

Determining nitrogen removal in US sewage treatment

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Introduction

1 Food consumption N footprint: In the N-Calculator, the food nitrogen (N) footprint includes food production and consumption, which represents excreted N released to the environment after sewage treatment.

2 Types of wastewater treatment in the US: Most US houses are connected to septic systems or to public sewer lines connected to wastewater treatment plants (WWTPs), of which only some employ treatment technologies to remove nutrients.

3 Updating methods: Updating the US N removal factor for wastewater treatment in the N-Calculator improves its calculation methodology, cross-country comparability, and policy relevance.

Less than secondary, 1%

No discharge, 5%

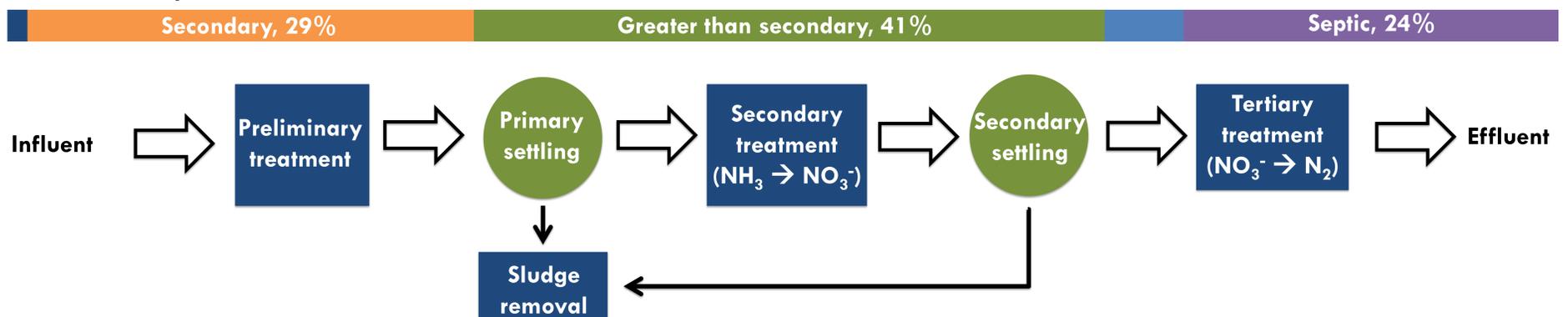


Figure 1. Above, the bar chart shows the percent of the US population connected to septic and different levels of treatment in 2012. Below is a simplified wastewater treatment plant (WWTP), showing some N conversion processes. If a WWTP has only preliminary or secondary, effluent is released after that step.

Methods

• **Objective: Use facility-specific data to update the N-Calculator value of N removal in sewage treatment**

• Calculation represents a combined 2011/2012 year

• Used a mass balance approach:

$$\% \text{ N removal} = (N_{IN} - N_{\text{released from septic}} - N_{\text{released from WWTPs (aq)}} - N_{\text{released as beneficial sludge (s)}}) / N_{IN}$$

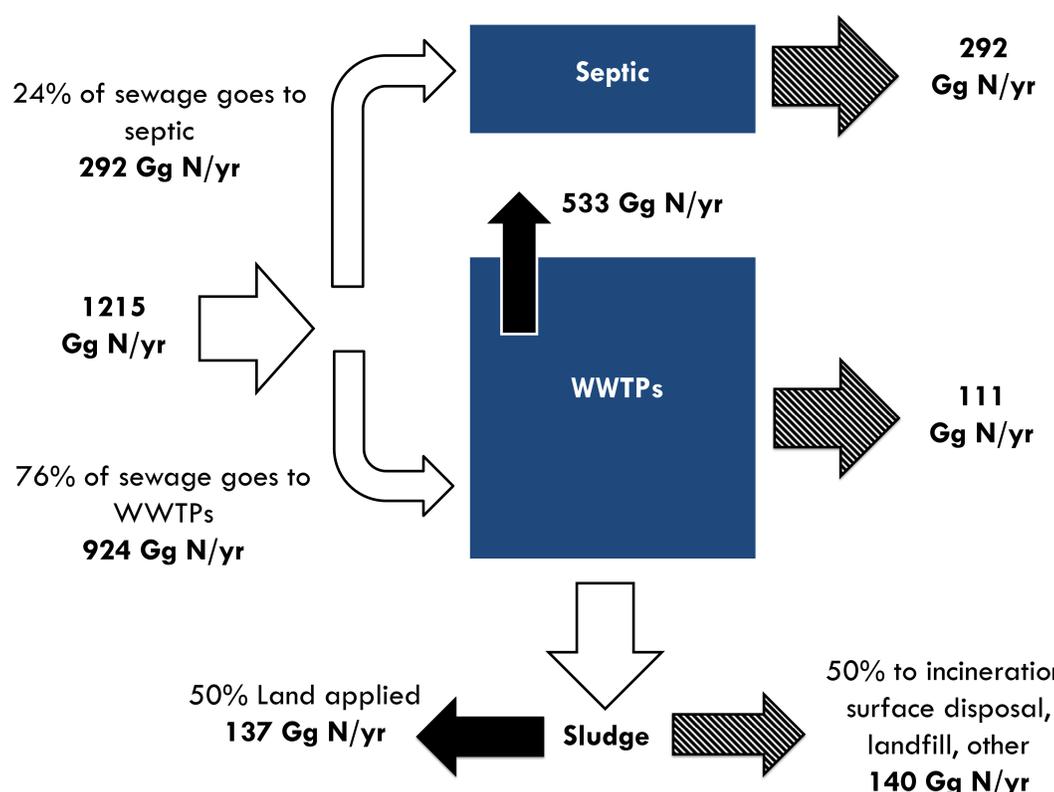
• Considered:

- Amount of N in wastewater, from national statistics
- N removal in septic systems (assuming 0% removal)
- N removal in sludge used for beneficial purposes or released to the environment
- N removal in WWTPs, from facility-specific release database

Results

1 WWTP (i.e. not septic) average N removal: 73%
Septic average N removal: 0% (assumed)
US average N removal: 55%

2 The new N removal factor for wastewater treatment reduces the average US food consumption footprint from 4.99 to 2.35 kg N/capita/yr, resulting in a total footprint decrease of 6.7% (based on 39 kg N/cap/yr footprint).



Conclusions

1 There is still much to be learned about the fate of N in sewage. For example, septic is an area that requires additional research. This example can serve as a starting point for the US and for other countries.

2 Updated N removal factor indicates that waste treatment in the US is much closer to European countries, which have overall removal factors around 90%.

Figure 2. Schematic of N mass flow rate, shown as bolded values. Removals of N (through denitrification in WWTPs or sludge beneficial use) are shown with solid arrows. Releases of N to the environment are shown with striped arrows. Nitrogen in sewage either goes to WWTPs or is treated on-site using a septic system.