Local & National Effects of P Recovery from Wastewater Treatment Plants in UK

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Abstract: **A much discussed method of improving the efficiency of P use and reducing P losses in the environment is to recover P from wastewater treatment plants (WWTP) as struvite fertiliser. The main driver for the recovery of P as fertiliser from the water industry viewpoint is the reduction in nuisance struvite clogging inside pumps and pipes. At suitable conditions, 90% recovery of P from centrifuge centrate stream allows 15.8% total P and 46.1% of PO4-P to be removed from influent and transferred into the struvite fertiliser. This gives rise to significant operational savings in the WWTP. If similar P recovery technologies were implemented in all large WWTP (>25,000 population equivalent) in the UK it would be possible to produce a national P fertiliser stock of 5.8 kt P. In combination with this method, if all sludge produced from WWTP underwent advanced energy recovery (incineration/pyrolysis) and appropriate P recovery processes applied to residues (ash/char), it would be possible to recover 22.3 kt P/year from sludge. Using these two methods of P recovery from WWTP, UK imports of P fertiliser can be significantly reduced by 35.5%. P Recovery has beneficial knock-on effects of protecting against eutrophication by reducing agricultural P run off into water bodies by 20.5% and decreasing P lost in landfills by 29%.**

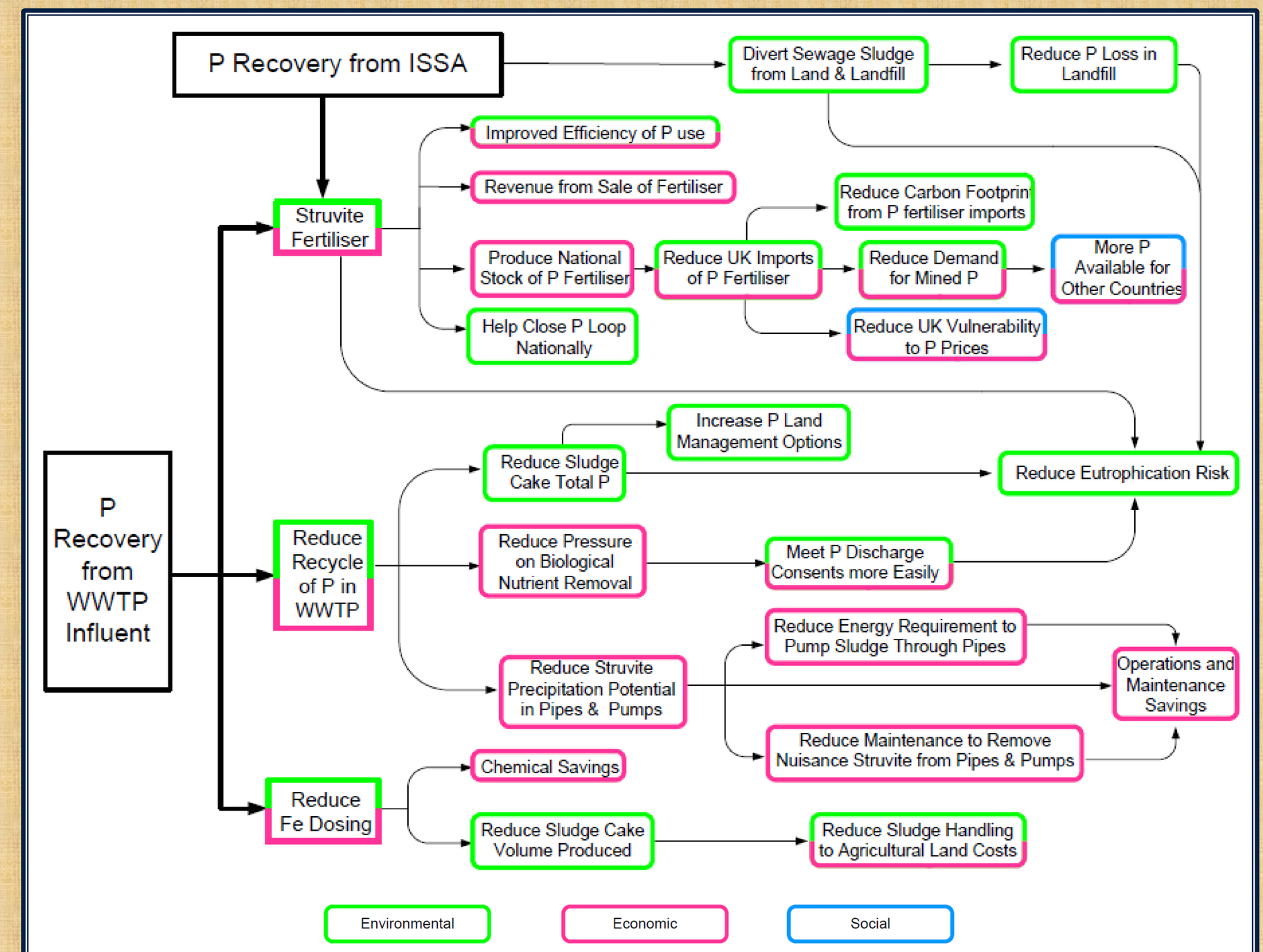

Figure 1: Evaluation of local & national effects of P recovery from WWTP

Local Effects

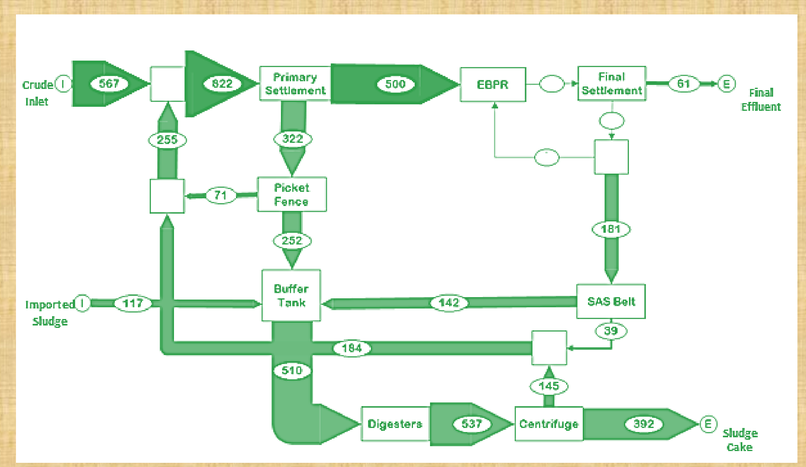

Figure 2: Total P mass balance – <u>Without</u> P recovery [All units kg/day]

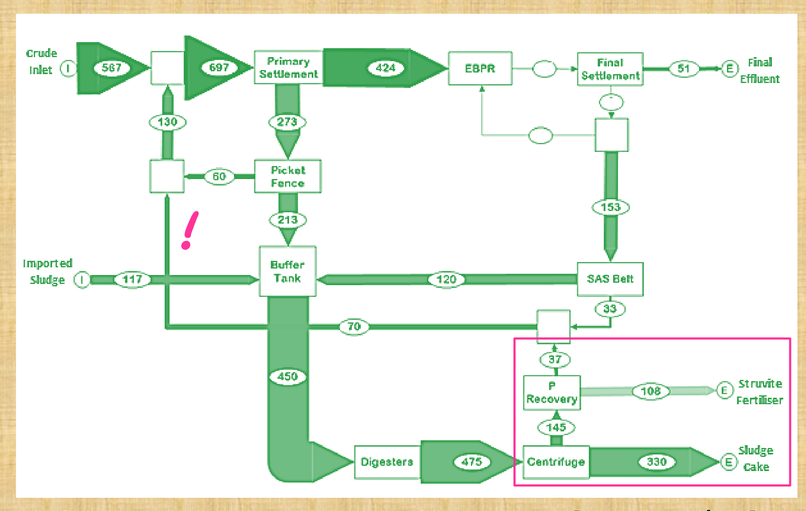

Figure 3: Total P mass balance – <u>With</u> P recovery [All units kg/day]

Table 1: Effect of P recovery on percentage contributions to WWTP Flows

	No P recovery		90% PO_4-P removal, 74.5% Total P removal	
	Total P	PO_4-P	Total P	PO_4-P
Contribution of recycle stream to influent	31.0%	44.4%	18.7%	20.7%
Centrate liquor contribution to recycle stream	56.9%	77.1%	28.5%	22.8%
P removed from influent into struvite fertiliser	n/a	n/a	15.8%	46.1%

Removing P as struvite fertiliser results in a reduction in contribution of the recycle stream to influent flows. This reduces the amount of P requiring retreatment, improving process performance, allowing the WWTP to meet final effluent discharge consents more easily. In order for P recovery to operate more efficiently, $FeCl_2$ solution dosing was reduced in the site to generate an increase in free soluble P concentrations. For this WWTP, $FeCl_2$ solution dosing can be significantly reduced by ~2 kt/year, providing chemical cost savings of up to £100,000. Sludge cake volume can be reduced by approximately 3,672 m^3/year; representing a reduction in sludge handling costs of £75,000. The operational, maintenance and transport savings alone are factors which would influence the full scale recovery of P from WWTP. These savings along with the sale of struvite fertiliser provide an attractive economic basis for water companies to recover P from WWTP.

National Effects

Using appropriate technologies, it is possible to recover 15% P from WWTP influent and 90% P from incinerated sewage sludge ash. Adding the potential P recovery from two methods would result in a national fertiliser P stock of 27.5 kt P/year. This recovery would reduce P fertiliser imports in the UK by 35.5% (based on 2009 P flows). Recovery of P from all WWTP in the UK would have beneficial knock-on effects of protecting against eutrophication by reducing agricultural P run off into water bodies by 20.5% and decreasing P lost in landfills by 29%. This would reduce dependence on primary phosphate sources and provide some protection from volatile P prices.

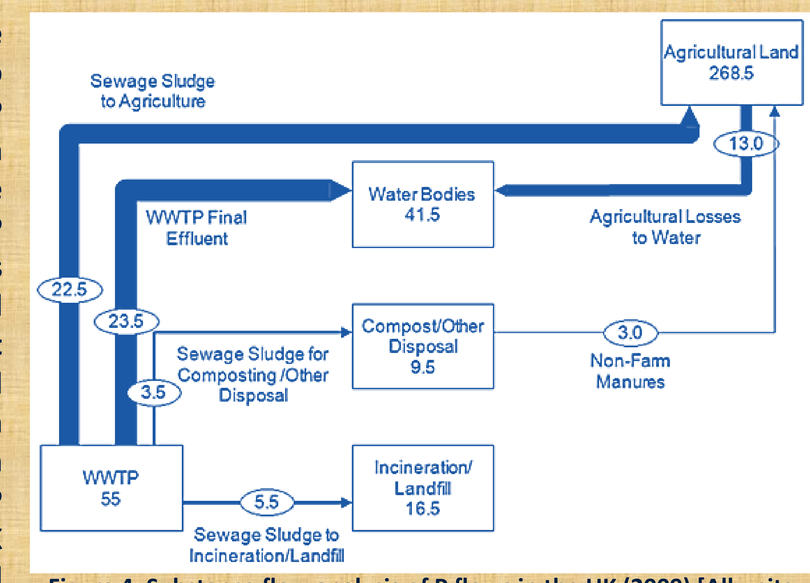

Figure 4: Substance flow analysis of P flows in the UK (2009) [All units kt P/year] (From Cooper & Carliell-Marquet, 2012)

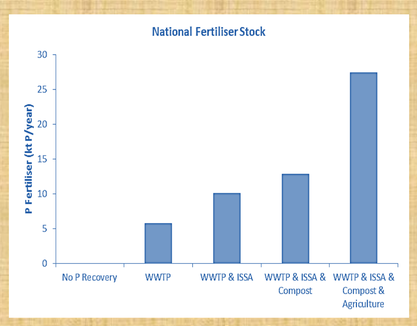

Figure 6: Potential P fertiliser recovery from WWTP and associated wastes

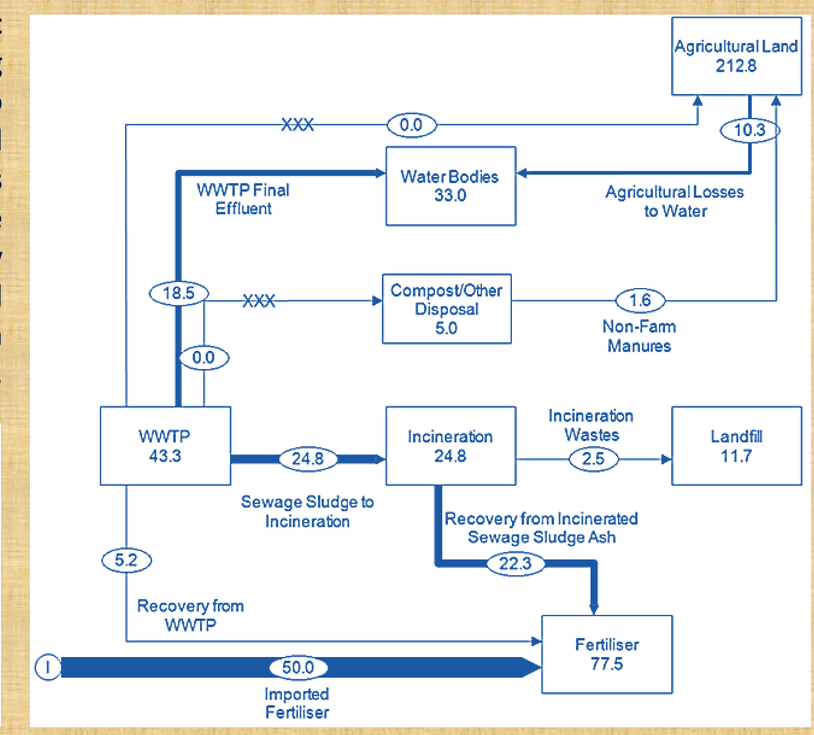

Figure 5: SFA of P Flows in the UK with 15% P recovery from WWTP & 90% P recovery from ISSA & composted sludge & sludge to agricultural land [All units kt P/year]

References: Cooper, J. & Carliell-Marquet, C., 2012. A Substance Flow Analysis of Phosphorus in the UK Food Production and Consumption System. *Resources, Conservation and Recycling,* Volume 74, pp. 82-100

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