WOULD YOU DRINK IT?

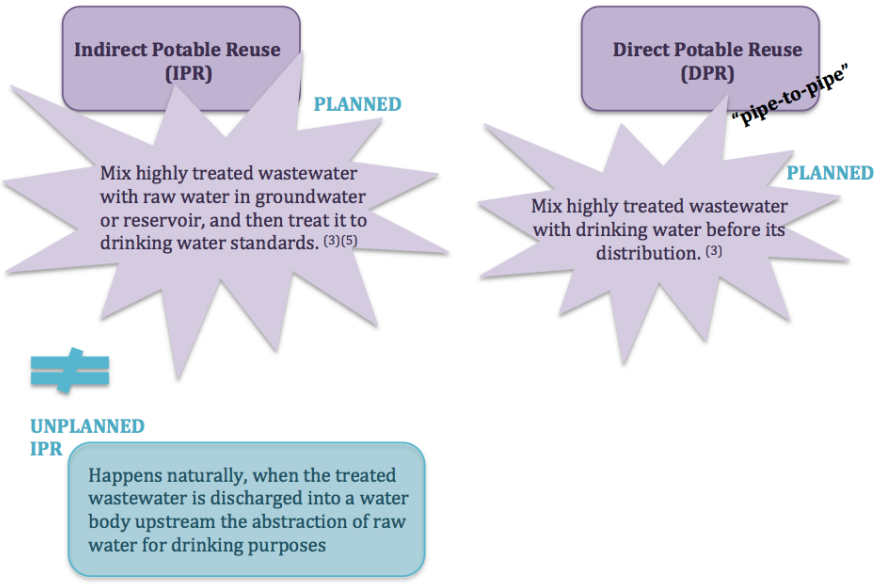
The World Economic Forum has recently identified Water Crises in the Top 5 of the risks the world will face in the next 10 years [(1)]. Can wastewater be reused to avoid this situation? Does regulation and management support this option?

Naiara Fonseca, Tuesday 14th May 2013

One of the alternatives to overcome the water crisis is mixing highly treated wastewater with drinking water for drinking purposes. It's essential to analyse whether this is a potential option for the UK and whether the government encourages its application. Photograph: AAA Agency[(2)]

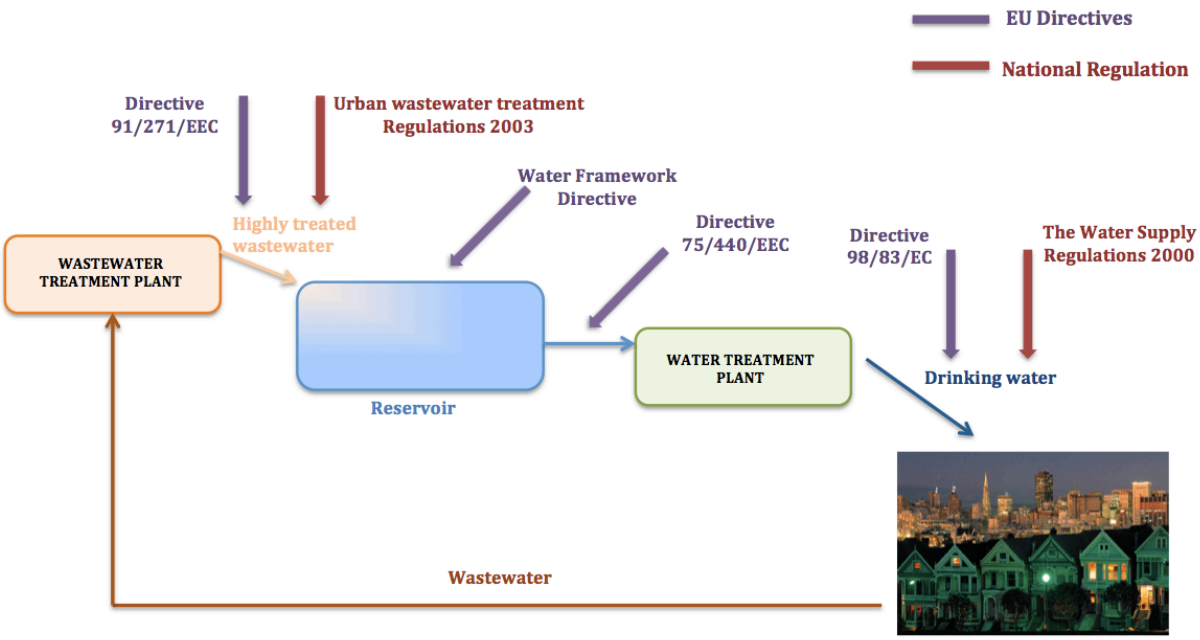
Water crises have been identified as one of the most likely risks the world will have to face, as well as one with the highest impact on society, according to the World Economic Forum [(1)]. In fact, many places in the world are already facing this water crisis, including parts of the UK. Population growth is increasing water demand, but new water sources are not increasing and being exploited at the same rate. Moreover, climate change results in longer drought periods, intensifying this water demand. Consequences of all this? A water crisis. A water crisis that is driving the development and implementation of new technologies for water treatment. For example, the desalination plant built in east London in 2010, which will treat tidal water from the River Thames when required in order to provide drinking water for 1 million people [(3)]. A water crisis that has forced the utilisation of wastewater for various purposes, including agricultural and landscape irrigation, aquaculture and industrial uses, such as cooling and process water [(4)] [(5)]. The next step in wastewater reuse is its application to drinking purposes, but do governments support this option through regulation and management?

Wastewater reuse for drinking purposes can be done by Indirect Potable Reuse (IPR), and Direct Potable Reuse (DPR) or the so-called "pipe-to-pipe" potable reuse[4]. As it can be seen in the figure below, the difference between IPR and DPR relies on the action of an environmental element (groundwater or reservoir), which acts as a controlling component [6]. Funnily enough, unplanned IPR happens naturally in many places, such as in the River Thames: treated wastewater is discharged into a water body and raw water is abstracted from it to be treated as potable water. Therefore, planned IPR does the same thing as nature but in a controlled manner.



To evaluate whether regulation and management supports wastewater potable reuse, we have to take a look at the different regulations that can be applicable. They are summarised in the table below, and the stages when they are applied depicted in the following figure.

Regulation concerning	Europe	England & Wales
Wastewater	Directive 91/271/EEC, concerning urban waste water treatment[7]	The Urban Waste Water Treatment (England and Wales) (Amendment) Regulations 2003[8]
Drinking water	Directive 98/83/EC *on the quality of water intended for human consumption* [9]	The Water Supply (Water Quality) Regulations 2000[10]
Water Bodies	Directive 2000/60/EC[11] or Water Framework Directive (WFD)	-



Wastewater

For countries of the European Union (EU), the main regulation is the *Directive 91/271/EEC*, which establishes the treatment, quality and monitoring of the treated wastewater before being discharged into a water body. It says to reuse wastewater "whenever appropriate"[7], without specifying any details about the type of reuse or its quality.

In England and Wales, this directive is worked into *The Urban Waste Water Treatment Regulations 2003*, which adds more quality parameters to the European Directive. It is also specified that waste water should be "reused whenever appropriate"[8]. Consequently, waste water regulations in the UK would indirectly encourage wastewater potable reuse, so long as it is suitable and beneficial.

Drinking water

Similarly, drinking water is also subject to different regulations. The main one is the European *Directive 98/83/EC*, which refers to any drinking water "regardless of its origin" [9]. Therefore, this regulation does not differentiate the source of the potable water.

In the UK, *The Water Supply (Water Quality) Regulations 2000* adds more water quality parameters and concentration limits to the EU regulation. There aren't any references to the origin of the drinking water in this regulation. Now, the water abstracted for drinking purposes must comply at least with a minimum quality established in the EU Directive *75/440/EEC, concerning the quality required of surface water intended for the abstraction of drinking water* [12].

Therefore, drinking water regulation could support wastewater reuse for drinking purposes, as long as the abstracted water meets the minimum criteria set down in the Directive 75/440/EEC and the drinking water meets the criteria established in the UK and European drinking water legislation.

> "Regulations concerning wastewater reuse in the UK would encourage wastewater potable reuse, so long as it is suitable and beneficial"

Water bodies

The Water Framework Directive (WFD) aims to improve the quality of the water bodies in the EU. No references are made to wastewater reuse in this Directive, although "efficiency and reuse measures" are encouraged to adopt [11]. In a sense, wastewater potable reuse would avoid its other alternative of discharging it to natural water bodies, being a better solution in order to improve the quality of these water bodies.

Therefore, it can be concluded that European and UK legislation does not specifically support wastewater potable reuse. However, this doesn't prohibit it from being carried out, as it is being done in the Langford Recycling Scheme in Essex since 2003. Highly treated wastewater (nutrients removed and chlorine added) from the Chelmsford Sewage Treatment Plant is conveyed by a pipe to the River Chelmer. It is then pumped to a reservoir before its abstraction and treatment for drinking purposes [13]. This scheme has proved to be very effective and it has allowed an 8% increase in raw water in this area [14].

The situation is different for some non-European countries, such as USA and Australia, where guidelines are in place for wastewater potable reuse, specifically for IPR [15][16]. These guidelines are not legally obligatory, but they establish suitable treatment processes for wastewater, as well as quality parameters and monitoring schemes that should be in place. Moreover, they also provide management practices to be applied, such as the minimum time the wastewater must be retained in the groundwater or reservoir in contact with raw water before being abstracted. This regulatory support provides the ideal environment for recycling schemes to be implemented. For instance, the Orange County Groundwater Replenishment System is the biggest facility in its kind and it treats wastewater to a very high standard (removing even pharmaceuticals and pesticides), before discharging to an aquifer and abstracting drinking water [15]. A very positive aspect of this scheme is that it gained great public support [15]. However, public opposition to this kind of projects has delayed or rejected many IPR schemes [15]. For example, an IPR project in Toowoomba (Australia) was rejected by public referendum, even though dam levels were at 20% of their total capacity [17]. This illustrates the importance of public opinion in implementing wastewater reuse schemes.

IPR is the most consolidated scheme for wastewater reuse. In fact, only two schemes with DPR have been studied: one in Windhoek (Namibia) and the eMalahleni Mine in South Africa. The first one is only used for drought situations[4], while the second one is used on a daily basis and is totally funded by two mining

companies[15]. The major reason why DPR is not more implemented is the uncertainty in potential health effects produced by many organic and inorganic compounds in the long-term. With more investigation and development in this area, it could eventually be another of the potential solutions to the water crisis. This raises another issue: developing countries are often the most in need for alternative water sources. However, they lack the investment needed to implement these sophisticated treatment processes. Not only this, but they would also need specialists in order to maintain the scheme working. Consequently, these schemes are currently potentially available to developed countries only.

All in all, the clear point is that if regulation and management support wastewater reuse by establishing additional quality parameters, monitoring schemes and management practices, the IPR would potentially become a established and reliable solution for tackling the water crisis. This would lead to more social support, which is essential for this kind of projects to develop. So, in the end, the main question to be asked is: if your tap water was supplied partly from treated wastewater, would you drink it?

REFERENCES

(1) World Economic Forum, 2013. Global Risks 2013, Eighth Edition [Online]. Available at: http://www3.weforum.org/docs/WEF_GlobalRisks_Report_2013.pdf (Accessed: 11th May 2013).

(2)http://www.arlingtonva.us/departments/environmentalservices/wpcp/EnvironmentalServicesWasteWastewaterMain.aspx (Accessed: 27th April 2013).

(3) Thames Water Utilities Ltd. (2012) *Thames Gateway Water Treatment Works*. Available at: http://www.thameswater.co.uk/about-us/850_10885.htm (Accessed: 27th April 2013).

(4) Tchobanoglous, G., Burton, F.L and Stensel, H.D. (2004) *Wastewater Engineering: treatment and reuse*. 4th Edition. New York: McGraw-Hill.

(5) International Water Association (IWA), Water Recycling and Reuse: Potential, Safety and Best Practices [Online]. Available at: http://www.iwahq.org/contentsuite/upload/iwa/Document/Water%20Reuse%20IWA%20%20SG%20flyer.pdf (Accessed: 27th April 2013).

(6) Meehan, K., Ormerod, K.J. and Moore, S.A. (2013) 'Remarking Waste as Water: The Governance of Recycled Effluent for Potable Water Supply', *Water Alternatives*, 6(1), pp. 67-85 [Online]. Available at: http://www.water-alternatives.org/index.php?option=com_content&task=view&id=230&Itemid=1 (Accessed: 27th April 2013).

(7) Council Directive of 21 May 1991 concerning urban waste water treatment. Available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1991:135:0040:0052:EN:PDF (Accessed: 27th April 2013).

(8) The Urban Waste Water Treatment (England and Wales) (Amendment) Regulations 2003. Available at: http://www.legislation.gov.uk/uksi/2003/1788/pdfs/uksi_20031788_en.pdf (Accessed: 27th April 2013).

(9) Council Directive 98/83/EC of 3 November 1998 on the quality of water intented for human consumption. Available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1998:330:0032:0054:EN:PDF (Accessed: 27th April 2013).

(10) The Water Supply (Water Quality) Regulations 2000. Available at: http://www.legislation.gov.uk/uksi/2000/3184/pdfs/uksi_20003184_en.pdf (Accessed: 27th April 2013).

(11) Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. Available at:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:327:0001:0072:EN:PDF (Accessed: 27th April 2013).

(12) Council Directive of 16 June 1975 concerning the quality required of surface water intended for the abstraction of drinking water in the Member States. Available at:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1975:194:0026:0031:EN:PDF (Accessed: 28th April 2013).

(13) Herring, C.D. (2002) 'Langford recycling scheme: new works recycles wastewater to augment river water', *Water Treatment & Supply* [Online]. Available at:
http://www.waterprojectsonline.com/case_studies/2002/E&S_Langford_2002.pdf (Accessed: 28th April 2013).

(14) Hills, S., 2008. Indirect Potable Reuse: UK Experiences & Lessons Learnt. In: Water Reuse Association and IWA, *Potable Reuse for Water Supply Sustainability Critical Today-Essential Tomorrow*. Long Beach, CA, 16-19 November 2008 [Online]. Available at: http://www.watereuse.org/files/images/Sian_Hills_0.pdf (Accessed: 28th April 2013).

(15) United States Environmental Protection Agency (USEPA), 2012. Guidelines for Water Reuse [Online]. Available at: http://nepis.epa.gov/Adobe/PDF/P100FS7K.pdf (Accessed: 28th April 2013).

(16) Natural Resource Management Ministerial Council, Environment Protection and Heritage Council, National Health and Medical Research Council, 2008. Australian Guidelines for Water Recycling: managing health and environmental risks (phase 2)- Augmentation of Drinking Water Supplies [Online]. Available at: http://www.ephc.gov.au/sites/default/files/WQ_AGWR_GL__ADWS_Corrected_Final_%20200809.pdf (Accessed: 28th April 2013).

(17) Hurlimann, A. and Dolnicar, S. (2010) 'When Public Opposition Defeats Alternative Water Projects - the Case of Toowoomba Australia', *Water Research*, 44 (1), 287-297.