

***Food Miles: Environmental Implications of Food Imports to the Kingston Region  
Brief Summary of Findings and Comparison to Waterloo Region***

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***The rapidly escalating impacts of climate change are making energy and emissions reductions a necessity. One of the biggest contributors is the usage of fossil fuels, especially with regards to transport. In an energy hungry world, it is well known that fossil fuel use continues to climb with regards to the shipping of items like food. The issue of “food miles” has been examined previously (Pretty et al. 2005, Pirog et al. 2001, Pirog and Benjamin 2003); one of the more recent Canadian analyses was conducted for food miles of imports into Waterloo (Xuerub 2005). Using the tool developed by Xuerub (2005), food miles for imports into the Kingston Region are examined relative to scenarios involving regional and local sourcing. In addition, the Kingston case is compared to the Waterloo Region. The 58 studied food items travelled approximately 4685 km<sup>1</sup> from their sources to retailers. It is found that if all 58 imports were sourced locally or regionally, the Kingston Region could reduce greenhouse gas emissions by ~20621 tonnes annually. This would be the equivalent to removing ~6747 cars from Kingston’s roads. It would also reduce household greenhouse gas emissions by a third of a tonne. When compared to Waterloo, Kingston stands to gain more from local or regional sourcing, due to its increased distance from common road shipping routes.***

## **Introduction**

Climate change impacts on the environment are being felt rapidly throughout the world. Events predicted to take centuries are already occurring within decades or a mere span of years. The importance of reducing environmental impacts and greenhouse gas emissions are beginning to slowly dawn on the world’s population and policy makers. One of the greatest contributions to atmospheric greenhouse gases are from fossil fuels – whose use is rapidly increasing due to increased road transport and freight shipping of items like food (rising by more than 20% in terms of energy use in Canada; see EC 2003, OEE 2005B). The issue of food miles has been examined in the literature previously (Pretty et al. 2005, Pirog et al. 2001, Pirog and Benjamin 2003) and one of the more recent Canadian analyses was conducted for food miles of imports into Waterloo (Xuerub 2005). Using the tool developed by Xuerub (2005), the food miles for imports into the Kingston Region are examined relative to scenarios involving regional and local sourcing. In addition, the Kingston case is compared to the Waterloo Region. What follows is a brief summary and discussion of the methodology and findings.

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<sup>1</sup> This is roughly the distance from Kingston all the way to Vancouver.

**Table 1: # of cars that could be removed if 58 common foods were locally sourced**

Food Product	Equivalent # of Cars Taken Off Road*	Food Product	Equivalent # of Cars Taken Off Road*
Apple Juice	169.0	Mushrooms - fresh	11.1
Apples - dried	3.6	Mushrooms - pres/prep	62.5
Apples - fresh	244.1	Oats/Oatmeal	15.7
Barley	–	Onions	243.8
Beans, Baked	15.7	Peanuts - prepared	–
Beans, White	–	Pears - fresh	618.7
Beef	1948.1	Pears - preserved	19.3
Beef/Pork Wieners	–	Peas - canned	1.6
Blueberries - dried	–	Peas - dried	20.9
Blueberries - fresh	84.4	Peas - fresh	38.6
Blueberries - frozen	1.6	Peas - frozen	3.3
Breakfast Cereals	27.8	Peanuts in shell	156.4
Broccoli	144.6	Peanuts, shelled	38.0
Cabbage	62.5	Peppers - bell, fresh	307.9
Carrots	197.0	Pork	40.6
Cheese	206.8	Pork (Ham)	–
Cherries - fresh	38.0	Potatoes - fresh	335.7
Cherries - prepared	–	Potatoes - frozen	24.2
Chicken	175.4	Pumpkins/Squash	26.5
Corn (Sweet) - fresh	20.3	Spinach - fresh	53.3
Corn (Sweet) – frozen	3.3	Spinach - frozen	3.6
Corn (Sweet) - preserved	4.9	Strawberries - fresh	109.6
Garlic - dehydrated (powders)	–	Strawberries - frozen	24.5
Garlic - dried	–	Strawberry jam	–
Garlic - fresh	41.6	Tomato sauces	61.8
Lettuce (incl. head and leaf)	625.6	Tomatoes - canned	105.0
Milk/Cream - con. or swt.	26.2	Tomatoes - fresh	382.8
Milk/Cream - fresh	0.0	Yogurt	1.0
Mushrooms - dried	–		
		<b>Total # of Cars off the road</b>	<b>6746.8</b>

\* The 2004 Corolla is used as the reference standard for the average GHGe of a typical car (see also Appendix 2).

## Methodology

As mentioned before, the analysis tool refined by Xuerub (2005) was adapted to the Kingston context. Much of the methodology is almost identical to that study with very few modifications. What follows are the more notable points or changes:

- The population of Kingston Region (which is smaller than Waterloo Region) was 177171 in 2001 for Frontenac, Lennox-Addington and Leeds-Lansdowne<sup>2</sup> (with approximately 70235 households).

<sup>2</sup> Addington Highlands, Central Frontenac, Frontenac Islands, Gananoque, Kingston, Leeds and the Thousand Islands, Loyalist, North Frontenac, South Frontenac and Stone Mills. Data was derived through PCensus for MapPoint (Stauffer Library, Queen’s University) from Canadian Census 2001.

- Food items were selected on the basis of whether they could be grown or raised locally; had accessible and reliable import data; reflected a mix of fresh and preserved products and whether they represented a basket of items that Kingston consumers would eat (which was assumed not to differ greatly from most Canadian urbanized regions including Waterloo).
- Food import data that was obtained from Industry Canada's Strategis database used by Xuerub (2005) was also used here (i.e. 2000-2004).
- The radial distance used to define the Kingston Region and SE Ontario Region was 40 and 160 km respectively (unlike the 30 and 250 km used in Xuerub 2005) due to the shape of the Frontenac, Lennox-Addington Counties surrounding the City of Kingston.
- Distances from sources of production origin were all calculated from the state and country capitals or the biggest port or airport if not in the same city as the capital. All travel from North American sources was assumed to be by truck.
- Greenhouse gas emissions took into account the mode of transport (g/tonne-km) – be it air, marine, rail or truck using the most recent available data from Environment Canada.
- Food consumption data was assumed to be the same as the national average for the most part.
- The tool used only data for the 58 selected food items. The percentage of imports that were actually consumed domestically was accounted for to determine the real GHG impact.

**Note:** *sample calculations for some of the more important measures in this study and expanded explanations are included in the Appendix.*

## **Results and discussion**

The top ten imports that contribute greenhouse gases are listed on Table 2. It was interesting to note that the list order was practically the same as Waterloo except that the lettuce and pears switch positions (lettuce rises to second place and pears drops to third). This isn't totally unreasonable as most people today eat similarly within most Canadian cities. Kingston and Waterloo are also similar in that they are not large multicultural, metropolitan urban cities like Toronto where we might be more likely to see a more different list. The fact that beef imports produce the highest emissions is important to note as it provides yet another reason to develop the local beef market and industry that already exists in the Kingston region. In addition, lettuce and tomatoes are also high emitters of greenhouse gases. Those two popular crops could be grown in greater quantities in local hydroponic greenhouses instead for example (see Blay-Palmer *et al.* 2006) but only if the energy trade off of growing those two *specific* crops in an energy intensive greenhouse are still less than importing it (this point is raised in the Study Limitations section of Xuerub 2005 in more detail, and is briefly mentioned below).

**Table 2: Top ten imported food item contributors to greenhouse gas (GHG) emissions, Kingston region**

Food Item	Annual GHG Emissions from Kingston Region Imports (tonnes)	Annual Equivalent in # of cars on Road	# of Times more Emissions than Local Product	WASD (km)	WAER (kg of GHG/kg of Food Item)
1. Beef	5954	1948.1	510.5	6039	5.511:1
2. Lettuce (incl. head and leaf)	1912	625.6	102.6	4079	1.107:1
3. Pears - fresh	1891	618.7	427.9	6320	4.62:1
4. Tomatoes - fresh	1170	382.8	114.0	3302	1.231:1
5. Potatoes - fresh	1026	335.7	78.2	3128	0.844:1
6. Peppers – bell, fresh	941	307.9	183.0	3726	1.976:1
7. Apples – fresh	746	244.1	116.4	6126	1.256:1
8. Onions	745	243.8	98.2	4030	1.06:1
9. Cheese	632	206.8	527.0	5448	5.689:1
10. Carrots	602	197.0	105.4	4279	1.138:1
		<b>Average (all studied products)</b>		<b>4685</b>	<b>1.298:1</b>
		<b>Median (all studied products)</b>		<b>4031</b>	<b>1.059:1</b>
<b>Total (all studied products)</b>	<b>20621</b>	<b>6747</b>			

WASD = the average distance travelled by imports of the food item to the Kingston Region.

WAER = the average amount (kg) of GHGs emitted for each kg of food item imported.

**Table 3: A comparison of imports to Waterloo and Kingston regions in terms of WASD, annual GHG Emissions and WAER for 58 common food items**

	Average WASD (km)	Median WASD (km)	Annual GHG Emissions from Specified Region Imports (tonnes)	GHG emissions generated by houses in the Specified Region (%)	Average WAER (kg of GHG/kg of Food Item)	Median WAER (kg of GHG/kg of Food Item)	Distance Travelled Relative to Locally Sourced Food (times)	Distance Travelled Relative to Regionally Sourced Food (times)
Waterloo	4497	3651	51709	5.9	~1.3	~1.0	150	18
Kingston	4685	4031	20621	5.9	~1.3	~1.1	117	29
<b>Percent Difference Relative to WR (%)</b>	<b>4.18</b>	<b>10.41</b>	<b>-60.12</b>	<b>0</b>	<b>0</b>	<b>10</b>	<b>-22</b>	<b>61.11</b>

WASD = the average distance travelled by imports of the food item to the specified Region.

WAER = the average amount (kg) of GHGs emitted for each kg of food item imported.

When comparing imports between Waterloo and Kingston regions, it is interesting to note that on average (even with the median value) imports travel further to get into the Kingston area by about 4-10% (Table 3) (4685 km relative to 4497 km for Waterloo). This would indicate that Kingston is somewhat further from standard road shipping routes relative to Waterloo. Imports to Kingston generate less emissions in total than Waterloo but only because Waterloo Region has a larger population than the Kingston counties (477400 in 2003 compared to 177171 in 2001 respectively – Kingston has an ~62.89% smaller population). Houses in both regions generated the same level of GHG emissions apparently while the

average WAER in both regions was approximately the same. If you use the median WAER value however then Kingston produces roughly 10% more kg of GHG per kg of food than Waterloo. The similarity in GHG emissions by household is not entirely unreasonable either due to roughly similar consumption patterns within many Canadian settlements.

**Table 4: A Comparison of foods sourced locally from Waterloo and Kingston regions for 58 Common Food items in terms of emissions**

	WAER (kg of GHG/kg consumed food)	How many times less GHGe generated than imports?	Distance Considered Local (km radius)
Waterloo	0.008	162.5	30
Kingston	0.011	120	40
<b>Percent Difference Relative to WR (%)</b>	<b>37.5</b>	<b>-26</b>	

GHGe = greenhouse gas emissions.

**Table 5: A Comparison of regionally sourced foods from Waterloo and Kingston regions in terms of emissions for 58 common food items**

Region	WAER (kg of GHG/kg consumed food)	How many times less GHGe generated than imports?	How many times more GHGe generated than locally sourced foods?	Regional Distance Considered (km radius)
SW-Ont (Waterloo)	0.067	19	8.375	250
SE-Ont (Kingston)	0.067	29.3	4	160
<b>Percent Difference Relative to WR/SW-ON (%)</b>	<b>0</b>	<b>54.21</b>	<b>-52.24</b>	

GHGe = greenhouse gas emissions.

SW-Ont = Southwestern Ontario.

SE-Ont = Southeastern Ontario.

In Table 4, a comparison of food sourced locally from within Waterloo compared to Kingston shows that Kingston still produces ~37.5% more kg of GHG per kg of consumed food. The higher value is likely to be influenced by Kingston’s greater distance from main road shipping lanes (and thus increased GHG emissions). Regardless, locally sourced food items produced far less emissions than imports (120 times less for Kingston).

When we look at regional sourcing of foods (Table 5) however we notice that the amount of GHGe produced per kg of consumed food is practically the same for both the Waterloo and Kingston Regions. What is striking are the differences in terms of GHGe reduction if you switch from imports to regional sourcing – the Kingston Region gains greatly from switching to regional sourcing in that it produces 29 times less GHGe than importing while only increasing its GHG relative to a complete switch to local sourcing by ~4X (relative to what Waterloo stands to gain). Regardless, regional sourcing is still far better than imports in terms of emissions and only somewhat worse than sourcing everything locally (considering the magnitude of differences – see Table 5, 6). This would support the idea that it would still

be a good to switch to regional sourcing in the foreseeable future in order to make immediate gains in reducing air pollution and greenhouse gas emissions (as was suggested in Xuerub 2005). This greater benefit for Kingston could be due to the fact that our food seems to travel further on average to get to Kingston than it does to get to Waterloo and thus a switch would compensate for this somewhat greater shipping distance.

**Table 6: A comparison of imports between Waterloo and Kingston regions in terms of mass, distance travelled and GHGe for 58 common food items**

	<b>Total Imports of 58 Studied Food Items (kg)</b>	<b>Distance Travelled By Imports Relative to Locally Sourced Food (times)</b>	<b>GHGe Generated By Imports Relative to Locally Sourced (times)</b>	<b>Distance Travelled By Imports Relative to Regionally Sourced Food (times)</b>	<b>GHGe Generated by Imports Relative to Regionally Sourced (times)</b>
Waterloo (SW-Ont Region)	36 million	150	161	18	19
Kingston (SE-Ont Region)	13.4 million	117	142	29	35
<b>Percent Difference Relative to WR/SW-ON (%)</b>	<b>-62.78</b>	<b>-22</b>	<b>-11.8</b>	<b>61.11</b>	<b>84.21</b>

GHGe = green house gas emissions  
 SW-Ont = Southwestern Ontario.  
 SE-Ont = Southeastern Ontario.

If *all* total imports (of the 58 selected products) were instead switched entirely to sourcing within the SE Ontario region or within the local Kingston Region then several things could be achieved:

1. We could gain a yearly potential reduction in greenhouse gases of ~20000 to 20621 tonnes.
2. That would be the equivalent of taking off ~6556 to 6747 cars from Kingston roads annually.
3. We would reduce household greenhouse gas emissions by ~0.285-0.3 tonnes annually. This would have been nearly 1/3 of what was needed for Canadian citizens to reach the 1 tonne goal in the One Tonne Challenge.

(The values calculated for Kingston are approximately 37% those of Waterloo and thus proportional to population size.)

It should be said that since the same analysis tool from Xuerub 2005 was used, the analysis also shares its limitations. It only measures the average source locations of selected imports. It also does not measure the WASD for *all* food items in the Kingston area making it difficult

to compare it with other studies like the one done by Pirog *et al.* (2001)<sup>3</sup>. Our studies also do not account for additional environmental externalities caused by food transport and *we do not account for the energy used in production or processing* (i.e. the shipping of inputs or machinery; sending beef across the border for processing and then being shipped back for sale). In addition, both studies do not account for the energy trade offs that might be specific or unique to each food item. The analysis also depends on national data with regards to consumption habits. There may be slight differences between different Canadian urban settlements but likely the assumption that citizens have similar consumption habits should hold for the most part.

Regardless, the conclusion reached for Kingston may not seem like much by itself but if every major urban centre in Canada were to do this then the gains could be significant – in terms of better environment and air quality as well as reducing the impacts of climate change on society (especially in terms of food security and economics). In both the case of Kingston and Waterloo, the significant potential for reduced energy use and greenhouse gas emissions are evident if food is sourced more often from the regional and local areas. Considering the rapid progression of climate change (evident in melting glaciers, disrupted habitats and erratic global weather) and the other environmental impacts of our fossil fuel economy, emissions reductions remain a pressing necessity worldwide.

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<sup>3</sup> It also means that the results of this analysis may be somewhat of an underestimation since we are not calculating the emissions of *all* food imports into the Kingston region (only 58).

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## Appendix

### *Sample Calculations*

#### 1. Calculating WASD and WAER

**Weighted Average Source Distance (WASD):** This is the average distance that a food travels from where it is produced to where it is consumed (see Annika Carlsson-Kanyama 1997, Pirog *et al.* 2001, Lifecycles, 2004 and Bentley 2005 in Xuerub 2005).

$$\text{(km)} = \frac{\sum(v * d)}{\sum v}$$

where:

$\Sigma$  = sum of

v = value (\$) of imports from each location of production origin

d = distance (km) from each location of production origin to the point of consumption

using beef imports:

WASD (km)

= ([net value (\$/km) x distance travelled for various assorted bovine parts for each location that sources it]+[net value (\$/km) x distance travelled for beef for each location that sources it])/net value (\$) of imports from each location of production origin

= (7,547,131,291,958 \$/km + 2,212,382,413,226 \$/km)/1616034623 (\$)

= 6,039 km

**Weighted Average Emissions Ratio (WAER):** This is the average amount of GHG emissions (in kg) created by each kg of a food item in its travel from point of production to consumption.

$$\frac{\sum (v * d * e)}{\sum v}$$

where:

v = value (\$) of imports from each location of production origin

d = distance (km) from each location of production origin to the point of consumption

e = greenhouse gas (GHG) emission level (g/T-km) for mode of transport (see next point)

**Table 7: GHG emissions by transport mode**

Transport Mode	GHG emission levels (g per tonne-kilometre)
Air	1,101.0
Marine	130.3
Rail	21.2
Truck	269.9

The Environment Canada emissions ratios represent the most recent available data of GHG emissions by transport mode in Canada (see McKibbin 2005 in Xuerub 2005).

Figures for greenhouse (GHG) emissions by mode of transport (the “e” variable in the formula to calculate WAER) were obtained from Environment Canada (2002). The levels, shown in Table A, represent the average amount of greenhouse gas emissions emitted by the four different transport modes in Canada in the years 1990-1999. The GHG emissions are mostly carbon dioxide (CO<sub>2</sub>), but also include nitrous oxide (N<sub>2</sub>O) and methane (CH<sub>4</sub>) converted into equivalent units of CO<sub>2</sub> based on their global warming potential (see Xuerub 2005).

Using beef imports:

$$\begin{aligned}
 & \text{WAER [kg GHGe/kg shipped/km travelled or kg/(kg}\cdot\text{km)]} \\
 & = \{[\text{net value (\$/km)} \times \text{distance travelled (km)} \times \text{GHGe determined for mode of transport for} \\
 & \text{various assorted bovine parts for each location that sources it (g/tonne-km)}] + [\text{net value} \\
 & \text{(\$/km)} \times \text{distance travelled (km)} \times \text{GHGe determined for mode of transport for beef for each} \\
 & \text{location that sources it (g/tonne-km)}]\} / \text{net value (\$) of imports from each location of} \\
 & \text{production origin} / (1 \times 10^6 \text{ tonne}\cdot\text{kg/g}\cdot\text{kg}) \\
 & = \{[8,309,391,510,689,530 \text{ \$}\cdot\text{km}\cdot\text{g/tonne}\cdot\text{km} + 597,122,013,329,774 \\
 & \text{ \$}\cdot\text{km}\cdot\text{g/tonne}\cdot\text{km}]\} / 1616034623 (\text{\$}) / (1 \times 10^6 \text{ tonne}\cdot\text{kg/g}\cdot\text{kg}) \\
 & = 5.511 \text{ kg/(kg}\cdot\text{km)}
 \end{aligned}$$

## 2. Annual GHGe generated by a product imported into Kingston Region

Annual GHGe Generated By Product (tonnes) = WAER [kg GHGe/kg shipped] x Amount Consumed in Kingston Region in 2003 [kg] x Imports as % of Domestic Consumption)/1000

Using beef imports as our example:

$$\begin{aligned}
 & \text{Annual GHGe Generated By Product (tonnes)} \\
 & = \text{WAER [kg GHGe/kg shipped]} \times \text{Amount Consumed in Kingston Region in 2003 [kg]} \times \\
 & \text{Imports as \% of Domestic Consumption} / 1000 \\
 & = (5.511 \text{ kg/km} \times 4,310,428 \text{ kg} \times 25\%) / 1000 \\
 & = 5954 \text{ tonnes}
 \end{aligned}$$

For the purposes of this report, food consumption in Kingston Region was assumed to be the same as the national average. Overall, we are attempting to *estimate* the actual consumption of food items by Kingston residents. The two data consumption sources were the Statistics

Canada's Food Expenditure survey (2003) and Supply and Disposition data (2005). (For more details, see Xuerub (2005) and his report in section 3.6 Food Consumption data)

In the example above, the 25% used for imports as a % of domestic consumption is not a value for all products. Canada imports different things in different amounts. For further illustration, the example used by Xuerub (2005) is presented here for concentrated or sweetened milk imports into Waterloo:

*“... For example, imports of concentrated or sweetened milk to Waterloo Region have a very high WASD (15,701 km – because they come mostly from New Zealand) and WAER (2.168:1 – meaning they produce over twice their weight in GHG emissions). Yet we import only 12% of this stuff in Canada meaning that the impact of imports is less than it would otherwise be...”* (For details see also section 3.7 Imports as a Percentage of Domestic Consumption in Xuerub 2005)

Thus one can interpret that percentage as a sort of “weighting” to properly account for the true amount of GHG attributed to Canadian import habits.

In fact, to calculate this import percentage, the underlying tool of both this and Xuerub's study (2005) used the supply and disposition data from Statistics Canada (2005), taking the total imports as a percentage of the net supply available for consumption.

Fifteen-year (1989-2003) totals were used in making the calculation, using the following formula:

$$\text{Imports as \% of Domestic Consumption} = \frac{\sum \text{Imports (1989-2003)}}{\sum \text{Net Supply (1989-2003)}}$$

Data was not available for all fifteen years for all selected food items: when they were not, the calculation was made for the years for which data were available. For the purposes of this report, the proportion of food consumption in Kingston Region made up by imports was assumed to be the same as the national average. For Kingston (and Waterloo) this does not seem an unreasonable assumption in some ways (as discussed previously).

### **3. Comparison to cars**

This is with regards to Table 1.

Fuel economy data for a typical compact vehicle was obtained from a calculator on the National Resources Canada website (OEE 2005a). An average annual driving distance of 18,000km (based on CAA 2005) was inputted into the calculator, and the average ratio of city to highway driving was assumed to be 50-50. The fuel economy number was then used to calculate GHG emissions per litre of fuel by referring to Environment Canada's Greenhouse Gas Inventory (EC 2004), which reports on the GHG emissions per litre of fuel burned in light-duty gasoline-powered vehicles. (Xuerub 2005)

Using all this information, the study calculated that a 2004 Toyota Corolla generates 3.06 tonnes of GHG emissions per year, which was used to generate figures for the equivalent number of cars for imports of each selected food. (Xuerub 2005)

GHGe Equivalent in Cars = Annual GHGe Generated By Product (tonnes)/GHGe from one year in a 2004 Corolla (tonnes)

Using beef imports as our example:

GHGe Equivalent in Cars

= GHGe Generated By Product (tonnes)/GHGe from one year in a 2004 Corolla (tonnes)

= [(WAER [kg GHGe/kg shipped] x Amount Consumed in Kingston Region in 2003 [kg] x Imports as % of Domestic Consumption)/1000]/3.06 tonnes

= 5954 tonnes GHGe from Kingston Region Imports/3.06 tonnes

= 1948 cars (equivalent)

#### **4. General formula for calculating the percent difference relative to Waterloo/SW-Ontario region**

This would apply to Tables 4, 5, 6. This is simply used to compare some calculated Kingston value from this study to some calculated value from the Waterloo study (Xuerub 2005) and to note the difference as a percentage (either it is a positive percentage increase or a negative percentage decrease).

% Difference of a Calculated Kingston (or SE-Ontario Region) Value Relative to a Calculated Waterloo (SW-Ontario Region) Value

= {[Kingston/SE-Ontario Value ÷ Waterloo/SW-Ontario Value] -1} x 100%

Using Table 4, first column:

% Difference of a Calculated Kingston WAER Value Relative to a Calculated Waterloo WAER Value

= {[Kingston value ÷ Waterloo value] -1} x 100%

= {[0.011 kg (GHG)•kg (food)/0.008 kg (GHG)•kg (food)]-1} x 100%

= {0.375} x 100%

= 37.5%

This means that the amount of GHG generated per kg of food consumed locally in Kingston is 37.5% greater than the Waterloo ratio. In this case however, that is due to the fact that the assumed local area for Kingston (40 km) is larger than the assumed distance in Waterloo (30 km).

#### **5. General method for determining the difference between imports and the local or regional production**

This is simply straight division of one value by another to determine the difference in terms of “number of times”. This is just to give a general sense of things.

In terms of distance for example (Table 6, column 2):

Difference (# of times) = Average WASD/assumed KT distance (i.e. region considered local)  
= 4685 km/40 km = 117.

In terms of greenhouse gases (Table 5, column 2):

Difference (# of times)

= Average WAER of 58 studied food items/SE-Ontario WAER

= 1298 kg/(kg•km) ÷ 0.043184<sup>4</sup> kg/(kg•km)

= ~30

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<sup>4</sup> This value was obtained by multiplying the average WAER value by the emissions for a truck on Table 7 and then dividing by 1 million to obtain units kg/(kg•km).