

What is Your Nitrogen Footprint?
Another Tool for the Toolbox
Valerie Giguere, P.E., Underwood Engineers

We've all heard of the term carbon footprint and have been made aware of changes we can make to reduce our green house gas emissions to the environment. Now there is Personal Nitrogen Footprint calculator (N-PRINT) available to determine our *nitrogen footprint*. There are direct and indirect environmental impacts associated with excessive nitrogen entering the environment. These include acid rain, smog, loss of biodiversity, dead zones along coastal waters, and global warming. It might surprise you to learn that a few simple lifestyle changes can reduce your nitrogen footprint and reduce the amount of nitrogen released to the environment. These lifestyle changes will be the focus of this article including how these changes can impact nitrogen loading to a watershed.

The number of people connected to a sewer system has a direct relationship to the amount of nitrogen entering a wastewater treatment facility (WWTF). Accordingly, the number of people on septic systems has a direct relationship to the amount of nitrogen entering the watershed. To estimate nitrogen to a WWTF loading from the population, engineers typically use a loading of 0.03/lbs/capita/day which equals approximately 11 lbs/capita/year. We will see how that relates to the nitrogen footprint calculator.

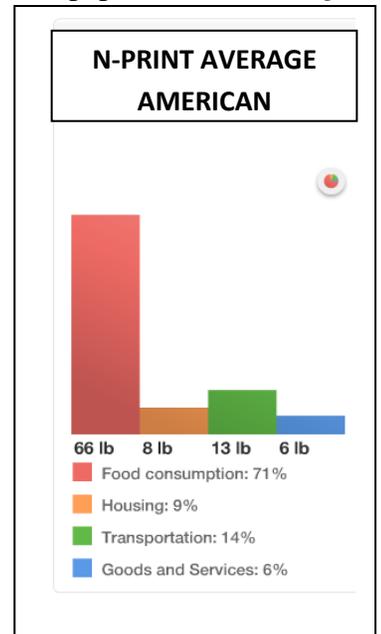
Nitrogen Footprint Calculator

The nitrogen footprint calculator was developed by a group of researchers in 2011 from the University of Virginia, University of Maryland and the Energy Research Centre (ECN, the Netherlands) as part of the International Nitrogen Initiative (INI)¹. The basis for the calculator can be found in the paper titled, *A nitrogen footprint model to help consumers understand their role in nitrogen losses to the environment*, (2012).²

There are four components to the nitrogen footprint calculator:

- Food consumption
- Housing
- Transportation
- Goods and Services

Based on the information provided in the nitrogen calculator, the N-PRINT of the average American is estimated to be 93 lbs/yr as shown in the figure. Of the 93 lbs/yr, approximately 66 lbs/yr or **72% of the nitrogen footprint was attributed to food consumption**. The other components (transportation, housing and goods and services) together make up the remaining 28%.



Food Consumption and Nitrogen Footprint

Food consumption is the largest component of our nitrogen footprint and is the area where we can make the most significant reductions in nitrogen being released to the environment. The food consumption portion of our N-PRINT is made up of two components:

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- **Nitrogen released before consumption (approximately 85%)** - nitrogen released in production of the food source including nitrogen not taken up by crops, crop waste, manure loss, processing waste, and nitrogen oxides emitted by fossil fuel combustion
- **Nitrogen released after consumption (approximately 15%)** – nitrogen consumed by humans (minus food wasted) and discharged to a wastewater treatment facility before treatment or to a septic system

Using the percentages above, the average American contributes nitrogen release to the environment before and after consumption as follows:

Before Consumption	56 lbs
After Consumption	10 lbs*
Total	66 lbs

* compares to 11 lbs wastewater basis of design

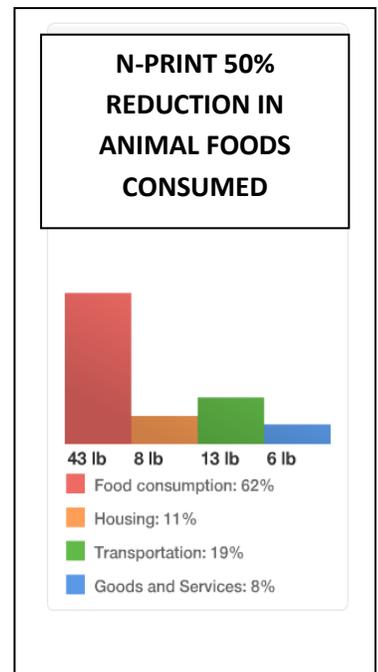
Consuming animal protein has the greatest impact on the environment *before* consumption due to the nitrogen required and released during production of the animal protein to be consumed. For example, approximately 8.5 grams of nitrogen is released to the environment for every gram of beef produced for consumption, 5.7 grams for milk, 4.7 grams for pork, and 3.4 grams for poultry, while only 1.4 grams is released to environment in the production of cereal grains. **Because the “before” consumption component of our nitrogen footprint has the greatest impact to the environment what we eat is very important in reducing nitrogen pollution overall.**

Protein and Nitrogen

According to the N-PRINT data, the average American is consuming an average of approximately 108 grams of protein per day based on the total protein consumed per week divided by seven. That protein is made up 90 grams from animal foods and 18 grams from plant foods.

The amount of protein an individual requires can be determined by using the recommended daily allowance (RDA) of 0.36 grams/lb. The Center for Disease Control reported that the average weight for American men and women in the United States in 2011 was 195 and 165 lbs respectively (up roughly 25 lbs since 1960). Based on the RDA, the average man requires 70 grams of protein/day and the average woman, 60 grams of protein/day. This suggests that the average American is consuming 38 to 48 grams of protein more than is required, primarily in the form of animal protein.

The excess consumption of animal protein impacts nitrogen released to the environment. Reducing *animal protein* consumption by 50% (45 g of protein/day) and replacing those servings with plant foods (grain, rice, potato,



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beans, vegetables, fruit) would reduce the food consumption portion of a person's N-PRINT by **23 lbs/year** (from 66 lbs/yr to 43/yr lbs) as can be seen in the figure.

Using the percentages (85% and 15%) above, nitrogen released to the environment before and after consumption would be **reduced** by approximately:

	Average American	50% Reduction in Animal Protein	Reduction
Before Consumption	56 lbs	36.5	19.5 lbs
After Consumption	10 lbs	6.5	3.5 lbs
Total	66 lbs	43 lbs	23 lbs

From a watershed point of view, if 100 people discharging to septic systems modified their diets to become more in line with the RDA for protein, nitrogen released to the watershed would be reduced by 350 lbs/year or by 35%.

NH Seacoast - Another Tool for the Toolbox

Reducing nitrogen loads to the Great Bay Estuary has been a topic of discussion for a long time. **Educating the public** on how their food choices are connected to nitrogen released to the environment may be another tool for the toolbox. It is another way for communities to reduce nitrogen loading from non-point sources (i.e. septic systems). And it is something that can be included in a community's efforts overall to educate the public on different ways they can reduce nitrogen loading to the Great Bay. The greatest benefit is that reducing nitrogen by making diet changes requires no capital (structure or equipment) cost.

The public often gets involved in improving the environment when they understand how their lifestyle choices can make a difference. In other areas of the country, some people have embraced a campaign called Meatless Mondays (<http://www.meatlessmonday.com/>). Meatless Mondays has been incorporated in the general public, elementary schools, colleges, businesses and has become an international campaign in response to impacts (health, environmental) associated with meat consumption. This is an interesting concept, and although this article is not intended to address all of the environmental impacts associated with excessive meat consumption - how much nitrogen could we prevent from entering the Great Bay estuary by going meatless one day a week?

We can all be stewards of the environment just by the food choices we make. What's your nitrogen footprint? You can find out by using the N-PRINT calculator at www.n-print.org/.

1. For more information visit - INI website: <http://initrogen.org/> and N-PRINT website: <http://n-print.org/>.
2. Allison M. Leach, James N. Galloway, Albert Bleeker, Jan Willem Erisman, Richard Kohn, Justin Kitzes