 605/2017). This encourages the efficient use of Phosphorous fertiliser and maximises the Phosphorous contribution from animal manures.*

[38] Dáil Question, 15th May 2018 to Minister Michael Creed on the urgency to recycle phosphorus. https://www.kildarestreet.com/wrans/?id=2018-05-15a.1192&s=section%3Awrans+speaker%3A411#g1193.q

Additionally, the re-use of natural raw materials, which currently go to waste, is one of the cornerstones of the Circular Economy Package, adopted in December 2015 by the EU Commission. The Department of Agriculture, Food and the Marine has supported the proposal for an EU Regulation on Fertilisers replacing Regulation No 2003/2003 whereby recycling of waste materials e.g. digestates, composts, food industry by-products and animal by-products can be transformed into organic fertilisers."

The Minister is certainly correct in stating that there is a high risk to the future supply of phosphorus for European fertilizers for agriculture. However, if the EU has declared that phosphorus is a critical raw material, and is encouraging more efficient use of phosphorus, the Minister should consider not only the efficient use of phosphorus in farm animal manures, but he should also be encouraging home owners to do likewise, and his Department should work with the Minister for Housing, Planning and Local Government to ensure that phosphorus is recycled from single houses and human excrement. There is a need to give new home owners the option to end the wasting of domestic wastewater phosphates from being lost through percolation into soil and from soil to groundwater.

The future threat and "high-risk" of phosphate shortages and increasing fertilizer costs to the Irish farming economy and the misery of future unaffordable food prices in supermarkets should also have been acknowledged by the Minister in his response to the Dáil question. The potential risk of high cost phosphate fertilizer and the eventual un-affordability of supermarket food prices is one of the "high-risk" consequences associated with mineral phosphorus depletion. As pointed out in the EPA STRIVE Research Report No. 189:[39]

"Phosphate rock is a limited non-renewable resource concentrated in a few countries and the supply is vulnerable to future scarcity, volatile pricing and geopolitical tensions. The economic importance and high supply risk of phosphate rock led to its inclusion in the European Union list of Critical Raw Materials in 2014. Phosphorus cannot be produced synthetically and has no substitute in food production. Owing to the dependence of food security on phosphorus availability and its potential to contribute to eutrophication in the receiving environment, there is a global need to promote more efficient use of phosphorus, as well as its recovery and reuse.

Phosphorus recycling is supported by the Circular Economy Package published by the European Commission in 2015, which proposes measures to contribute to closing the loop of product lifecycles through increased recycling and reuse, with benefits for

[39] Identification and evaluation of phosphorus recovery technologies in an Irish context. EPA STRIVE Research Report 189. Prepared for the Environmental Protection Agency by University of Limerick. Authors: Michael P. Ryan, Angela Boyce and Gary Walsh. EPA Research Programme 2014–2020. Published by the Environmental Protection Agency, Ireland. October 2016.

the environment and the economy. Almost all of the 3 million tonnes of phosphorus consumed in food per year by the global population enters the wastewater sector. Municipal wastewaters, therefore, represent a major point source from which to recover phosphorus and re-establish a circular economy.

Current wastewater treatment approaches are driven by water pollution concerns and are "treatment orientated" with emphasis on phosphorus removal to meet discharge requirements as opposed to recovery and recycling. A recovery-focused approach viewing phosphorus as a resource as opposed to a pollutant needs to be adopted

This EPA-funded report makes recommendations for phosphorus recycling from municipal sewage treatment systems only. We agree with the authors about the need to recycle phosphorus, but we go further in recommending that a recovery focused approach for phosphorus and nitrates should be prioritized for single houses also.

The European Phosphorus Platform has produced some very useful information and YouTube videos relevant to the case we are making for the conservation of phosphorus:[40]

"Phosphorus is essential for worldwide food security. This irreplaceable natural resource is being used up increasingly fast. The demand for phosphorus is growing and virtually all phosphorus rock is mined in countries outside of Europe.

In Europe, phosphorus is not being treated sustainably. It disappears from the food chain as animal manure, human excreta and organic waste. However, solutions are available. We invite you to our Phosphorus Platform to participate, collaborate and innovate.

Hardly any raw phosphorus is available in Europe

Raw phosphorus is obtained from mining phosphate rock. These mines are for the largest part located in Morocco, the US and China. In Europe hardly any raw phosphorus is available, except for a very small quantity in Finland.

Therefore, virtually all phosphorus in Europe has to come from outside Europe. Due to increasing welfare in Africa, Latin America and Asia and an ever increasing world population, the demand for phosphorus is growing. The dependency of Europe on raw phosphorus from outside Europe endangers our access and threatens our future food security.

Wasting phosphorus impacts the environment

[40] European Phosphorus Platform – Facts. https://www.phosphorusplatform.eu/links-and-resources/p-facts

> *In Europe, phosphorus is being treated in an unsustainable way. Through fertilizers, sewage and animal manure, large amounts of phosphorus and other nutrients end up in ground water and water bodies.*
>
> *This is a direct threat for our aquatic ecosystems due to the process of eutrophication: increased levels of nutrients resulting in oxygen depletion. The impact on biodiversity is critical, since certain fish and other aquatic animal populations do not survive or invasive new species are introduced.*
>
> ***A phosphorus crisis affects us all***
>
> *Developing countries are already facing the negative effects of the phosphorus challenge. As prices of raw phosphorus rise, access to fertilizers becomes increasingly difficult and eventually causes soil degradation. The developing world is the first victim of shortage and will be hit hardest.*
>
> *For European countries, several factors already pose a serious threat for the access to raw phosphorus. Political unrest and climate change in phosphorus mining countries exert pressure on price and export security in any scenario. In the end, exhaustion of phosphorus and consequently the shortage of food will lead to political turmoil, from strikes and demonstrations to migration and war.*
>
> ***Call to action: participate, collaborate, innovate***
>
> *Without access to raw phosphorus, Europe will be unable to feed its population unless we start to recycle more phosphorus and using it less. It is vital that we do not wait and we start taking action today. This is how we can close the phosphorus value chain:*
>
> ***Use less:** food for people and animals contains more phosphorus than necessary. The surplus of phosphorus disappears through human excreta, manure and solid waste.*
>
> ***Recycle more:** The surplus of phosphorus ending up in human excreta, manure and solid waste is currently wasted. We should aim for maximum recovery and re-use of phosphorus from those waste streams".*

Since 2015 the European Commission has been calling for the end of waste and the recycling of phosphorus. A recent example of the 2007 to 2008 fertilizer price crisis occurred when oil as well as phosphate price increases occurred at the same time. This same problem will inevitably occur again.

6.4.2 Phosphorus – World Supply and Demand

The image below shows the projected forecast of the world supply and the world demand for phosphorus rock:

- It assumes that the growing world population will continue to increase the international market demand for phosphorus;
- It assumes that the bio fertilizer industry will not be fully developed adequately to meet world demand;
- It assumes that the recycling of phosphates from waste water and waste food generally will not be adequate; and,
- It assumes that the known projections of the availability of economically available resources are correct, and that no major significantly new mineral resources for phosphorus will be found.[41]

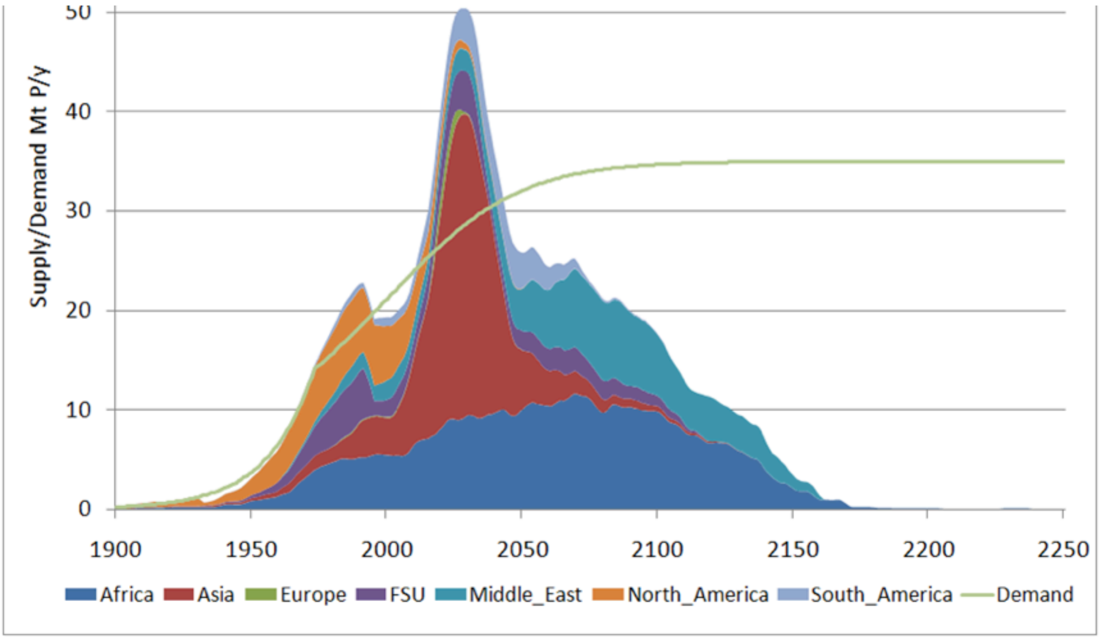

Figure 6.4.2.1 World supply and demand for phosphate rock

The above forecast shows a serious shortfall in the market supply of fertilizer to meet the growing world food demand by 2050. This would lead to increasing fertilizer and food costs. Increasing efficiency in commercial farm crop outputs might not increase fast enough to feed the world population that will still be growing. Under this not-enough-action scenario, poverty stricken nations and anyone on low incomes will eventually be struggling to buy increasingly unaffordable food.

A further paper, by Nikolay Khabarov and Michael Obersteiner, emphasises the links between the availability of phosphate fertilisers, market volatility, food insecurity, and political problems:

[41] New Projection Of Peak Phosphorus, by Steve Mohr and Geoffrey M. Evans, 05 September 2013. http://www.resilience.org/stories/2013-09-05/new-projection-of-peak-phosphorus/

"The commodity market super-cycle and food price crisis have been associated with rampant food insecurity and the Arab spring. A multitude of factors were identified as culprits for excessive volatility on the commodity markets. However, as it regards fertilizers, a clear attribution of market drivers explaining the emergence of extreme price events is still missing. In this paper, we provide a quantitative assessment of the price spike of the global phosphorus fertilizer market in 2008 focusing on diammonium phosphate (DAP). We find that fertilizer market policies in India, the largest global importer of phosphorus fertilizers and phosphate rock, turned out to be a major contributor to the global price spike".[42]

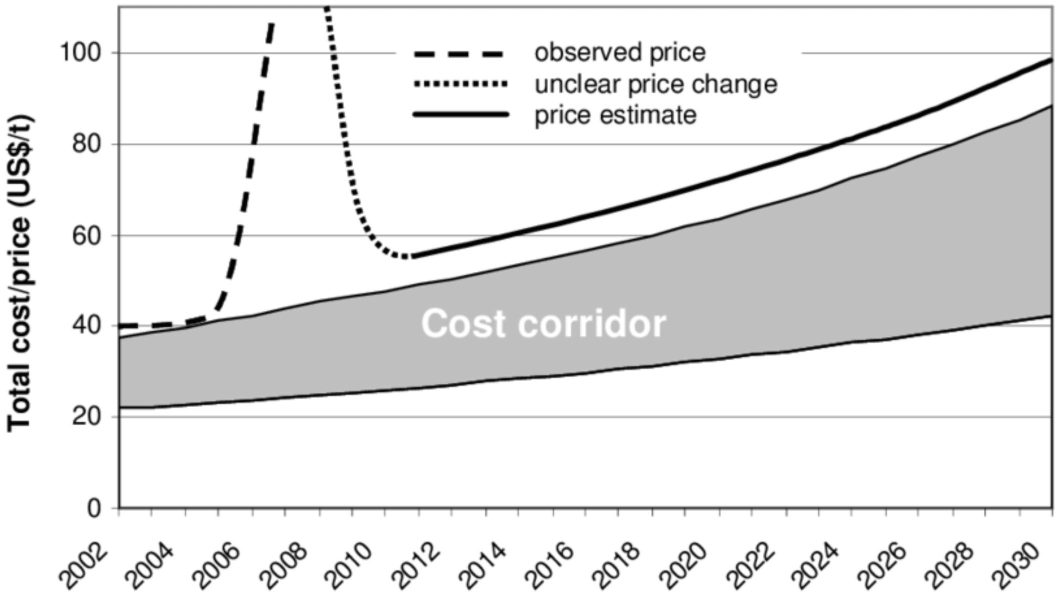

Figure 6.4.2.2 World phosphate rock price fluctuations

"There was a global price spike for phosphate fertilizers in 2008 to 2018. More worrying is that some of the factors that caused this price increase are likely to cause a future more permanent global price increase. Phosphate depletion and its future increasing price, along with the increasing price of other key resources are all projected to rise at the same time as world population growth. This growing depletion of resources, this gradual increasing price for these key resources and this endless growth in market demand is therefore unsustainable".[43]

[42] Global Phosphorus Fertilizer Market and National Policies: A Case Study Revisiting the 2008 Price Peak; by Nikolay Khabarov and Michael Obersteiner. Front Nutr. 2017; 4: 22. Published online 2017 Jun 14. doi: 10.3389/fnut.2017.00022.

[43] Nikolay Khabarov and Michael Obersteiner, op. cit.

6.4.3 Toxic Metals In Phosphate Rock Fertilizer

The concern for humanity is that it will be eventually be only Morocco that will have the remaining economically viable phosphate rock deposits in the world. But these Moroccan deposits are already contaminated with cadmium and radioactive uranium, and this problem has attracted concern in Europe:

> *"According to the current EU proposals, cadmium would be tightened from 60mg/kg to 40mg after three years and to 20mg after 12 years, which would require Morocco and most in Africa to invest in new technologies to lower the limits.*
>
> *Scandinavian countries together with Austria and the Baltic Republics are pushing for a lower cadmium level ranging from 20mg to 40mg, while a second group of countries, headed by Poland, Spain and the U.K. are supporting much higher levels from 60mg to 90mg".*[44]

Dana Cordell who wrote the paper from which we quote below is correct – eventually the world will recognize the potential of using human urine as a "clean" source of nitrates and phosphates because it has none of the concerns caused by the quantities of toxic metals in phosphate rock.

> *"The quality of phosphate rock is declining for two reasons: the concentration of P205 in mined P rock is decreasing; and the concentration of associated heavy metals like Cadmium are increasing. The Cadmium content of phosphate rock can be very high. This is either considered a harmful concentration for application in agriculture, or, expensive and energy intensive to remove (maximum concentrations for fertilizers exist in some regions, like Western Europe)."*
>
> *Human excreta (urine and faeces) are renewable and readily available sources of phosphorus. Urine is essentially sterile and contains plant-available nutrients (P,N,K) in the correct ratio. Treatment and reuse is very simple and the World Health Organisation has published 'guidelines for the safe use of wastewater, excreta and grey water in agriculture'. More than 50% of the worlds' population are now living in urban centres, and in the next 50 years 90% of the new population are expected to reside in urban slums. Urine is the largest single source of P emerging from human settlements.*
>
> *According to some studies in Sweden and Zimbabwe, the nutrients in one person's urine are sufficient to produce 50-100% of the food*

[44] *Fertilizer hits the fan. The Commission's proposed new limits would oblige Morocco to heavily invest in technologies to remove cadmium https://www.politico.eu/article/europe-unexpected-conflict-the-phosphate-war-cadmium-fertilizer-russia/*

requirements for another person. Combined with other organic sources like manure and food waste, the phosphorus value in urine and faeces can essentially replace the demand for phosphate rock. In 2000, the global population produced 3 million tonnes of phosphorus from urine and faeces alone." [45]

ZWAI believes that the raw materials of nitrates and phosphates in domestic waste water that is currently going to waste in the ground must end. These nutrients should be better managed or transformed using separate treatment systems; to be recycled as a safe-to-use bio-fertilizer.

6.5 Synthetic Nitrogenous Fertilisers

When we examine nitrogenous fertilisers, we find different problems which also provide a strong argument for conserving these materials – they are produced from fossil fuels (primarily natural gas, but also from coal), and fertiliser production consumes large amounts of energy.

Ammonia is one of the most important feedstocks for the production of urea and other nitrogenous fertilisers (e.g., ammonium nitrate) and approximately 88% of the world's ammonia production is used for fertilizing agricultural crops. The production of ammonia consumes around 2% of all man-made power -- a significant component of the world energy budget.

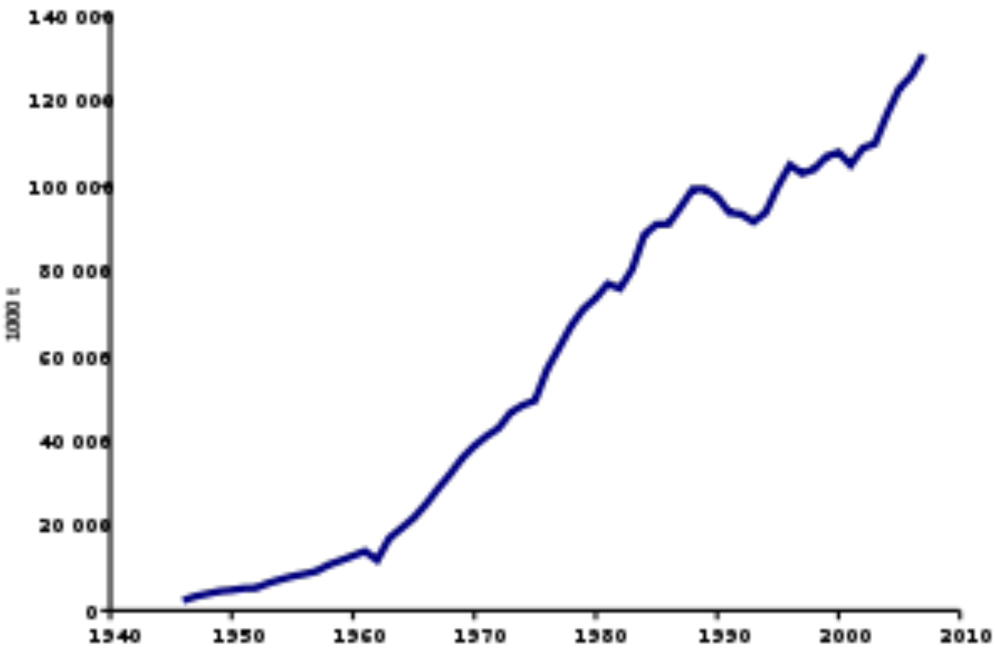

Figure 6.5.1 Production of ammonia between 1947 and 2007 (From Ammonia - Synthesis and production https://en.wikipedia.org/wiki/Ammonia and https://en.wikipedia.org/wiki/File:Production_of_ammonia.svg).

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[45] 8 reasons why we need to rethink the management of phosphorus resources in the global food system. http://phosphorusfutures.net/wp-content/uploads/2015/02/1_P_DCordell.pdf

Because of its many uses, ammonia is one of the most highly produced inorganic chemicals; dozens of chemical plants worldwide produce ammonia, and the graph in Figure 6.5.1 above shows the huge increase in production between 1947 and 2007.

> *"About 40% of our food would not exist without synthetic ammonia (NH_3) for fertilization. Yet, NH_3 production is energy intensive. About 2% of the world's energy is consumed as fossil fuels for NH_3 synthesis based on the century-old Haber-Bosch (H.-B.) process".*[46]

6.5.1 Relationship Between Nitrogenous Fertilisers, Agriculture and Climate Change Mitigation

The Haber-Bosch process for synthesising ammonia made it possible to mass-produce synthetic nitrogen fertilizers, its global output rising rapidly since the 1960s, as shown in Figure 6.5.1 above.

The EU Joint Research Centre has been examining this issue, and two very relevant and important reports emphasise the dependence of agriculture on synthetic nitrogen fertiliser, so that while the world population increases so also does the demand for synthetic nitrogen fertilizer.[47] The climate change challenge for mankind is to end this increasing world dependency on coal and natural gas based ammonia. We must reduce the generation of greenhouse gases emitting from the manufacture of ammonia and nitrate fertilizer. Mankind instead must maximize the development and use of nutrient rich waste to be treated and recycled as bio fertilizers. In the context of single house waste water treatment, families must also play their part in this new paradigm shift; moving away from making waste to a new system of recycling and reusing waste water nutrients.

These EU-funded reports concluded that:

> *"Synthetic N-fertilizers now provide just over half of the nutrient received by crops worldwide, and alternatives to reduce dependence upon mineral fertilizers while protecting the environment are receiving more and more attention. Among these potential sources of nitrogen, we wish to highlight the recycling of animal manure and human excreta, which has a large potential to substitute synthetic fertiliser use".*

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[46] Towards sustainable agriculture: fossil-free ammonia. Peter H. Pfromm, Department of Chemical Engineering, Kansas State University, Durland Hall, 1701A Platt Street, Manhattan, Kansas, 66506-5102, U.S.A. https://core.ac.uk/download/pdf/84312607.pdf

[47] NPK: Will there be enough plant nutrients to feed a world of 9 billion in 2050? Jean-Paul Malingreau, Hugh Eva, Albino Maggio. JRC Science And Policy Reports; Foresight and Horizon Scanning Series 2012. And: Anticipation Study NPK - will there be enough plant nutrients to feed a world of 9 billions? Supply of and access to key nutrients NPK for fertilizers for feeding the world in 2050 -- Maria Blanco.pdf Author: María Blanco Fonseca, Universidad Politécnica de Madrid (UPM), Department of Agricultural Economics, ETSI, Agrónomos Avda., Complutense s/n, 28040 Madrid, Spain. https://esdac.jrc.ec.europa.eu/projects/NPK/Documents/Madrid_NPK_supply_report_FINAL_Blanco.pdf

The importance of sustainable production and conservation of resources was also emphasised more generally by the European Commission Vice-President for Energy Union, Mr Maroš Šefčovič, when he spoke in Dublin on 09 November 2018:

> "*Let me conclude on our joint work to help build financial systems that are future-proof … current levels of investment are not sufficient to support an environmentally sustainable economic system that fights climate change and resource depletion.*
>
> *The Action Plan aims to achieve a number of policy goals:*
>
> *1. Reorient private capital flows towards sustainable investment in order to achieve sustainable and inclusive growth;*
>
> *2. Manage financial risks stemming from climate change, resource depletion, environmental degradation and social issues".*

ZWAI believes that the EPA CoP for domestic waste water should be amended to be in compliance with the recommended goals as stated by the Commission Vice President Maroš Šefčovič, and with the conclusions of the EPA STRIVE Research Report No 189 by Michael P. Ryan, Angela Boyce and Gary Walsh (quoted in section 6.4.1 above).

To summarise the reasons why we should not continue to waste nitrates into the ground water from DWWTSs:

- About 2% of the worlds energy resources are used just to make ammonia and nitrate fertilizer from coal and natural gas;
- this use of coal and natural gas contributes to the creation of greenhouse gases and every opportunity must therefore be taken to reduce emissions;
- our continuing dependency on natural gas to make ammonia and nitrogen fertilizer is therefore not sustainable, especially there is only enough natural gas in proven reserves to meet 58.6 more years of global production at present rates;
- we cannot simply move to burning coal to make ammonia when the natural gas supplies become un-economic, especially as coal is a much "dirtier" fuel from a climate perspective;
- our current fertilizer-making, food-growing, food-transporting, distribution supply system consumes too much oil and is emitting too much greenhouse gas emissions; and we must also reduce the "food miles" and encourage local or back garden and more local food production based on bio fertilizers; and,
- it is therefore thoughtless and irresponsible that our present domestic waste water treatment regulations are forcing single houses to be so wasteful of ammonia and nitrates; the world is starting to suffer very badly from climate change and in addition the resources to make nitrogen fertilizer are based on finite mineral resources that will eventually come to an end; and instead of wasting resources, we should

be educating and encouraging home owners to conserve and utilise organic nitrogen.

ZWAI and Herr Ltd believe that if the current COP proposal for domestic waste water treatment continues to deny the opportunity or the choice for new home owners to remove and recover or recycle nitrates and phosphates; then the EPA will be irresponsible by imposing a regulation that:

- will continue to perpetuate and allow the problems of environmental degradation of groundwater and nearby surface waters caused by septic tanks in various areas of the country with inadequate percolation;
- will contribute to resource depletion by wasting or land-filling phosphates into the ground;
- continues to force new single house buildings to be wasteful of finite nutrient resources, increasing the likelihood of high food prices and food shortages for low income people and low income countries;
- continues to degrade the local environment by wasting or losing nitrogen and nitrates into the groundwater and local surface water;
- continues to keep new house buildings in a system that contributes to climate change by keeping mankind dependent on the use of finite fossil fuels such as natural gas and coal to make ammonia and nitrate fertilizer; and,
- in addition, the use of natural gas and coal to make ammonia for fertiliser production will continue to contribute to climate-damaging greenhouse gas emissions.

6.6 Impacts of Future Fertiliser Shortage on World Food Prices

In sections 6.4 and 6.5 above, we referred briefly to the growing problem of food insecurity caused by impending shortages of phosphate and nitrogenous fertilisers, our dependence on these synthetic fertilisers, and the consequences of their production (use of fossil fuels and emission of greenhouse gases).

A communication from the European Commission to the European Parliament states that:

> *"Measures have already been taken at national EU and international level, mainly to address water pollution problems from phosphorus and to reduce the waste of materials such as food or other biodegradable waste that also contain phosphorus. However, these actions were devised with the prevention of water pollution in mind or for other policy objectives, rather than for the purposes of recycling and saving phosphorus.*
>
> *There has been recent price volatility - in 2008, prices of phosphorus rock rose by 700% in a little over a year, contributing to increases in fertiliser prices. There is little scope to switch from less important uses of phosphorus, as the essential use of feed and*

fertiliser already consumes around 90% of the total mined resource. Improving the use of recycled phosphorus in the EU and worldwide would help safeguard the supply of this fundamental raw material and encourage a more even distribution of phosphorus at both regional and global level. Economically, diversifying the supply of phosphate to the EU businesses that depend on it would improve their resilience faced with any future price instability and other trends that might aggravate their import dependency.

Initiatives that are directly focused on phosphorus efficiency and recovery remain scattered, and are rarely considered in policy development. An exception is Sweden, where a national interim target was established: "By 2015, at least 60% of phosphorus compounds present in wastewater will be recovered for use on productive land. At least half of this amount should be returned to arable land.

The Netherlands has put in place a phosphate value chain agreement, in which a range of stakeholders have committed themselves to targets such as using a set percentage of recycled phosphorus in their manufacturing process.

A European Phosphorus Platform has been set up by stakeholders in order to create a European recycled phosphorus market and to achieve a more sustainable use of phosphorus.

Greater recycling and use of organic phosphorus where it is needed could stabilise the amounts of mined phosphate required and mitigate the soil contamination and water pollution issues. This will then put us on track to close the phosphorus cycle in the long term, when the physical limitations of the resource will become increasingly important".[48]

Ireland and the EPA should take proper warning of the 2008 international food shortages that happened as a result of 700% phosphorus price increases of that year. The information from Wikipedia details the very many ways that a fossil fuel and fertiliser price increase can impact on people's lives and cause all kinds of human misery:

"World food prices increased dramatically in 2007 and the first and second quarter of 2008, creating a global crisis and causing political and economic instability and social unrest in both poor and developed nations. Although the media spotlight focused on the riots that ensued in the face of high prices, the ongoing crisis of food insecurity had been years in the making.

Starting in 2007, the prices of fertilizers of all kinds increased dramatically, peaking around the summer of 2008. Prices

[48] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions -- Consultative Communication on the Sustainable Use of Phosphorus. http://ec.europa.eu/environment/consultations/pdf/phosphorus/EN.pdf

> *approximately tripled for ammonia, urea, diammonium phosphate, muriate of potash (KCl), and sulphuric acid (used for making phosphate fertilizer), and then fell just as dramatically in the latter part of 2008.*
>
> *Some prices doubled within the six months before April 2008. Part of the cause for these price rises was the rise in the price of oil, since the most fertilizers require petroleum or natural gas to manufacture. Although the main fossil fuel input for fertilizer comes from natural gas to generate hydrogen for the Haber–Bosch process, natural gas has its own supply problems similar to those for oil. Because natural gas can substitute for petroleum in some uses (for example, natural gas liquids and electricity generation), increasing prices for petroleum lead to increasing prices for natural gas, and thus for fertilizer.*
>
> *Costs for fertilizer raw materials other than oil, such as potash, have been increasing as increased production of staples increases demand. This is causing a boom (with associated volatility) in agriculture stocks".*[49]

Let us not be as thoughtless today in preparing for the future as we were in the past. Britain in the early 1800's did not heed the early warning signs of a famine. Ireland's potato crop failures in the past had always been regional and short-lived with modest loss of life. Between 1800 and 1845, sixteen food shortages had occurred in various parts of Ireland, but the British Government in Ireland took no preventative action. It was inevitable then when the full scale potato blight hit Ireland that millions would die.

Ireland today must not likewise ignore the warning signs of a future food catastrophe. The information is freely available to us on the international fertilizer and food price problems of 2007 and 2008. We must not repeat the mistakes of the past. We must start now to build a robust circular economy for bio fertilizer from domestic wastewater. ZWAI are doubtful that a national mobile rural *struvite*-making service can be established. The Government is no further down the road with a national septic-tank sludge collection service either.

The EPA Domestic waste water treatment policy should be influenced not just by the issues of waste water pollution but by considering also about future price increases and eventually the probability of future market shortages for all or any of the following:

- The end of cheap oil - to transport fertilizers and food;
- The end of cheap natural gas - to make ammonia for fertilizer;
- The end of cheap phosphorus - to make phosphate fertilizer; and,

[49] 2007–08 world food price crisis, From Wikipedia. https://en.wikipedia.org/wiki/2007%E2%80%9308_world_food_price_crisis

- The end of cheap coal - to make ammonia fertilizer.

All these issues should be considered while at the same time phosphates and nitrates are currently being wasted from DWWTs. The wasting of nutrients from ST's from single houses will be an element in our growing global vulnerability to increasing resource depletion. A recent example of the 2007 to 2008 fertilizer price crisis occurred when oil as well as phosphate price increases occurred at the same time, as described in the paper by Nikolay Khabarov and Michael Obersteiner, cited in section 6.4.2 above. This same problem will inevitably occur again.

6.7 Pharmaceuticals in current wastewater discharges

One of the problems which has until recently been ignored, but which is finally receiving attention, is the amounts of pharmaceutically active substances being discharged untreated from wastewater treatment plants and from domestic WWTs. These substances are either not biodegraded by micro-organisms in the wastewater treatment process, or are partially degraded, to produce other undesirable and, in some cases, equally toxic products.

Some recent reports highlight this problem:

> *"Pharmaceutical residues are finding their way into our rivers and lakes, and scientists are concerned about the effects they may have on species – including us, writes Anthony King*
>
> *Martin Cormican, a professor of bacteriology at NUI Galway School of Medicine, has concerns over antibiotics entering our waterways. He believes this may be contributing to the worldwide problem of antibiotic resistance. One drug he is researching is ciprofloxacin, which is used to treat urinary tract infections and other more serious conditions. He says when a patient takes 750mg in a pill, they excrete most of the drug "in working form".*
>
> *This can rebound on patients when bacteria in the environment are exposed to this drug. Microbes may develop and transfer resistance genes to bacteria that may subsequently cause disease. Already, ciprofloxacin resistance seems to have moved from environmental into infectious bacteria. This isn't only of academic concern. The level of resistance to ciprofloxacin in* E coli *has increased steadily in Ireland.*
>
> *"In the course of my clinical work we see ciprofloxacin resistance practically every day, so it is a significant problem," Cormican says. Traces of drugs used in the treatment of depression and traces of oestrogen from the oral contraceptive pill have also been detected in the environment.*
>
> *"We are not saying that they are proven to be doing a great deal of harm to health, but these are biologically active compounds and they are designed to have an effect in small doses," says Cormican.*

He argues that "dilution is not the solution to pollution" and that we need to take a precautionary approach".[50]

Another study, quoting from experience in California, also drew attention to the problem of pharmaceutically active substances being absorbed from irrigation water by food plants:

> *"As water scarcity is exacerbated by urbanization and climate change, especially in arid and semi-arid regions, treated wastewater is increasingly an attractive alternative source of water for agricultural irrigation.*
>
> *For example, in Israel, the use of treated wastewater for irrigation by agricultural sector was about 50% of the total irrigation water in 2010. In California, the state legislature recently called for a three-fold increase of treated water reuse by year 2030.*
>
> *However, studies over the last two decades show that many man-made chemicals, including pharmaceutical and personal care products (PPCPs), are present in the "finished effluent of wastewater treatment plants (WWTPs). Therefore, when treated wastewater is used for agricultural irrigation, the trace contaminants have the potential to enter and accumulate in plants. Results from this study clearly showed that vegetables were capable of taking up many PPCPs when exposed to these chemicals".*[51]

The consequences of plants absorbing ingested medicines from sludge and treated wastewater are not fully known, but this is a problem which will become increasingly important, especially if treated wastewaters are used more as a water supply for crop production.

The evidence that plants will bio-accumulate pharmaceuticals and personal care products from waste water can be used to advantage however. It is our submission that, to minimise the growing problem of anti-biotic and personal care products from entering our rivers and streams, we should deliberately grow non-food plants that will transpire some of the wastewater through their leaves. The plants will also bio accumulate and remove these potentially harmful pharmaceutical and personal care products (PPCPs).

We should therefore use the ability of growing "non food plants" as a way to accumulate PPCPs from human urine when the urine is used as a source of nitrogenous fertiliser, and in **section 7** below we describe how this process can be easily and effectively undertaken.

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[50] The undiluted truth about chemicals in our waters – Irish Times Jan 5, 2012. http://www.irishtimes.com/news/science/the-undiluted-truth-about-chemicals-in-our-waters-1.439674

[51] Comparative uptake and translocation of pharmaceutical and personal care products (PPCPs) by common vegetables. Xiaoqin Wu, Frederick Ernst, Jeremy L. Conkle, Jay Gan. Department of Environmental Sciences, University of California, Riverside, CA 92521, USA. https://www.sciencedirect.com/science/article/pii/S0160412013001591

6.8 Organic Nutrients and the Circular Economy

One of the first countries to create a kind of "circular economy for nutrients was the Netherlands.

In 2011, the Dutch government brought together 20 water, chemical and food industry and agricultural stakeholders through the '*Nutrient Platform'* to sign the '*Phosphate Value Chain Agreement'.* This was a Green Deal that aimed to turn the Netherlands into a net exporter of secondary phosphate. The Ministry of Infrastructure and Environment appointed and funded a full-time value-chain director to head the network for two years and work closely with the Nutrient Platform to execute the agreement.[52]

The deal brought together stakeholders in the value chain that do not normally work together and generated trust even when certain parties stood to benefit more than others. The government set new rules for the use of recovered phosphates as fertiliser in the Netherlands, to overcome the barrier of legislation hindering the use of recovered materials, in particular if they contain heavy metals or other pollutants. The Nutrient Platform also involved the financial sector to make a closer connection between innovative companies and financial institutions to accelerate sustainable secondary phosphate innovations being brought to market. This action was needed to overcome the barrier of high price volatility in the secondary phosphate market discouraging investment.

On 02 July 2014 the Commission published a Communication entitled "*Towards a circular economy: A zero waste programme for Europe"* (COM (2014) 398, final).

This Communication makes it clear that a circular economy is needed to support sustainable growth, this is difficult to achieve while "*valuable materials are leaking from our economies"*; and *"in a world where demand and competition for finite and sometimes scarce resources will continue to increase, and pressure on resources will cause greater environmental degradation and fragility, Europe can benefit economically and environmentally from making better use of those resources".*

However, it was not until 2015 that the European Commission began considering the recycling of nutrients as an important component of the Circular Economy:

> *"Recycled nutrients are a distinct and important category of secondary raw materials, … They are present in organic waste material, for example, and can be returned to soils as fertilisers. Their sustainable use in agriculture reduces the need for mineral-based fertilisers, the production of which has negative*

52 https://www.phosphorusplatform.eu/images/download/Dutch_phosphate_value_chain-_agreement_-_Oct_4th_2011.pdf

environmental impacts, and depends on imports of phosphate rock, a limited resource".[53]

In 2015, the European Commission presented the first deliverable of the EU Circular Economy Package with new rules on organic and waste-based fertilisers in the EU. The proposed Regulation would significantly ease the access of organic and waste-based fertilisers:

> *"The Regulation sets out common rules on converting bio-waste into raw materials that can be used to manufacture fertilising products. The new rules will apply to all types of fertilisers to guarantee the highest levels of soil protection. The Regulation introduces strict limits for cadmium in phosphate fertilisers. The limits will be tightened from 60 mg/kg to 40 mg/kg after three years and to 20 mg/kg after 12 years, reducing health and environmental risks.*
>
> *Today only 5% of bio-waste is recycled. According to estimates, if more bio-waste was recycled, it could replace up to 30 % of non-organic fertilisers. Currently, the EU imports around 6 million tonnes of phosphates a year but could replace up to 30% of this total by extraction from sewage sludge, biodegradable waste, meat and bone meal or manure".*[54]

In 2016, Finland launched a nutrient recycling innovation programme, at a two-day seminar in Helsinki, on 19-20 April 2016, in which more than 500 people participated. The programme is entitled "Recycle Nutrients for Clear Waters", for innovation in nutrient recycling technologies and logistics, and is supported by Government funding of €12 million.

At the launch, the Finland Minister of Agriculture and the Environment, Kimmo Tiilikainen, stated that:

[53] Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions. Closing the loop - An EU action plan for the Circular Economy; Brussels, 2.12.2015 COM(2015) 614 final Page 11 https://ec.europa.eu/transparency/regdoc/rep/1/2015/EN/1-2015-614-EN-F1-1.PDF

[54] Circular Economy: New Regulation to boost the use of organic and waste based fertilisers Brussels, 17 March 2016 European Commission. file:///C:/Users/User/Downloads/IP-16-827_EN.pdf

> *"Nutrient recycling is one of the key elements of the circular economy and our national food security. The profitability of farms depends on new thinking, sustainable production, resource efficiency, promotion of local food and economies, and branding the products. There are new business opportunities, for example, in recycling the nutrients contained in animal manure and sewage sludge. At the same time we will considerably reduce loading to waters when nutrients that are about to run into waters are brought back to the cycle".*[55]

The aims of the programme include the promotion of processing technologies, nutrient recycling logistics and service solutions as well as developing high-quality products from biomasses. The funding is primarily targeted to companies developing and testing new technologies and project actors working in close collaboration with companies to promote nutrient recycling.

6.9 Compliance with the UN Sustainable Development Goals

In addition to complying with the principles of zero waste, nutrient recycling and the circular economy, it is our submission that the new EPA CoP for single houses should also comply with the "UN Sustainability Goals." For example, the **UN Goal number 6**, "Clean Water and Sanitation", **Target No. 3**, states that:

> *"By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally."*

In accordance with the UN Sustainability Goals, ZWAI is requesting changes to the new EPA CoP for Single Houses, to permit new home buildings to avoid waste and loss of nitrates, phosphates and ingested pharmaceuticals into the ground, and to prevent pollution of groundwater or nearby wells or streams with these same substances.

If the EPA is acknowledging that pollution from septic tanks already occurs in parts of Ireland during low flows or where the soil percolation conditions are inadequate (see section 6.3 above); then a different treatment solution should be promoted in the new EPA CoP as well as in Part H of the Building Regulations.

We must "*minimize the release of hazardous chemicals",* as required by the UN Goal 6.3 quoted above. It is now commonly known that hormones, antibiotics, pharmaceuticals and personal care products are not completely or adequately removed at the end-of-the-pipe by conventional waste water treatment systems and we know they are now increasingly present in our rivers. We know also there is a problem in hospitals where super-bugs or bacteria are showing

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[55] https://phosphorusplatform.eu/scope-in-print/scope-in-press/1200-finland-launches-nutrient-recycling-programme.

increasingly resistance to antibiotics. The EPA and the Department of Housing, Planning and Local Government should allow single house owners permission to prevent or avoid these from entering with the waste water at the front-of-the-pipe. Prevention of pharmaceuticals getting into the rivers is much more easily achieved in single houses. Domestic plumbing systems that can keep the source of these pollutants separate from the rest of the grey water should be permitted. Domestic plant-based growing systems treating urine, along with faecal and biomass composting systems; should be permitted and encouraged in the new CoP. Using these systems, we should be "*substantially increasing recycling and safe reuse"* of plant nutrients to grow food.

UN Goal No. 6, "Clean Water and Sanitation", **Target No. 6A**, requires us to comply with the following statement:

> *"By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies."*

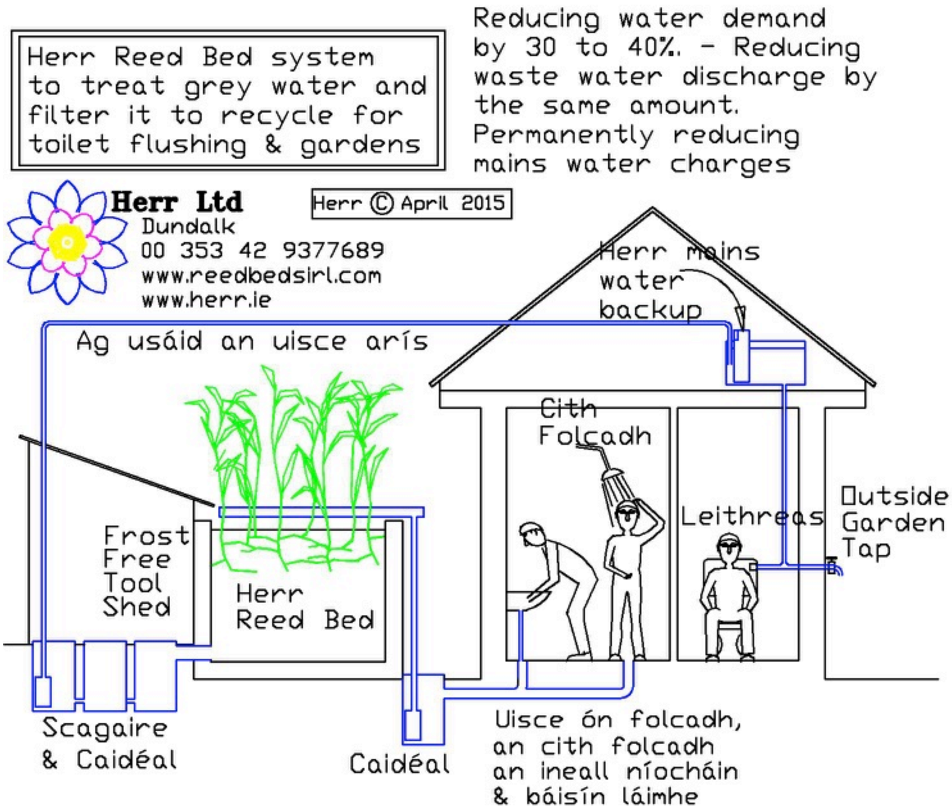

Figure 6.9.1 **Reducing water demand and recycling water, using the Herr reed-bed system.**

The UN Sustainability Goals are calling for "water harvesting" from roofs and the "treatment, recycling and reuse" of water. Part H of the Building Regulations already details the important measures to be used to recover rainwater but no detailed information or technical recommendations is available for the treatment and recycling of grey water.

Ireland has suffered from a serious summer drought in 2018 and will probably suffer further repeated drought over the coming decades. Treating and recycling grey water (as shown in Figure 6.9.1) would have helped home owners in times of a water supply crisis and should therefore be detailed and encouraged in the new CoP (see section 6.1 above and section 7.5 below).

Since grey water, excluding the kitchen and toilets, accounts for about 40% of the waste water volume then the COD should show diagrams of deep Vertical Flow Reed Beds followed by a clarifier and a sand filter. Herr Ltd has implemented this treatment method at the Airfield Trust City Farm, Dundrum Co Dublin. The necessary treatment standard has been achieved for re use of the water for toilet flushing (see section 7.5 below).

UN Goal No 2, Zero Hunger, **Target No 4**, states that:

> *"By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality".*

It is our submission that the attainment of this goal also requires conservation and reuse of organic nitrogen and phosphorus, to provide the necessary "*resilient agricultural practices"* that will allow human societies to escape from the current dependency on fossil fuels for agricultural production.

UN Goal No. 12, Sustainable Consumption and Production, includes the following targets:

> *12.2. By 2030, achieve the sustainable management and efficient use of natural resources;*
>
> *12.5. By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse; and,*
>
> *12.8. By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature.*

ZWAI believes that nitrogen and phosphorus are important "natural resources" for human use. Without additional sources of nitrogen and phosphorus it won't be possible to ensure sustainable food production for growing world populations.

Single houses are not sustainably managing nitrogen and phosphorus which are being leached into the ground and are contaminating groundwater and surface water, as a result of using septic tanks and DWWTSs. If the nitrogen and phosphorus from approximately 571,000 septic tanks are being lost, then this country cannot be in compliance with UN Goals 2, 6 and 12.

Furthermore, Ireland cannot comply with Target 12.8 of Goal No. 12, while the EPA in the current CoP Document is not doing enough to highlight or to issue "relevant information" on the need to recycle nitrates and phosphorus from domestic waste water. The public needs to be informed that current domestic waste water treatment systems are unable to prevent nitrate pollution or prevent ingested pharmaceuticals in treated waste water emissions.

7. OUR PROPOSED SOLUTIONS

In section 6, we have identified multiple issues concerning the use of single-dwelling wastewater treatment systems; and in the following sections we attempt to demonstrate how these problems might be resolved.

7.1 Urine Separation and Composting Toilets

For individual homes that are willing, ZWAI and Herr proposes that separated urine and faeces that contain the majority of these nutrients in domestic waste water should be individually treated in a safe hygienic way to become a bio-material that can be fully composted and re-used. The growing of plants in separated and diluted human urine should be an option for single houses in the future.

The draft EPA CoP Document already refers to the ability of plants to use nitrates as food; in section 3.2.3, Nitrogen. on page 17, the draft CoP states that:

> *"Domestic sources of nitrogen include human waste," "algae and plants use nitrates as a source of food."*

The draft CoP Document also takes note of urine separation toilets and composting toilets, and refers to the EPA Strive Report No. 108, Water Saving Technologies to Reduce Water Consumption and Wastewater Production in Irish Households (Dubber and Gill, 2015a), which mentions "*the use of urine separating toilets and toilet composting systems"* on page 19.

We are therefore pleased that the EPA is acknowledging and is perhaps open to recommending urine separating toilets and composting toilets systems. Hopefully the EPA will consider these toilets as a way to remove and reuse nitrates and phosphates that is otherwise being wasted in the ground.

In the Nordic countries they have been using the nitrogen and phosphorus that is contained in human urine to grow crops and plants.

In 2015, Denmark's agriculture and food council collected 54,000 litres of urine from festival-goers. The urine was then transformed into fertiliser, yielding 11 tonnes of malting barley. After harvesting and brewing, the beer-dubbed "Pisner" – not Pilsner – will be released on the market in June.

Though urine is practically sterile when it comes out of the body, Danish brewers insist there is no actual urine in the beer. However urine is full of nitrogen, potassium and phosphorus, the same ingredients found in regular fertiliser. “*When it comes to circular economy, Danish farmers are some of the best in the world,”* said Karen Hækkerup, CEO of the Danish Agriculture and Food Council. *“If you can brew a beer with urine as fertiliser, you can recycle almost anything”.*[56]

There is therefore no doubt that plants will absorb and remove the nitrogen and phosphorus from human urine. Given that most of the nutrients in domestic waste water come from urine and faeces – surely as a first step urine should be separated and separately treated by deliberately growing plants in some form of reed bed?

Analysis of various pollutants & nutrients in Domestic waste water These "approximate" figures depend on the diet, lifestyle & nationality of the residents	**Grey Water**	**Kitchen Solids**	**Faeces**	**Urine**	**Faeces & Urine together**
Phosphorous P	**14%**	**14%**	**26%**	**47%**	**73%**
Nitrogen N	**7%**	**8%**	**15%**	**70%**	**85%**
Potassium K	**10%**	**37%**	**18%**	**35%**	**53%**
Faecal bacteria & viruses			**100%**		**100%**
Ingested medicines & hormones			**faeces & urine**		**100%**
Volume of waste water / person/ day	**140 litres**		**0.6 litre**	**1.5 litres**	

Table 7.1 **Analysis of various pollutants and nutrients in domestic grey water, kitchen solids, faeces and urine**

The ZWAI believes its time now that the EPA started to follow the lead from the European Commission to allow and encourage more innovation by Irish SME’s to purposefully recycle phosphorus and nitrogen from domestic waste water. Ireland should not continue to be casual or ignore the serious recent warnings from other countries about fertilizer price volatility and food insecurity.

Unfortunately it is not acknowledged in the EPA CoP draft consultation document that the separation and composting of toilet solids will contribute greatly to the reduction of septic tank sludge. Nor does it acknowledge that composting toilet solids will recover nitrates and phosphates and reduce the nutrients that are otherwise get lost in the ground after a septic tank or from standard domestic waste water treatment systems.

56 Danish farmers take the piss by turning urine into beer. https://www.irishtimes.com/news/offbeat/danish-farmers-take-the-piss-by-turning-urine-into-beer-1.3046295

With this toilet shown below, the solids, when separated from the rest of the domestic waste water will account for a reduction of 25% of the phosphorus and 15% of the total nitrogen.

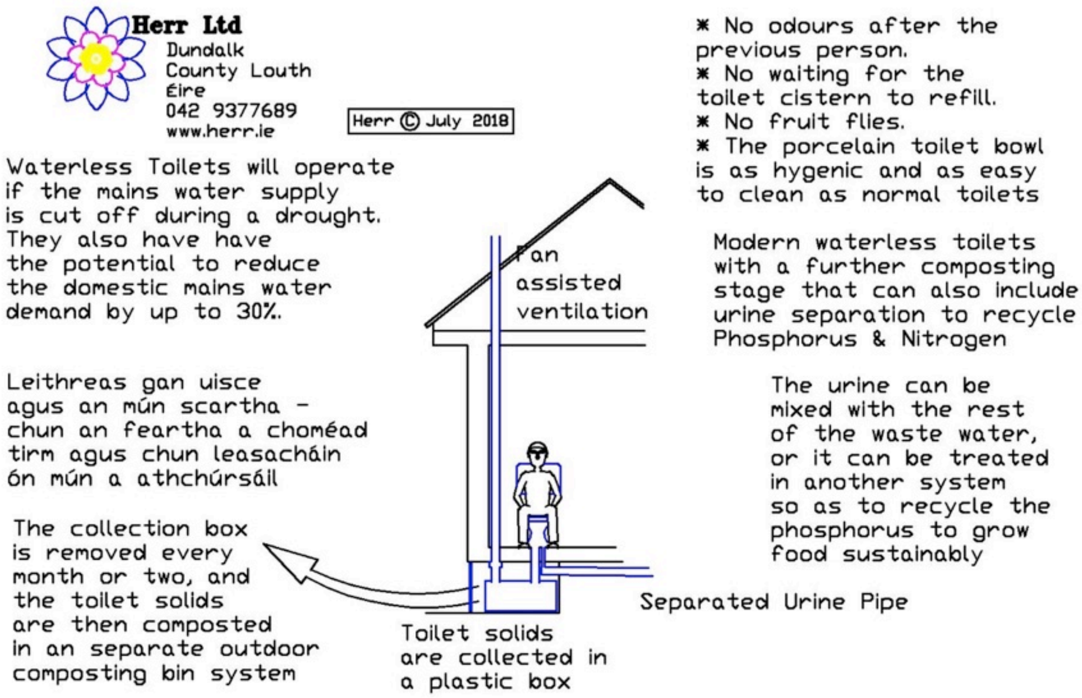

Figure 7.1.1 Schematic of a waterless toilet system.

The above diagram shows the arrangement for an almost zero flush-water toilet. The photographs below show the side view as well as the view from above


View 7.1.1 Side view and top view of an almost zero-flush toilet with urine separation.

The advantages of this almost waterless and urine separating toilet are:

- A very small amount of water is needed to flush the remaining urine away from the front part of the toilet;

- No flush water is needed for the toilet solids because they simply drop down into the faecal collection chamber below;
- Keeping water and urine separate from the toilet solids provides the best low moisture conditions for proper composting that takes place later;
- The porcelain toilet is hygienic to clean and looks very similar to conventional toilets;
- No fruit flies are a problem because with the ventilation the faecal matter is kept reasonably dry, however in addition a fly zapper is also located just above the faecal pile; a blue light attracts any insects up to the zapper where they then get electrocuted when they come near to the electro statically charged bars;
- Waterless toilets are an appropriate socially responsible response to water shortages and droughts in Ireland, as happened in the summer of 2018. There is every reason to believe that similar water shortages will occur again in future as global climate change continues to cause Irish summers to be dry;
- From a resource recovery point of view almost all of the nitrogen phosphorus and potash in faeces will be recovered to be later added to a separate compost heap;;
- Along with the composting toilet, if the nutrients of the urine are also recovered using the HANAPAK hydroponic system, then a total of 73% of P , 85% of N and 53% of Potassium will be recovered, for recycling; and,
- This compares very favourably with the much lower recovery rate of nutrients from the existing 571,000 Irish septic tanks which is only 20% for P & 15% for N.

This composting toilet is marketed and supported in the market by Herr Ltd.

Another type of composting toilet system is the Aquatron system from Sweden. This allows the use of standard flush toilets. The Irish Agents are Herr Ltd., and we are attaching details of the Aquatron which has been extensively tested and awarded the CE mark, so it can be sold in the EU.

The diagram below illustrates the elements of an existing integrated waste water system in Ballymun, County Dublin, to remove and recover nitrogen and phosphorus from the urine and faeces as a priority and then to treat the remaining waste water and by using a vertical flow reed bed at the end of the system. The advantage of this system is that normal flush toilets are used and the toilet solids are shortly afterwards separated from the flush water. The solids are dropped into one of a 4 chamber rotating carousel composter. Over a period of 6 to 9 months earthworms in the chambers consume and compost the toilet solids.

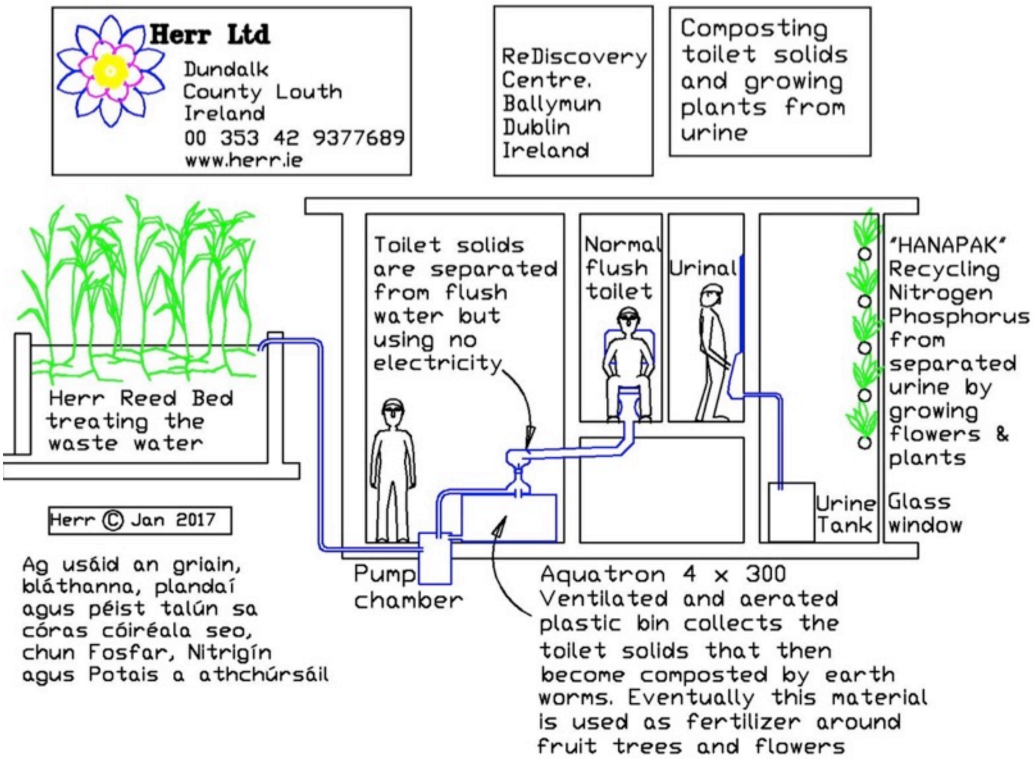

Fig. 7.1.2 **Integrated urine-separating toilet and wastewater treatment system at the Re-Discovery Centre, Ballymun, County Dublin, using urine to grow plants, and reed-bed to treat wastewater.**

View 7.1.2 **Toilet composting system in the Ballymun ReDiscovery Centre with two urine storage tanks**

The photograph above shows the toilet composting system in the Ballymun ReDiscovery Centre as well as the two urine storage tanks that fertilize the plants that are growing in the western window.

In Sweden where basements are more common, this toilet composting system is located in the basement under the floor of the house, as shown in the photo below. Electric fly zappers are also added in the room to eliminate any fruit fly problem.

View 7.1.3 Swedish composting toilet system in the basement of a house

Each of the 4 compost chambers is rotated to the next position every 2 to 3 months. Therefore the material in each chamber has a further 6 to 9 months for the material to dry out and for the earth worms to ingest everything. The volume of the composted toilet solids will also reduce over this period. When emptying the chamber at the ReDiscovery Centre Ballymun, the earthworm compost is crumbly and dry and looks like this.

View 7.1.4 Appearance of dry composted toilet solids during the process of emptying the chamber at the ReDiscovery Centre, Ballymun.

7.2 Health Issues – Safe Removal of Pathogens, Parasites and Pharmaceutically Active Substances

While we know now that the levels of toxic metals from human excrement will be very low and will not be a threat to the food chain; there is still a need to ensure that no parasitic worm eggs persist in the compost. More importantly there can be no guarantee about people excreting ingested medicines, pharmaceuticals or antibiotics. For this reason we believe it necessary to compost the material for a further 4 years.

The earth worm will have achieved a certain standard of composting but we believe that the EPA should insist on a further composting period of 4 years if the compost is to be used to grow food crops. The harvested plant leaves that were grown in the dilute urine should also be added to these contained composting boxes. This is in order to allow enough time for any ingested medicines or antibiotics to eventually break down.

In the possible situation where future supermarket food prices become unaffordable, ZWAI believes that in complying with the “precautionary principle” that:

- The waste vegetation from the plants that were grown from the human urine,
- Along with kitchen waste, excluding cooked meats that might attract rats
- And perhaps also garden waste should be added
- Along with the 6 to 9 month old toilet solids that come from waterless toilets or the Aquatron;

These should all be added to the first compost chamber. We suggest 4 number, good big 3 sided concrete boxes 1.5 m x 1.5 m x 1.2 m tall that are open on one side be constructed.

The material to be composted should have a source of carbon added to better achieve the carbon to nitrogen ratios, so it will heat up as it is composting. Air pipes with holes in them along the bottom or a wide perforated plastic floor could be provided for a better air availability to the bottom of the pile. Every year the material should be turned over and added to the next composting bin. An easily removable rain run-off roof should be provided to prevent flooding during very heavy rain and to protect it from drying too much in the sun. Some rotting sticks that are already colonized with mycelium fungus should be added for years 2, 3 and 4. We know that mycelium is great at breaking down long chain carbon molecules that make up wood or synthetic compounds and medicines. A complete 4 years system to properly compost the harvested vegetation that was grown from human urine is shown below.

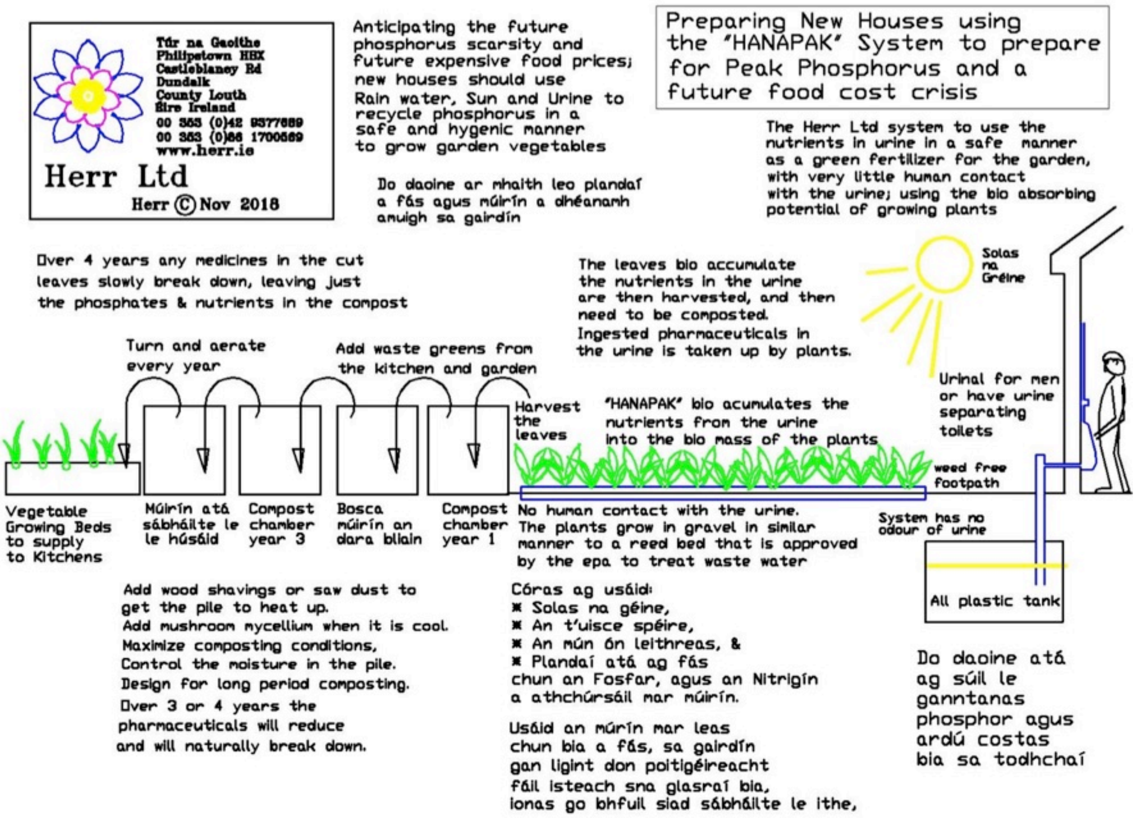

Fig. 7.2 **A complete HANAPAK system to properly compost the harvested vegetation grown from human urine.**

Rather than having the containment for the 4 bins constructed from materials that will eventually start to fall apart, perhaps home owners should spend a bit of money on a more permanent concrete block wall structure. The owner of this composting system below is very right to be pleased with himself!

View 7.2 **A permanent concrete block wall structure for a complete four-year system to properly compost the harvested vegetation grown from human urine**

There is strong scientific evidence that composting is a good way to remove antibiotics from animal manure even over very short time periods. It is self evident that if the residence time for the composting is as long as 4 years, instead of short term composting; then this will offer much greater security that ingested medicines from humans will be bio degraded. This assurance about the safety of re-ingesting pharmaceuticals is needed before allowing this compost to be used in a vegetable garden or to enter the food chain.

> *"On-farm manure management practices, such as composting, may provide a practical and economical option for reducing antibiotic concentrations in manure before land application, thereby minimizing the potential for environmental contamination. The objective of this study was to quantify degradation of chlortetracycline, monensin, sulfamethazine, and tylosin*
>
> *At the conclusion of the composting period (22-35 d), there was >99% reduction in chlortetracycline, whereas monensin and tylosin reduction ranged from 54 to 76% in all three treatments. Assuming first-order decay, the half-lives for chlortetracycline, monensin, and tylosin were 1, 17, and 19 d, respectively. These data suggest that managed compositing in a manure pile or in a vessel is not better than the control treatment in degrading certain antibiotics in manure. Therefore, low-level manure management, such as stockpiling, after an initial adjustment of water content may be a practical and economical option for livestock producers in reducing antibiotic levels in manure before land application".*[57]
>
> *"On-farm manure management practices, such as composting, may provide a practical and economical option for reducing antibiotic concentrations in manure before land application, thereby minimizing the potential for environmental contamination.*
>
> *The objective of this study was to quantify degradation of chlortetracycline, monensin, sulfamethazine, and tylosin in spiked turkey (Meleagris gallopavo) litter during composting.*
>
> *Three manure composting treatments were evaluated:*
>
> 1. *A control treatment (manure pile with no disturbance or adjustments after initial mixing),*
> 2. *A managed compost pile (weekly mixing and moisture content adjustments), and,*
> 3. *In-vessel composting.*

[57] Antibiotic degradation during manure composting. Dolliver H, et al. J Environ Qual. 2008 May-Jun. https://www.ncbi.nlm.nih.gov/m/pubmed/18453444/

Despite significant differences in temperature, mass, and nutrient losses between the composting treatments and the control, there was no difference in antibiotic degradation among the treatments.

Chlortetracycline concentrations declined rapidly during composting, whereas monensin and tylosin concentrations declined gradually in all three treatments. There was no degradation of sulfamethazine in any of treatments. At the conclusion of the composting period (22-35 d), there was >99% reduction in chlortetracycline, whereas monensin and tylosin reduction ranged from 54 to 76% in all three treatments. Assuming first-order decay, the half-lives for chlortetracycline, monensin, and tylosin were 1, 17, and 19 d, respectively.

These data suggest that managed compositing in a manure pile or in a vessel is not better than the control treatment in degrading certain antibiotics in manure. Therefore, low-level manure management, such as stockpiling, after an initial adjustment of water content may be a practical and economical option for livestock producers in reducing antibiotic levels in manure before land application.[58]

Composting has been identified as a viable means of reducing the environmental impact of antibiotics in manure. The focus of the present study is the potential use of composting on the degradation of salinomycin in manure prior to its field application. Manure contaminated with salinomycin was collected from a poultry farm and adjusted to a C:N ratio of 25:1 with hay material.

The manure was composted in three identical 120 L plastic containers, 0.95 m height x 0.40 m in diameter. The degradation potential for salinomycin was also ascertained under open heap conditions for comparison (control). Salinomycin was quantified on HPLC with a Charged Aerosol Detector, at an interval of every 3 days.

The salinomycin level in the compost treatment decreased from 22 mg kg(-1) to 2 x 10(-5) microg kg(-1) over 38 days. The corresponding decrease in the control was from 27.5 mg kg(-1) to 24 microg kg(-1). The changes in pH, EC (dS m(-1)), temperature, total kjeldahl nitrogen (TKN), total potassium (TK), total phosphorus (TP) and carbon content in both the composting and the control samples were monitored and found to be different in compost as compared to the control.

During the composting process, the loss of TKN was 36%, which was substantially lower than corresponding loss of 60% in the control. The loss of carbon was 10% during composting, whereas the loss in the control was 2%. In composting, the temperature modulated from 27 degrees C (initially) to a high of 62.8 degrees C (after 4 days), and then declined to 27.8 degrees C at the end of 38 days. On the basis of the

[58] Antibiotic during Manure Composting - University of Wisconsin - River Falls - https://www.researchgate.net/publication/5400224_Antibiotic_Degradation_during_Manure_Composting.

> *results obtained in this study, it appears that the composting technique is effective in reducing salinomycin in manure.*[59]

There is little doubt therefore that medium term composting can play an important part in preventing ingested pharmaceuticals from re entering the food chain. It follows therefore that the reuse of bio fertilizer from human excrement to grow vegetables should not be permitted for food production – unless a composting period of 4 years is undertaken. The best way for a state organization to regulate this is by making a planning condition that a permanent 4 chamber composting structure is built.

Most importantly we want to point out that the conversion of domestic nutrient rich waste into a safe to use bio fertilizer is in compliance with the new EU circular economy regulations (see section 6 above).

ZWAI or Herr Ltd is not suggesting that bio fertilizers generated from domestic waste water become "CE marked" in order to be sold on the open market. It would be too difficult to regulate and anyway it would be un-necessary. We are proposing instead that the finished compost generated from the various treatment steps would be available only for garden use by the families themselves. The additional 4 year composting of the toilet solid waste and the urine fertilized green leaves must be carried out in the interest of protecting the safety of the family alone. We are convinced that only very responsible people will be interested in doing the necessary training that we suggest. Only environmentally aware and educated people will be willing to invest in this domestic eco waste water nutrient recycling system.

7.3 Using Separated Human Urine to Grow Non-food Plants

As mentioned earlier, the amended EPA COP for single houses should encourage phosphate and nitrate recovery, and one simple option for doing so is to separate human urine and allow its use in botanically based treatment systems. The growing of more desirable flowers and terrestrial based plants can effectively bio-absorb the nitrates and phosphates.

We show in the photographs below some examples of existing systems that grow non-edible plants fertilized only with separated urine. When there is enough sunlight and enough of these plants are growing; the rate of nutrient removal from the urine will be constantly bio-absorbed by the plants. Herr Ltd has been experimenting and using this urine nutrient removal system for over a decade now.

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[59] The effect of composting on the degradation of a veterinary pharmaceutical. Ramaswamy J, Prasher SO, Patel RM, Hussain SA, Barrington SF. https://www.ncbi.nlm.nih.gov/pubmed/19944598

View 7.3 **Examples of existing urine nutrient removal systems by Herr Ltd that grow non-edible plants fertilized only with separated urine**

As well as growing plenty of green plants – more appealing colourful flowers can be grown from the nitrogen and phosphorus in urine as well. There is no doubt that the Herr Ltd method of growing of terrestrial plants for their later harvesting and composting is now a proven and established way to remove nitrogen and phosphorus from any waste containing these elements. Photos below of indoor flowers removing and bio accumulating nitrogen and phosphorus from separated human urine:

View 7.4 **More appealing colourful indoor flowers grown by Herr Ltd., to demonstrate a proven and established way to remove nitrogen and phosphorus from separated human urine.**

View 7.5

Flowers growing in the "HANAPAK" system in the western-facing glass corridor at the ReDiscovery Centre in Ballymun, Co. Dublin.

"HANAPAK" is an acronym for "Herr ag athchúráil Nitrogen (N) agus Phosphorus (P) agus Potash (K)".

A new trend is growing in architecture where nature is being brought inside buildings and houses. These indoor plants are growing inside a public building centre in Ballymun County Dublin. Because the urine is diluted, there are no odours from the system. These plants are automatically watered and fertilized. Apart from managing greenfly, the removal of excess leaves and the harvesting of leaves; there is little work involved with the system.

For humans, the bright sunshine coming through this western window is softened by a variety of plants that are self watered and self fertilized. The containment of the nutrient solution inside the pipes also protects small children who visit the centre from having any manual contact with the urine. Indoor gardens can also contribute to the pleasant appearance in the room.

Advantages of growing Non Food Plants from human urine:

- Reducing Greenhouse Gases. Unlike any other form of mechanical or energy dependent waste water treatment system, this flower and plant growing system uses very little electrical pumping energy. Indeed it's probable that the photosynthesis that is happening with the growing plants is also removing carbon dioxide from the atmosphere and is therefore reducing greenhouse gases;

- Ease of use for single houses. It is not safe having single houses using ferric sulphate to remove phosphates as they do for municipal treatment systems. Nor is it practical for families to be adding or using organic carbon to remove nitrates. This more natural flower growing system should be promoted as a treatment system that is safe to use, easier for gardeners and therefore is more appropriate for single home use;

- Appealing and potentially popular, indoor system for families. The idea of having a wide variety of plants growing indoors or outdoors, that are also automatically watered and fertilized, with no foul odours and that treats a portion of the waste water also; will be appealing to a reasonably large number of environmentally aware people;

- Safe secure system for small children. Systems where the urine or faeces is contained and is kept away from small children will be suitable for home use – subject to proper training. Indeed even if urinals alone were used so that there was zero chance of faecal contamination – excreted human urine in healthy individuals without urinary tract infections is free of viruses and bacteria;

- Non technical training for people to use these systems will be easy to deliver. Since we require training for people to drive cars, aeroplanes, buses, or to install gas fired central heating systems – then the certified training of home owners in the use and the safety of these botanic treatment systems should, be provided;

- Removal of 70% of the nitrogen; the biggest advantage of growing terrestrial plants with separated human urine is that it helps to avoid algae in local lakes by removing about 70% of the nitrogen from domestic waste water treatment systems. This of course should be regarded as a pollution treatment system to protect nearby wells and nearby streams;

- Removal of 50% of the phosphates. Another big advantage is that it removes about 50% of the phosphates that would otherwise be lost in the soil after the domestic sewage treatment systems and that should be recycled instead;

- More efficient removal of nutrients than from septic tanks. The growing of plants from human urine is a more efficient nutrient removal system than having sludge removed from septic tanks. The removal rate from septic tanks is only about 15% for nitrogen and only about 20% for phosphates; and,

- Less worry about toxic metals. Separated human urine will eventually be acknowledged as having less toxic metals than municipal sewage sludge or even commercial synthetic fertilizer. Already there is a Statutory Instrument to limit the levels of toxic metals going onto farm land. This is to protect the food chain from containing rising toxic metals. In addition there is now a serious public health concern in the EU about toxic metals such as cadmium in commercial mined phosphorus rock from Morocco that is being applied as fertilizer to farm land in Europe.

7.4 Removal of Nitrates and Phosphates by Growing Trees or Plants and Making Compost

In nature however nutrients have been recycled by plants for millions of years. The nitrogen and phosphorus in faeces and urine of animals have been used and bio absorbed by trees and plants. This natural tree growing method to remove phosphorus is acknowledged in the draft EPA COP document itself.

On page 54, the EPA Draft CoP states:

> *Research has been completed on willow bed evapo-transpiration systems and their use and applicability in Ireland, especially in the context of low permeability soils and/or subsoil's (Curneen and Gill, 2014, 2016; Gill et al., 2015).*
>
> *In small-scale experiments, evapo-transpiration rates were highest for those cultivars receiving primary effluent, followed by those receiving secondary treated effluent, which, in turn, had much higher evapo-transpiration rates than those receiving just rainfall. Hence, the results obtained show that the addition of effluent has a positive effect on evapo transpiration. In addition, water quality monitoring showed that the willows could also take up a high proportion of nitrogen and phosphorus from the primary- and secondary treated effluents added each year* (section 8.2.4 Willow Bed Evapotranspiration Systems).

We agree that this nutrient removal certainly happens when willow trees grow next to open wetland ponds that receive domestic waste water.

Organic Centre, County Leitrim - Zero Water Discharge 1

We have seen the positive impacts of growing willow trees beside an unlined waste water wetland at the Organic Centre, Rossinver, in County Leitrim. The willow trees that grow beside the pond are very mature now since the system has been running for over a decade now. During more recent winter visits there has been no liquid discharge at all from the end of the shallow pond for over 5 years now or more.

Furthermore according to feedback from Leitrim County Council to the Organic Centre, there is no measurable nutrient pollution in the adjacent stream. The willow trees are mature now and are very effectively trans-evaporating all of the waste water, so there is no discharge. In addition, the willows are bio-accumulating all of the nitrates and phosphates.

View 7.6 Willow trees in winter around the former pond at the Organic Centre in Rossinver, County Leitrim.

This photograph was taken at the Organic centre in winter (note that there are no leaves on the willow trees) the ground at the end of this pond is so dry that grass is growing and you can walk across it, while wearing shoes. In the early years of operation the 4" horizontal Wavin pipe used to be submerged in the water with 20 mm holes to evenly collect and discharge the water to a second pond but it now effectively dried out and no longer has any function.

Apart from the water absorbed by willows in summer during photosynthesis, we consider that the roots of the mature willows are also opening a better pathway through the soil in winter also. How else can it be that there is no sitting water in the pond or discharge from the back end of this wetland in winter?

ZWAI certainly believes that willows should be grown at the discharges for all existing domestic wastewater treatment systems where there is a risk of nearby nutrient pollution.

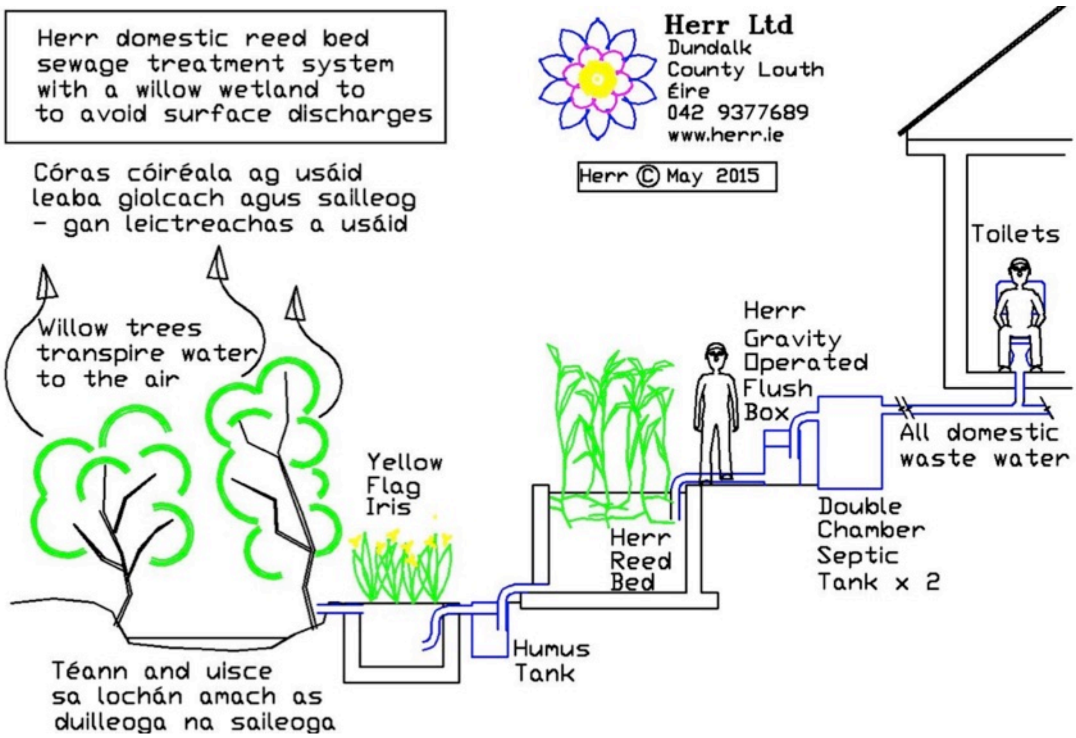

Fig. 7.4.1 **Herr Ltd domestic reed bed sewage treatment system with a willow wetland to avoid surface discharges, similar to the system in use at the Organic Centre, County Leitrim.**

Ionad Cois Locha Summer Visitors centre – Zero Water Discharge 2

This is a centre for tourists in summer located at the base of Slieve Errigal in the County Donegal Gaeltacht. The buildings are quite close to the nearby lake. The waste water is generated primarily in summer from the summer visitors to the centre. As there is only a thin layer of turf soil sitting on granite in the general area there is no possibility of finding the optimum soil conditions for percolation down hill from the septic tank. The waste water from the septic tank is therefore being pumped up hill to a large mound of excavated soil previously taken from the edge of the lake by the ESB over 20 years ago.

This area was already has mature evergreen pine trees. The waste water was pumped up to a holding tank located among the trees. Once full a special valve released the water from this tank to be sprayed evenly among the trees, via a network of Wavin 4” pipes. These have been then painted to protect the sewer pipes from sunlight. This area is cordoned off from the public. The roots of the trees would have made the burying of pipes impossible. The network of pipes was therefore fixed above the ground on timber posts. Holes drilled to be facing downwards from the pipes spray the water onto the forestry ground surface below.

View 7.7 **Photo of the system at Ionad Cois Locha Summer Visitors centre to eliminate wastewater discharge by evapo-transpiration through trees, and with removal of nitrogen and phosphorus.**

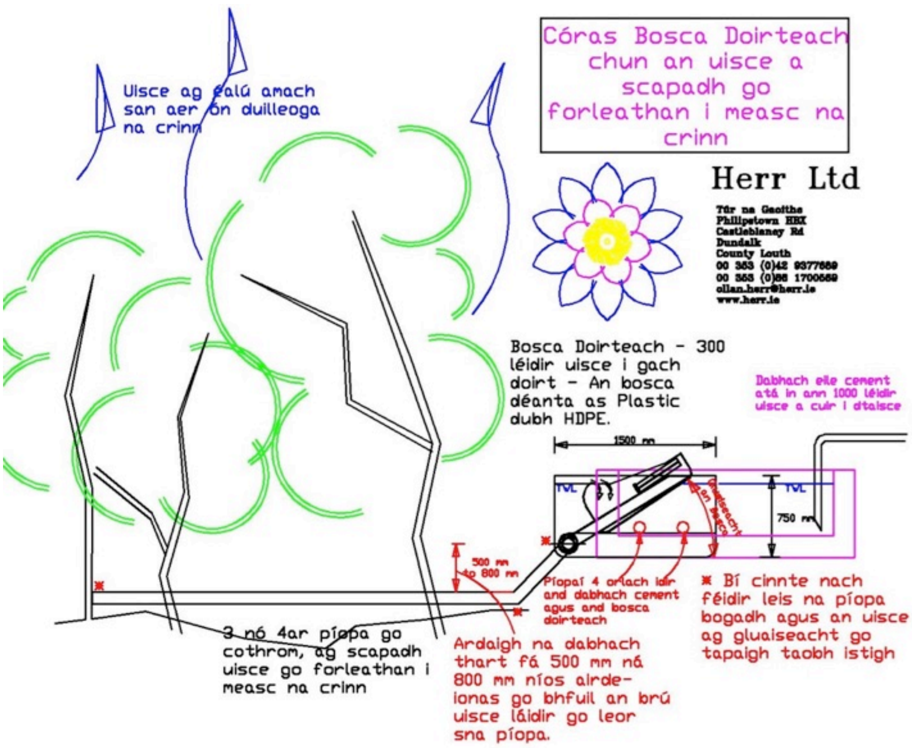

Fig. 7.4.2 **Schematic of the zero wastewater discharge system at *Ionad Cois Locha Summer Visitors centre, using evapo-transpiration to eliminate wastewater discharges.***

The land where these trees were growing had the deepest soil cover above the granite rock. For this reason this was to be the location for the final waste water destination. Down hill from these trees and pipes three vertical pipes were sunk deep into the soil. Water samples from these water sample pipes were sent to Donegal County Council for analysis on 2 or 3 occasions. The system has been running for two busy tourist summer seasons now. Donegal Co Co has requested no further water treatment measures for this system.

Rather than having inadequate "sub soil storage, open topped ponds or wetlands on the other hand have better winter storage capacity". The additional use of "mature" willow trees around the pond or the spraying of water on mature fir trees, will be:

- More likely able to store the winter waste water
- More likely to achieve reliably low or and eventually zero water discharge as the willow trees mature.
- Willows are also more likely to bio absorb and remove nitrates and phosphates as the trees mature
- More likely to also prevent nearby water bodies from receiving ingested pharmaceuticals and medicines that are untreated in the DWWTS.

7.5 Reuse of Grey Water

As pointed out above, The UN Sustainability Goals are calling for "water harvesting" from roofs and the "treatment, recycling and reuse" of water. Part H of the Building Regulations already details the important measures to be used to recover rain water but no detailed information or technical recommendations is available for the treatment and recycling of grey water.

Ireland has suffered from a serious summer drought in 2018 and will probably suffer further repeated drought over the coming decades. Treating and recycling grey water would have helped home owners in times of a water supply crisis and should therefore be detailed and encouraged in the new CoP. A relatively simple system for grey water harvesting is shown in Figure 6.9.1 above.

Since grey water, excluding the kitchen and toilets, accounts for about 40% of the waste water volume the revised CoD should show diagrams of deep Vertical Flow Reed Beds followed by a clarifier and a sand filter. Herr Ltd has implemented this treatment method at the Airfield Trust City Farm, Dundrum Co Dublin. The necessary treatment standard has been achieved for re use of the water for toilet flushing.

7.6 Awareness Raising and Implementation

At present Part H of the Irish Building Regulations permits rain water harvesting and grey water treatment and reuse, and we have advocated that grey water should be separately treated to be reused for toilets and gardens.

However the take-up by people building new houses to install these systems is very disappointing. The housing developers certainly have no interest. Why should they or the general public spend money on water systems when the mains water is free from Irish Water? Why should people spend money to treat urine to recover the nitrates leaking into nearby wells and rivers? Why would people spend money to recover phosphates in their own home when food in the supermarkets is still so cheap? Why would the Government spend money to recover phosphorus from municipal sewage treatment system when there is no specific directive coming from the EU or the electorate to recycle phosphorus? These are all good reasons for public information and the education of the public by the EPA on the matter of Phosphorus and nitrogen; in accordance with the UN Sustainability Goal 12, 8. Please see more on UN Sustainability Goals below.

It’s almost certain that very few people will choose to install the phosphorus and nitrogen recycling systems that we have proposed here either.

The vast majority of Irish people have very little understanding of the potential of a future food crisis and will certainly be repulsed by the thought of anything to do with the separated management of urine or faeces. Some of the older generation have bad memories in their childhood of rural schools with nothing but a cess pit under boards for a toilet. The cultural memory of our society and the social history of cholera epidemics in the past will leave people with an attitude of being repulsed by the thought of anything we are suggesting.

Indeed any forced obligation for anything more expensive or costly than a septic tank and some buried percolation pipes will probably be resisted by many rural politicians. For this reason the adoption of the systems we are recommending should only be imposed by the consent of the new family who want to build with long term sustainability in mind.

The EPA must now make a choice. If not into the nearby rivers and wells, where then does the EPA want the nitrates in domestic waste water to go? The EPA must decide whether these nutrients are ***“waste”***, or whether they should be regarded as a ***“resource”***.

With regard to DWWTSs we suggest that there are 3 questions that the Irish EPA should consider:

- Does the EPA consider nitrates and phosphates from domestic waste water as waste? Should the EPA permit waste Nitrates and Phosphates from single house septic tanks and DWWTS’s to continue to be lost and wasted in the ground?

- Should the EPA continue to allow nitrates and phosphates into the ground in some parts of the country with bad percolation; to end up causing algae in local lakes and to potentially compromise nearby wells?
- Will the EPA take seriously its role as protectors of the environment and of the welfare of Irish people? Should the new EPA CoP now start to recommend action on the "circular economy"; to recover and recycle what we now know to be finite and very valuable resources? Should there therefore be a basic description in the new EPA CoP on how to treat nitrate and phosphate resources from single houses in a safe reusable manner? Will the new CoP document for DWWTS's describe the use of compost toilet solids and the growing of non-food crops to make bio fertilizers? In so doing will the EPA be serious about protecting the environment and allowing new single houses to play their own small part in sustainably feeding 7 billion people?

Ollan Herr and Jack O Sullivan

19 March 2019

Environmental Protection Agency

Appendix I

Consultation on the Code of Practice: Wastewater Treatment and Disposal Systems Serving Single Houses

Summary: A draft revision of the 2009 EPA Code of Practice: Wastewater Treatment and Disposal Systems Serving Single Houses (p.e. ≤ 10) is now open for public consultation. The closing date for comments is 5pm on Friday 22nd March 2019.

Published: 2018
Pages: 70

Available Downloads

- Code of Practice: Domestic Waste Water Treatment Systems (Population Equivalent ≤ 10 Draft 26 November 2018 , 5,471kb
- Site characterisation form , 130kb
- Comment sheet for submssions on the Code of Practice, 9kb

Please email your comments using the attached comment sheet to d.inspections@epa.ie. The closing date for comments is **5.00pm on Friday 22nd March 2019**.

Notes:

The Code covers site assessment, installation, and operation of septic tanks and other domestic waste water treatment systems. The building regulations and planning control system require compliance with it. It is therefore of interest to prospective rural dwellers, consultants/engineers, planners and others involved in the domestic waste water treatment sector.

Two key issues emerged since 2009 that required further research:

1. Feasibility of alternative treatment systems for low permeability soils.
2. Review of desludging rates.

The EPA also received comments and requests for clarifications in relation to the Code. The EPA has revised the Code to incorporate the research findings and the comments/requests received.

The name of the Code is changed as the term 'Domestic Waste Water Treatment System' is defined in legislation since 2013.

The revision was guided by a Steering Committee with representatives from:

- EPA (Chair)
- Department of Housing, Planning and Local Government
- Trinity College Dublin
- Irish Onsite Wastewater Association
- Irish Water Treatment Association
- City & County Managers Association

Appendix II

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Authorised and notified according to Article 10 of the Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products (89/106/EEC)

SITAC
MEMBER OF EOTA

European Technical Approval ETA-13/0078

Handelsnamn Trade name	**Aquatron avloppsseparator** Aquatron sewage separator
Innehavare Holder of approval	**Aquatron International AB** **Norrängsgatan 10** **725 91 Västerås** **Sweden**
Produktbeskrivning och avsedd användning	**Separator för att separera vatten och urin från fasta beståndsdelar i avloppsvatten. Avsedd för 1-10 toaletter. Separatorn skall endast anslutas till toaletter med vattenlås.**
Generic type and use of construction product	Separator for separating water and urin from solid waste in sewage water. Intended for 1-10 toilets. The separator shall only be connected to toilets with water trap.
Giltighetstid **från** Validity: from **t o m** to	**2013-03-11** 11.03.2013 **2018-03-10** 10.03.2018

Godkännandet innehåller This Approval contains	7 Sidor inklusive bilagor 7 Pages including annexes

I LEGAL BASES AND GENERAL CONDITIONS

1 This European Technical Approval is issued by SITAC in accordance with:

- Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1], modified by Council Directive 93/68/EEC[2] and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council[3];
- Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex to Commission Decision 94/23/EC[4];

2 SITAC is authorized to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European Technical Approval and for their fitness for the intended use remains with the holder of the European Technical Approval.

3 This European Technical Approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European Technical Approval.

4 This European Technical Approval may be withdrawn by SITAC in particular pursuant to information by the Commission according to Article 5(1) of Council Directive 89/106/EEC.

5 Reproduction of this European Technical Approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of SITAC. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European Technical Approval.

6 The European Technical Approval is issued by the approval body English. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

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1 Official Journal of the European Communities L 40, 11.2.1989, p. 12

2 Official Journal of the European Communities L 220, 30.8.1993, p. 1

3 Official Journal of the European Union L 284, 31.10.2003, p. 25

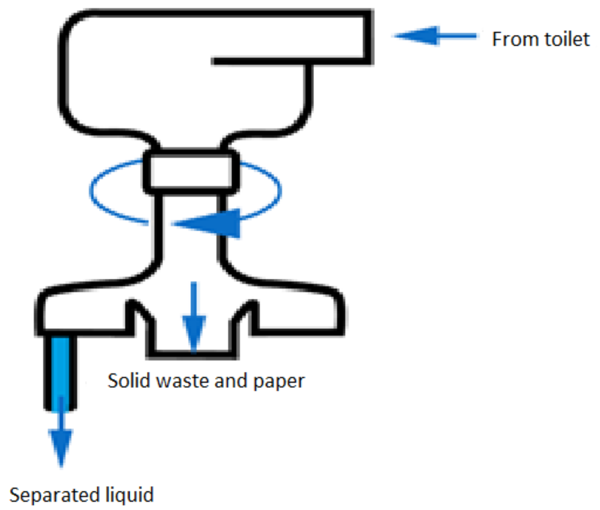
4 Official Journal of the European Communities L 17, 20.1.1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1 Definition of the construction product

Separator that use water flow, centrifugal force and gravity to separate feces and paper from sewage water. The liquid is separated and should be connected to a pipe that is intended to take care of water and urin. Solid waste falls down from the middle of the separator, the separator should be placed on top of a bio composting chamber. Bio composting chamber is not included in this ETA.
The inlet to sewage separator is DN110, outlet for liquid is DN50 or DN110.
The sewage separator is made of PE (polyethylene) with characteristics according to standard EN 12566-3:2005+A1:2009 chapter 6.5.5.1.



1.2 Intended use

Sewage separator for installation inside building to separate water and urin from solid waste in sewage water. Intended for 1-10 toilets. The separator shall only be connected to toilets with water trap.

The provisions made in this European Technical Approval are based on an assumed working life of the sewage separator of 50 years, provided that the conditions laid down in sections 4.2, 5.1 and 5.2 for the packaging, transport, storage, installation and maintenance are met. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

2 Characteristics of product and methods of verification

2.1 Mechanical resistance and stability (ER1)

Not relevant.

2.2 Safety in case of fire (ER2)

No performance determined.

2.3 Hygiene, health and the environment (ER3)

2.3.1 Content and/or release of dangerous substances

Based on the declaration of the manufacturer, the separator does not contain harmful or dangerous substances as defined in the EU database.

Note: In addition to the specific clauses relating to dangerous substances contained in this European technical approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

2.3.2 Hydraulic efficiency

Declared values according to annex 1.

2.3.3 Water tightness

According to annex 1.

2.4 Safety in use (ER4)

2.4.1 Design

Internal and external surfaces of separator are smooth, free from blistering and impurities when viewed without magnification. Inlet and outlet pipes are cleanly cut.

2.5 Protection against noise (ER5)

No performance determined.

2.6 Energy economy and heat retention (ER6)

Not relevant.

2.7 Durability

The used material is in accordance to EN 12566-3:2005+A1:2009 chapter 6.5.5.1.
Declared values in annex 1.

3 Evaluation and attestation of conformity and CE marking

3.1 System of attestation of conformity

According to the communication of the European Commission[5] system 4 of the attestation of conformity applies.

These systems of attestation of conformity are defined as follows:

System 4: Declaration of conformity of the product by the manufacturer on the basis of:
Tasks for the manufacturer:

(1) initial type-testing of the product;
(2) factory production control.

---

[5] Letter of the European Commission of 31/05/2012 to EOTA

3.2 Responsibilities

3.2.1 Tasks for the manufacturer

3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European Technical Approval.

The manufacturer may only use raw materials stated in the technical documentation of this European Technical Approval.

The factory production control shall be in accordance with the Control plan which is a part of the technical documentation of this European Technical Approval ETA. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited within SITAC.

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

3.3 CE marking

The CE marking shall be affixed on the separator. The CE symbol shall be in accordance with Directive 93/68/EC and accompanied by the following information:

- the name or identification mark and address of the producer,
- the last two digits of the year in which the CE marking was affixed,
- the number of the European Technical Approval,
- Hydraulic efficiency,
- Water tightness,
- Design,
- Production date

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

The European Technical Approval is issued for the product on the basis of agreed information, deposited within SITAC which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited information being incorrect, should be notified to SITAC before the changes are introduced. SITAC will decide whether or not such changes affect the approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the approval, shall be necessary.

4.2 Installation

All components of the sewage separator are assembled in the factory or on-site according to installation instruction. Installation instruction is enclosed to each separator.

5 Indications to the manufacturer

5.1 Packaging, transport and storage

Separator shall be packed to avoid damages during storage and transportation.

5.2 Use, maintenance, repair

Regular inspection and maintenance will be required to retain performance and to obtain the estimated working life of the separator. This is of major importance to keep the functionality. Maintenance instructions shall be enclosed to the separator.

On behalf of SITAC

Borås, 11 March 2013

Lennart Månsson

ANNEX 1 - DESCRIPTION OF PRODUCT

Product description according to 1.1 in this ETA.

Characteristics of product

Property	Result
Safety in case of fire	NPD
Hydraulic efficiency, water	99 %
Hydraulic efficiency, toilet paper	100%
Hydraulic efficiency, solid material	100%
Water tightness	Pass
Design	Pass
PE density	936 kg/m^3
PE melt mass-flow rate	4,2 g/10 minutes
PE tensile strain at yield	≥ 14 MPa
PE tensile strain at yield	≤ 25%
PE tensile strain at break	≥ 80%
Noise level	NPD

ASSESSMENT

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Norrängsgatan 10
725 91 VÄSTERÅS

Test of Sewage Separator

(1 appendix)

Assignment

On December 28th 2012, SP witnessed a test of an Aquatron sewage separator according to CUAP 07.04/22. The test was performed at Avloppscenter in Västerås. The test rig, which had been prepared in advance by Aquatron International, was checked by SP and found to be conforming with the requirements in the CUAP, see figure 1. The test was performed using a closed-couple WC, model Gustavsberg Nautic 5500.

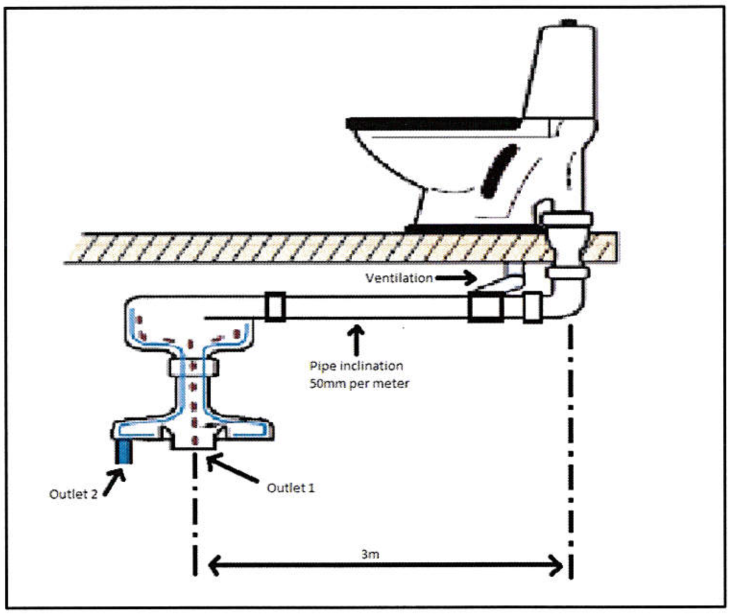

Figure 1 Test rig

Test method and equipment

Testing according to sections 2.1, 2.2 and 2.3 was performed under supervision of SP, and the measurement results were noted mutually in the test journal, see appendix 1. For weighing of water volumes, a calibrated scale from SP was used, inventory no. 201 368. The measurement accuracy for this equipment is better than ± 0.1%.

Miscellaneous

When testing the separator with toilet paper according to item 2.2, it was noted that, at some flushes, one or more pieces of paper were stuck on the metal threads in the separator. However, these pieces were normally flushed out (through outlet 1) at the next flush with toilet papers.

After testing the separator with the pipe inclination 50 mm/meter, as prescribed in the CUAP, the tests were repeated with the inclination described in Aquatron's installation instructions; 10mm/meter, except for the last meter of pipe, where the inclination is 50mm/meter. The results from these tests can also be found in the test journal in appendix 1 (test no. 2). With this inclination, no pieces of paper were stuck on the metal threads in the separator.

SP Technical Research Institute of Sweden
Energy Technology - Building Services Engineering

Performed by

Thomas Ljung

Examined by

Caroline Haglund Stignor

Appendix

Test journal

Appendix 1

Test Journal - Test for CUAP 07.04/22 Annex 1

Date	28th of December 2012
Test Item	Aquatron Sewage Separator
Representative from Aquatron International AB	Daniel Larson
Representative from SP Sveriges Tekniska Forskningsinstitut	Thomas Ljung
Calibrated balance from SP, inventory no. 201 368	

Test no. 1 – test rig according to CUAP

Pipe length: 3,03 m

Inclination: 50 mm/meter

2.1 Water test

Cycle no.	Water amount (grams)		Expressed in %		Total flush amount (g)
	Outlet 1	Outlet 2	Outlet 1	Outlet 2	
1	244	5868	3.99%	96.01%	6.112
2	247	5837	4.06%	95.94%	6.084
3	192	5938	3.13%	96.87%	6.130
4	234	5868	3.83%	96.17%	6.102
5	219	5950	3.55%	96.45%	6.169
Average	227	5892	3.71%	96.29%	6.119

2.2 Toilet paper test

Paper used, ICA Skona Extra Toalett, 24g/m^2

Cycle no.	Number of sheets		Expressed in %	
	Outlet 1	Outlet 2	Outlet 1	Outlet 2
1	6	0	100.00%	0.00%
2	6	0	100.00%	0.00%
3	6	0	100.00%	0.00%
4	6	0	100.00%	0.00%
5	6	0	100.00%	0.00%

Note: At some flushes, one or more sheets of paper are stuck on the metal threads in the separator. These sheets are normally flushed out (through outlet 1) at the next flush with papers.

Appendix 1

2.3 Solid material test

Natural sponges

Cycle no.	Number of Sponges		Expressed in %	
	Outlet 1	Outlet 2	Outlet 1	Outlet 2
1	2	0	100.00%	0.00%
2	2	0	100.00%	0.00%
3	2	0	100.00%	0.00%
4	2	0	100.00%	0.00%
5	2	0	100.00%	0.00%

Cellulose sponges

Cycle no.	Number of Sponges		Expressed in %	
	Outlet 1	Outlet 2	Outlet 1	Outlet 2
1	2	0	100.00%	0.00%
2	2	0	100.00%	0.00%
3	2	0	100.00%	0.00%
4	2	0	100.00%	0.00%
5	2	0	100.00%	0.00%

Appendix 1

Test no. 2 – test rig according to Aquatron's installation instructions

Pipe length: 3,00 m
Inclination: 10mm/meter (first 1,71 m)
50mm/meter (last meter of pipe)

2.1 Water test

Cycle no.	Water amount (grams)		Expressed in %		Total flush amount (g)
	Outlet 1	Outlet 2	Outlet 1	Outlet 2	
1	86	5839	1.45%	98.55%	5925
2	100	6073	1.62%	98.38%	6173
3	86	6145	1.38%	98.62%	6231
4	88	6023	1.44%	98.56%	6111
5	75	5975	1.24%	98.76%	6050
Average	87	6011	1.43%	98.57%	6098

2.2 Toilet paper test

Paper used, ICA Skona Extra Toalett, 24g/m²

Cycle N°	Number of Sheets		Expressed in %	
	Outlet 1	Outlet 2	Outlet 1	Outlet 2
1	6	0	100.00%	0.00%
2	6	0	100.00%	0.00%
3	6	0	100.00%	0.00%
4	6	0	100.00%	0.00%
5	6	0	100.00%	0.00%

Note: With this inclination, no pieces of paper were stuck on the metal threads in the separator.

2.3 Solid material test

Natural sponges

Cycle N°	Number of Sponges		Expressed in %	
	Outlet 1	Outlet 2	Outlet 1	Outlet 2
1	2	0	100.00%	0.00%
2	2	0	100.00%	0.00%
3	2	0	100.00%	0.00%
4	2	0	100.00%	0.00%
5	2	0	100.00%	0.00%

Aquatron International AB
Norrängsgatan 10, 725 91 Västerås
Sweden
13

ETA-13/0078
Sewage separator inside building

-Hydraulic efficiency	
• Water	99%
• Toilet paper	100%
• Solid material	100%
-Water tightness	Pass
-Design	Pass
-Reaction to fire	NPD

ZERO WASTE ALLIANCE IRELAND

Towards Sustainable Resource Management

Joint Submission by Zero Waste Alliance Ireland and Herr Ltd to the Environmental Protection Agency in Response to the Agency's Public Consultation on the Draft Code of Practice for Wastewater Treatment and Disposal Systems Serving Single Houses

Appendix III

Responses to the questions in the EPA Spreadsheet

Comment	Your proposal for modification	Rationale / supporting data
Page 21		
"As DWWTS's do not remove significant amounts of nitrogen or phosphorus, a high density of systems in areas of extreme or high groundwater vulnerability may cause plumes of nitrate."	Any further or supplementary method or treatment system that is able to remove, treat or bio absorb phosphates and nitrates naturally shall be encouraged in the new COP. Plant based treatment systems that can achieve this and that also removes greenhouse gases and ingested antibiotics shall be encouraged.	In order to comply with the Circular Economy for nitrogen and phosphorus, these need to be recycled before mineral fertilizer and world food prices eventually become too expensive and unaffordable
Page 53, section 8.2.4		
8.2.4 Willow Bed Evapotranspiration Systems In addition, water quality monitoring showed that the willows could also take up a high proportion of nitrogen and phosphorus from the primary- and secondary treated effluents added each year.	**Use willow trees at the end of treatment systems.** Where there is problems with percolation - every opportunity should therefore be used to grow willows and other trees between the end of DWWTS's and any nearby stream or lake; in order to bio-accumulate nitrates and phosphates and to prevent ingested medicines from entering any nearby drinking water wells	We now know that willow trees will bio accumulate nutrients, therefore every effort must be made to grow trees in order to prevent nitrates, phosphates and ingested pharmaceuticals from entering rivers and streams.

The "Urgency" for Phosphate & Nitrate Recycling		
	Composting toilets shall be permitted.	
Permit the use of composting of toilet solids in the new COP **Permit the use of dry composting toilets that also separate human urine**	**Composting toilets shall be permitted.** Composting toilets shall be encouraged in new houses to recycle nutrients. They shall be operated and maintained as per the manual of the toilet manufacturer.	This is to prevent the wasting of nitrates, phosphates and to stop ingested pharmaceuticals from entering nearby wells, rivers and streams
	In the interest of sustainability all new houses will be encouraged to recover and the recycle phosphates and nitrates. This shall be the preferred new goal of single house DWWTS's	This is to reduce the sludge that needs to be emptied from septic tanks.
	The separation, treatment and recycling of nutrients are also to be used where there are a high density of buildings in an area, where there is likely to be a high water table or where there is rock below only a shallow depth of soil.	The number of septic tanks in Ireland is very significant. If 1/3 of the population continue to waste N and P in the ground then there will be a national shortage of cheap fertilizer when we reach "peak phosphorus".
Prevent Phosphate and Nitrate Pollution. **Prevent the nutrients from human urine from being wasted or lost into the ground percolation system or the soil.**	**Separating urine for separate treatment is permitted.** Grow terrestrial plants in grow beds using just separated urine and rain water. Recover and recycle nitrates and phosphates from human urine. Grow plants then cut and harvest the leaves and add into compost boxes over a period of 4 years to remove ingested pharmaceuticals and antibiotics.	Provide a safe source of compost from the harvested leaves in order to grow vegetables in home gardens; in anticipation of future food price increases and the eventual depletion of phosphorus rock fertilizers

Treat and Recycle Grey Water to reduce mains water demand	**Separate grey water from toilet waste water.** **Treat Grey water separately.** To recycle grey water, use vertical flow reed beds followed by clarifiers, and sand filters with back wash. Grey water treatment should be in compliance with the requirements of Part H of the Irish Building Regulations	When treating waste water, treat the grey water separately for reuse. Treat and reuse grey water in order to reduce mains water demand during future summer droughts and to reduce mains water demand.
Rain water harvesting should be a requirement for all new houses and buildings	**For systems to recover phosphates from urine.** Only rain water can be mixed with separated human urine as the phosphorus and calcium would form solids in pipes and pumps if mains "hard water" was to be used. It is best to use only rain water that contains no calcium when using urine nutrient recycling systems. No toxic metals are to be allowed or added into this system.	Rain water harvesting should be an obligation for all new houses anyway as a means to reduce mains water demand, reduce the water pressure and water leakage in pipes, and help to maintain water in reservoirs in advance of more frequent summer droughts
Training for Architects, plumbers and new home owners	**New Training is required for installation and operation** Nutrient separation and recycling system shall be an encouraged option for new single homes. Families who choose to adopt these systems shall be "required" to be trained and certified to safely operate these systems. Records of the training, operation and maintenance of these systems shall be kept safely for inspection of any domestic sewage treatment inspectors from the Local Authority.	There is a worrying ignorance by many people in matters of domestic sewage treatment. Since car driving and bus driving require training and a licence - then architects, plumbers and home owners likewise need to be trained in nutrient recovery systems also.

Compliance with International Sustainability Goals	**Proof of knowledge of Sustainability Goals** New home builders who choose to use these nutrient recycling systems in new or refurbished buildings must quote from the various documents that outline the UN Sustainability Goals and the EU Resource Recycling Goals when proposing these systems for their application for planning permission.	All the above are in compliance with UN Sustainability Goals and the Circular Economy requirements for phosphates and nitrates in the EU

Jack O'Sullivan, Zero Waste Alliance Ireland

Ollan Herr, Zero Waste Alliance Ireland and Herr Ltd

Gmail

Jack O'Sullivan <jackosullivan2006@gmail.com>

RE: Draft CoP for Wastewater Treatment and Disposal Systems Serving Single Houses -- Submission by Zero Waste Alliance Ireland and Herr Limited to EPA.

DWWTS Inspections <D.Inspections@epa.ie> 22 March 2019 at 14:25
To: Jack O'Sullivan ZWAI <jack@zerowasteireland.com>

Dear Sir,

Appendix IV

I wish to acknowledge receipt of your e-mail.

Thank you for your comments, these will be reviewed as part of the consultation.

Regards

Mary Parle

Urban Waste Water Team

Environmental Protection Agency

Johnstown Castle Estate

Wexford

053 -9160600

From: Jack O'Sullivan ZWAI [mailto:jack@zerowasteireland.com]
Sent: Thursday 21 March 2019 18:26
To: DWWTS Inspections <D.Inspections@epa.ie>
Cc: ollan@zerowasteireland.com
Subject: Draft CoP for Wastewater Treatment and Disposal Systems Serving Single Houses -- Submission by Zero Waste Alliance Ireland and Herr Limited to EPA.

For attention of d.inspections@epa.ie

Dear Sir/Madam,

Joint Submission by Zero Waste Alliance Ireland and Herr Limited to the Environmental Protection Agency on the Draft Code of Practice for Wastewater Treatment and Disposal Systems Serving Single Houses

On behalf of Zero Waste Alliance Ireland (ZWAI) and Herr Limited, and in response to the invitation on the Agency’s website, I have pleasure in attaching an electronic copy of our observations on the draft

Code of Practice for Wastewater Treatment and Disposal Systems Serving Single Houses, published by the EPA on 26 November 2018.

We hope that you will find our ideas and suggestions interesting and useful to the Agency, as they are based on our joint experience of domestic wastewater treatment systems, together with our work as advocates for zero waste and efficient resources management; and, it may be appropriate to note, that many of the technical solutions offered in this submission are derived from innovative ideas and work undertaken by Herr Ltd.

ZWAI and Herr Ltd welcome this public consultation being carried out by the Agency, and we are pleased to have the opportunity to present our observations.

An acknowledgement that you have safely received this email and the attached submission would be greatly appreciated.

Yours sincerely,

Jack O'Sullivan

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ZERO WASTE IRELAND

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