



**Project no. 4CE439P3**

**URBAN\_WFTP**

**Introduction of Water Footprint (WFTP) Approach in Urban Area  
to Monitor, Evaluate and Improve the Water Use**

**WP4.3.3**

**Water distribution and users' behavior – Analysis Report  
Innsbruck**

**Lead contractor for deliverable WP 4.3.3: alpS**

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## Abstract

Nowadays Water use has become a main issue discussed internationally, mainly at a scientific level. The Water Footprint was introduced in order to reach a complete and clear knowledge of actual water use and management aspects. Furthermore, the Urban Water Footprint was introduced as the Water Footprint referring to distinct regions respectively urban settlements as cities and villages or governmental departments.

In order to advance the assessment of the Urban Water Footprint of Innsbruck, a small sample of data was gathered by the *Innsbruck U WFTP Lab* in 2 classes of a local school.

The data collected by students gives information about the amount of usages, respectively the amount of consumption of different categories domestic appliances and products. Depending on the category, this data was converted into a direct or indirect water consumption. Hence the results of the survey are interpreted and the two classes are compared to each other.

Afterwards, data provided by external sources as *Statistik Austria* (2012), *FAOSTAT* (2009) and *Neunteufel et al.* (2012) was consulted in order to build a basis of comparison to the quantities of the students.

## 1. Introduction

This report describes the data gathering analysis and its characteristics for the municipality of Innsbruck, Austria. It is based on data gathered by PP6 (alpS Ltd.) in the *Innsbruck UWFLab* and data provided by *Statistik Austria* (2012). This report not only provides real water data and analysis but also information on virtual water consumption within households. This allows for a better application of the Water Footprint concept for analyzing environmental issues associated with the use and management of water resources. This report helps not only to contribute to local water management, it also broadens the view on a supraregional or even global level. Furthermore this serves as a first step towards a whole Urban Water Footprint cycle analysis of real and virtual water consumption.

This document is divided in four main sections: firstly details on the data gathering by the lab is provided (Chapter 2), followed by a through description of the data (Chapter 3). The results of the gathering are presented afterwards (Chapter 4) and finally further comparisons with other data sources (e.g. from the *The Food and Agriculture Organization of the United Nations*) are conducted (Chapter 5).

## 2. Data Gathering

The Innsbruck UWFLab, represented by alpS Ltd., managed the Data gathering concerning direct and indirect water consumption. The gathering took place during some workshops held at Reithmann Gymnasium with two classes (44 students in total) participated. In the first workshop the students were introduced to a tally sheet (Appendix 1), with which they were able to monitor their water consumption over a period of four weeks. In addition, they filled in a questionnaire concerning their number of jeans, the size of their households, the age of their washing machines and dish washers and additional information on the size of their garden and the existence of a swimming pool. After the monitoring period, each student calculated (Appendix 2) both their direct and indirect water consumption in litres per day per capita.

### 3. Data Description

As the gathered sheets contain absolute frequencies of use or consumption of the respective categories, they have to be converted into a corresponding amount of consumed water. The following Tables Table 1, Table 2 and Table 3 give an overview about the different conversion factors. The quantity in liters always refers to a single use of the respective categories, respectively the consumption of one of the specified unit.

Table 1 gives information about the conversion factors for the direct water consumption, whereas Table 2 and Table 3 contain the conversion factors for the indirect water consumption like food and jeans.

**TABLE 1**  
**CONVERSION FACTORS FOR THE DIRECT WATER CONSUMPTION**

<b>Direct water consumption</b>	<b>Liters/use</b>
washing machine (new < 5 years)	44
washing machine (old > 5 years)	100
dishwasher (new < 5 years)	16
dishwasher (old > 5 years)	50
dishwashing by hand	35
showering	36
bathing	76
brushing teeth (running water)	5,2
brushing teeth (tap turned off)	1,7
toilet flush (economy button)	3
toilet flush (normal button)	7
car cleaning	100

**Table 2**  
**CONVERSION FACTORS FOR THE INDIRECT WATER CONSUMPTION**

<b>Indirect water consumption</b>	<b>Liters</b>
coffee (cup)	132
tea (cup)	27
dairy products (kg)	1675
eggs (piece)	196
fruits (kg)	967
vegetables (kg)	322
meat products (kg)	7320
cereal products (kg)	1600

**TABLE 3**  
**CONVERSION FACTORS FOR THE WATER CONSUMPTION OF ADDITIONAL INFORMATIONS**

<b>Additional information</b>	<b>Liters</b>
jeans	8000

The following Tables Table 4, Table 5 and Table 6 show the tally per class for each category. Based on the values of those tables as well as the conversion factors from Table Table 1, Table 2 and Table 3 sopra, the direct water consumption is calculated.

As it can be seen, the number of usages of new washing machines is about the same for both classes. A rather big difference between both classes was observed for old washing machines (300 versus 195 usages per 28 days).

Also the tally of dishwashers differs in a large extend. Class 1 has a higher usage rate of both new and old dishwashers. Furthermore, class 1 shows twice as high numbers in dishwashing by hand. Looking at the tally of brushing teeth, class 1 shows again a comparable high numbers, the same applies to toilet flushing and cleaning the car. These tables indicate that class 1 has in a higher direct water consumption per capita than class 2, even if their number of participants of 76 persons in this case study is higher than that of class 2 with a total of 60. Comparing the tally lists for the indirect water consumption in Table 5, the distribution between the two classes is mostly conversely to the direct water consumption. Except for consumption values of coffee, class 2 shows higher consumption rates than class 1 in all categories. The biggest disparities can be found in the categories fruits and cereal products, where class 2 consumes more than the double amount of class 1, despite the smaller group.

In Table 6, the test persons were asked to count their present number of jeans in their wardrobes. As it does not make sense to split this values on a basis of 28 days as the other data they are left as is for comparison reasons.

**TABLE 4**  
**TALLY FOR THE DIRECT WATER CONSUMPTION**

Description	Class 1	Class 2
	tally/28days	tally/28days
washing machine (new < 5 years)	211	228
washing machine (old > 5 years)	300	195
dishwasher (new < 5 years)	195	114
dishwasher (old > 5 years)	344	253
dishwashing by hand	392	173
showering	1729	1360
bathing	109	87
brushing teeth (running water)	390	209
brushing teeth (tap turned off)	3532	2879
toilet flush (economy button)	2733	2239
toilet flush (normal button)	3829	3256
car cleaning	16	11

**TABLE 5**  
**TALLY FOR THE INDIRECT WATER CONSUMPTION**

Indirect water consumption	Class 1	Class 2
	tally/28days	tally/28days
coffee (cup)	1637	940
tea (cup)	749	886
dairy products (kg)	465,75	591
eggs (piece)	616	830
fruits (kg)	181,1	402
vegetables (kg)	191,2	274,8
meat products (kg)	165,35	244,4
cereal products (kg)	195,95	430,75

**TABLE 6**  
**TALLY FOR THE WATER CONSUMPTION OF ADDITIONAL INFORMATIONS**

Additional information	Class 1	Class 2
	tally	tally
jeans	320	430

## 4. Results

The conversion from tally into liters with the calculation bases described in the Table 1, Table 2 and Table 3 above result in the water consumption shown in the following Tables TABLE 7, TABLE 8 and TABLE 9. For the further calculation steps, both classes were considered as an entire sample. The summed up water consumption of both classes was divided by the total number of 136 participants.

Table 7 below gives information about the usage per capita and day as well as the converted associated water consumption in liters per capita and 28 days for different categories. Obviously the test persons use to have a shower for their regular body hygiene. Taking a bath seems to be an exception.

Furthermore, a great difference can be seen in the direct water consumption between old and new domestic appliances. Looking at the washing machines, they are used about equally often but the water consumption for older machines, defined as devices with an age over 5 years, usually use more than double the amount of water. This also applies for dishwashers, where the amount of uses per capita and day of older dishwashers is almost twice as high as the use of newer dishwashers. Although, the water consumption of older dishwashers per capita and 28 days is more than quadruple of the water consumption of newer dishwashers.

Table 8 shows the absolute values for the consumption of different food categories per capita and day. Those values are always referred to the respective given units. Additionally, Table 8 gives information about the converted indirect respectively virtual water consumption for each category in liters per capita and day. As it can be seen, the amounts of indirect water consumption are differing in a wide range between 7.70 liters per person and day and 1275.44 liter per person per day. The highest virtual water consumption is related to the consumption of cereal products, whereas the lowest virtual water consumption relates to the consumption of dairy products.

Table 9 shows the average amount of jeans possessed by the test persons as well as the corresponding indirect water consumed with the product.



**TABLE 7**  
**AVERAGE DIRECT WATER CONSUMPTION OF BOTH CLASSES**

Direct water consumption		Test persons	
		usage/c/d	l/c/28d
washing machine	new (< 5 years)	0,10	144,68
	old (> 5 years)	0,14	359,87
	sum	0,24	504,55
dishwasher	new (< 5 years)	0,09	35,73
	old (> 5 years)	0,16	218,57
	sum	0,25	254,30
shower		0,81	817,50
bath		0,05	109,60
toilet flush	economy button	1,28	109,92
	normal button	1,80	366,27
	sum	3,08	476,18

**TABLE 8**  
**AVERAGE INDIRECT WATER CONSUMPTION OF BOTH CLASSES**

Indirect water consumption		Test persons	
		[]/c/d	l/c/d
coffee	cups	0,66	87,70
dairy products	kg	0,29	7,70
eggs	pieces	0,39	656,20
fruits	kg	0,16	31,79
vegetables	kg	0,13	122,53
meat products	kg	0,11	35,93
cereal products	kg	0,17	1275,44

**TABLE 9**  
**AVERAGE POSSESSION OF INDIRECT WATER DUE TO JEANS**

Additional informations		Test persons	
		[]/c	l/c
jeans	pieces	5,51	44117,65

## 5. Comparison with other Data

### 5.1 Data sources

Other data partially comparable to the collected data were taken from FAOSTAT (2009), Statistik Austria (2011) and Neunteufel et al. (2012). The different references are described in the following:

FAOSTAT (2009) shows the availability for each commodity in connection with its source and its utilization. Based on the total amount of production, the total amount of imported goods and eventual stock variation, the available range is calculated. Further, the sum of the total amount of exported goods, the amount used for agricultural reasons (e.g. livestock and seeds) and different losses (e.g. through transport or storage) represent the amount of consumption. Finally, the difference between the available range and the amount of consumption is what remains for human consumption.

The calculated values for the food supply quantity (in kg/cap/year) do not give information about the household consumption, but include the consumption by gastronomy, trade and commerce. It could not be clarified if they include the amounts consumed by the industry.

Statistik Austria (2011) carried out a sample survey comprising 6534 private, randomly chosen volunteering households, which started at the end of April 2009 and ended at the beginning of May 2010. All households were asked to keep book over their food consumption. Further, data concerning the members of the households and the dwellings as well as the equipment of the accommodations were collected. The collected data should inform about the consumption expenditures by private households and give an indication about the consumption habits as well as the standard of living of Austria's private households. Those data only include the goods consumed by the households themselves, they do not include goods consumed outside, for example the coffee in the office.

Neunteufel et al. (2012) summarized data from different water supply companies spread all over Austria. They collected data from their supplied volume and data from water meters. The information reaches back to the year 2000. Furthermore, a sample survey about use-related data was carried out with selected households. Therefore additional water meters were installed at different tapping points to meter the specific water usages. Based on those measurements, the specific water usage for Austrian inhabitants was projected.

Neunteufel et al. (2012) also differentiated between winter (October to March) and summer (April to September) season. As the school survey was performed during the winter period, the corresponding literature values are used for comparison.

The following Tables Table 10 and Table 11 compare selected data given to the data from the literature described above.

**TABLE 10**  
**COMPARISON OF THE DIRECT WATER CONSUMPTION**

Direct water consumption		Students		Neunteufel (2012) for winter	
		usage/c/d	l/c/28d	usage/c/d	l/c/28d
washing machine	new (< 5 years)	0,10	144,68	0,3	336
	old (> 5 years)	0,14	359,87		
	sum	0,24	504,55		
dishwasher	new (< 5 years)	0,09	35,73	0,25	84
	old (> 5 years)	0,16	218,57		
	sum	0,25	254,30		
shower		0,81	817,50	0,6	700
bath		0,05	109,60	0,04	168
toilet flush	economy button	1,28	109,92	6,1	1008
	normal button	1,80	366,27		
	sum	3,08	476,18		

Looking at the consumption by washing machines, the amounts of daily usage are in a suitable range. Neunteufel et al. (2012) calculated with a specific water consumption of 44 l per wash, whereas the actual survey took 44 l per wash only for the new washing machines and 100 l per wash for the older ones.

The frequency of using a dishwasher is about the same for the actual survey and for the older, more extensive surveys of Neunteufel et al. (2012). Again, our survey calculated with an increased water consumption per wash of 50 l for older dishwashers and 16 l for the newer ones. Neunteufel et al. (2012) is again at the level of new dishwashers with a calculation basis of 16,3 l per wash.

Regarding the showering habits, the actual survey shows a slightly increased amount of using the shower than the surveys of Neunteufel et al. (2012). As a reason for this difference, Neunteufel et al. (2012) found out, that persons in a full time or a part time job use showers

more often than persons who are at home for the most part of the day. As the structure of the surveyed households is not raised that detailed, it is only a potential explanation.

Bathing is not that common anymore, the trend goes to an increased usage for wellness and relaxing than for regular body hygiene. So the frequency of taking a bath is only a small proportion of the one for showering. But still, the survey is in a reasonable range and also the calculation basis of 76 l per bath is the same for the survey as well as for the studies of Neunteufel et al. (2012).

The comparison of the frequency of flushing the toilets shows, that the persons in the households use their toilet at home only half the amount as the Austrian average calculated by Neunteufel et al. (2012). Either way, it is still plausible according to Neunteufel et al. (2012). There it is mentioned, that the lowest frequency of use is measured with 3 times per person per day. This number was occurring in households with all persons in a full time or a part time job. Also the water consumption for calculation is in the same range and thus plausible.

**TABLE 11**  
**COMPARISON OF THE PARAMETERS FOR THE INDIRECT WATER CONSUMPTION**

Indirect water consumption		Students	Statistik Austria (2011)	FAOSTAT (2009)
		[l]/c/d	[l]/c/d	[l]/c/d
coffee	cups	0,66	2,50	2,24
dairy products	kg	0,29	0,24	0,68
eggs	pieces	0,39	0,43	0,63
fruits	kg	0,16	0,18	0,35
vegetables	kg	0,13	0,18	0,28
meat products	kg	0,11	0,15	0,33
cereal products	kg	0,17	0,20	0,32

For the comparison of the indirect water consumption, respectively the amounts of consumption which cause indirect water consumption, data from Statistik Austria (2011) and FAOSTAT (2009) were used.

Only the consumption of coffee shows a gross deviation in the survey from other statistical data. The original data of Statistik Austria (2009) showed a consumption of 600g coffee per person per month. With a calculation basis of 8g coffee per cup, which usually results in a rather strong cup of coffee, the average Austrian inhabitant still drinks 2.5 cups of coffee per day. Our survey only results in about a quarter of the estimated consumption. Despite the fact, that there is a small number of children with an age under 10 years, the consumption of coffee

is still below-average. Due to the simplification, that the survey only distinguished in children from an age of 0 to 10 years, juveniles between 10 and 20 years and adults over 20 years, it could be possible, that the participated households consist of many younger juveniles, which do not yet drink coffee, but are not specially recognized in this survey.

*A comparison of the total indirect water consumption would not make sense, as there are no other plausible calculation bases than the ones already used in the survey.*

## 6. Conclusion

As a conclusion, the amounts of usage of different categories as parameters for the direct and the indirect water consumption are compared numerically. The number to be regarded is the result of the following division:  $\frac{\text{amount of students}}{\text{amount of external source}}$

The following tables Table 12 and Table 13 show the different ratios of the student's behavior of the comparison data from Statistik Austria (2011) respectively FAOSTAT (2009) and Neunteufel (2012).

**TABLE 12**  
**RATIO OF STUDENT'S AMOUNT OF AMOUNT FROM COMPARISON DATA FOR INDIRECT WATER CONSUMPTION**

indirect water consumption	Statistik Austria (2011)	FAOSTAT (2009)
coffee	0,27	0,30
dairy products	1,17	0,42
eggs	0,90	0,62
fruits	0,88	0,46
vegetables	0,70	0,45
meat products	0,74	0,34
cereal products	0,89	0,55

**TABLE 13**  
**RATIO OF STUDENT'S AMOUNT OF AMOUNT FROM COMPARISON DATA FOR DIRECT**  
**WATER CONSUMPTION**

Direct water consumption		Neunteufel (2012) for winter	
		ratio of usage/c/d	ratio of 1/c/28d
washing machine	new (< 5 years)	0,33	0,43
	old (> 5 years)	0,47	1,07
	sum	0,8	1,5
dishwasher	new (< 5 years)	0,36	0,43
	old (> 5 years)	0,64	2,6
	sum	1	3,03
shower		1,35	1,17
bath		1,25	0,65
toilet flush	economy button	0,21	0,11
	normal button	1,80	0,36
	sum	0,5	0,47

The only absolute accordance between the student's amount of usage and the external source is at the sum of the usages of dishwashers. Summing up both the new dishwashers and the old dishwashers, the students have identically the same average amount of usage per capita per day as Neunteufel (2012) proposes.

Almost the same average consumption or usage is to be regarded at the consumption of dairy products, eggs, fruits, cereal products and at the usage of the washing machines when comparing to Statistik Austria (2011).

Compared to FAOSTAT (2009), the student's amounts of consumption are almost always less than half of the data of FAOSTAT (2009). Only two times, at the consumption of eggs and cereal products, the student's data lie a little bit more than the half of FAOSTAT (2009).

To combine the comparison to both sources it can be assumed, that the indirect water consumption of the sample classes is rather low.

A significant deviation can be observed in the consumption of coffee, where the average student's consumption is less than a third of the amounts proposed by Statistik Austria (2011) and FAOSTAT (2009).




All in all, the major part of the gathered data from the students is rather small compared to other data. So it can be assumed, that their indirect as well as their direct water consumption is to be assessed as low respectively their behavior is to be judged as economical.

## 7. References

- FAOSTAT. (2009). *Food Balance Sheets*. Retrieved April 08, 2014, from <http://faostat.fao.org/site/368/DesktopDefault.aspx?PageID=368#ancor>
- Neunteufel, R., Laurent, R., Perfler, R., Tuschel, S., Böhm, K., & Haas, E. (2012). *Wasserverbrauch und Wasserbedarf - Auswertung empirischer Daten zum Wasserverbrauch*. Wien: Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft.
- STATISTIK AUSTRIA. (2011). *Konsumerhebung 2009/10*. Retrieved April 08, 2014, from [http://www.statistik.at/web\\_de/statistiken/soziales/verbrauchsausgaben/konsumerhebung\\_2009\\_2010/055858.html](http://www.statistik.at/web_de/statistiken/soziales/verbrauchsausgaben/konsumerhebung_2009_2010/055858.html)

## 8. Appendices

Appendix 1: Data gathering sheet to monitor direct and indirect water consumption




 		Tally sheet to assess the water footprint						
Name:		Week:			Date:			
Direct water consumption (mark once per use)								
How often do you use the washing mashine?								
How often do you	with a dish washer							
clean the dishes?	by hand							
How often do you have a shower?								
How often do you take a bath?								
How often do you	with running water							
brush your teeth?	with tha tab switch off							
How often do you	using saving button							
flush the toilette?	using normal button							
How often do you wash your car?								
Indirect water consumption (mark once per used unit, e.g. cup, piece, kg)								
Coffe (cups)								
Tea (cups)								
Milk products (kg)								
Eggs (pieces)								
Fruits (kg)								
Vegetables (kg)								
Meat products (kg)								
Grain products (kg)								



Appendix 2: Data gathering sheet additional information on direct and indirect water consumption

<b>Additional Information</b>		
<p><b>1. How many people live in the household:</b> _____</p> <p>Adults (older than 20 years): _____</p> <p>Youths (10-20 years): _____</p> <p>Children (younger than 10 years): _____</p>	<p><b>2. Do you know your annual water consumption?</b></p> <p style="text-align: right;">_____ m<sup>3</sup></p>	<p><b>3. How many pieces of jeans clothes do you have in your household?</b></p> <p style="text-align: right;">_____ pieces</p>
<p><b>4. Do you have a dish washer</b></p> <p>Yes <input type="checkbox"/></p> <p>No <input type="checkbox"/></p>	<p><b>If yes, how old is the dish washer?</b></p> <p>younger than 5 year: <input type="checkbox"/></p> <p>older than 5 years <input type="checkbox"/></p>	
<p><b>5. Do you have a washing mashine?</b></p> <p>Yes <input type="checkbox"/></p> <p>No <input type="checkbox"/></p>	<p><b>If yes, how old is the washing machine?</b></p> <p>younger than 5 year: <input type="checkbox"/></p> <p>older than 5 years <input type="checkbox"/></p>	
<p><b>6. Do you have a swimming pool?</b></p> <p>Yes <input type="checkbox"/></p> <p>No <input type="checkbox"/></p>	<p><b>If yes, how big is the pool?</b></p> <p style="text-align: right;">_____ m<sup>3</sup></p>	
<p><b>7. Do you have a garden?</b></p> <p>Yes <input type="checkbox"/></p> <p>No <input type="checkbox"/></p>	<p><b>If yes, how big is the garden?</b></p> <p style="text-align: right;">_____ m<sup>2</sup></p>	<p><b>Do you grow vegetables?</b></p> <p>Yes <input type="checkbox"/></p> <p>No <input type="checkbox"/></p>

Appendix 3: Water footprint calculation sheet

Water Footprint Calculation Sheet					
					
classes	2				
students	40				
persons	136				
days	28				
Water consumption direct		Water consumption over the total periode			Water consumption per day
Consumption category	Consumption per use (in l)	Total amount of marks	Total water consumption	Litre/capita	Litre/capita
Washing mashine (new < 5 years)	44	376	16.544	122	4
Washing mashine (old > 5 years)	100	558	55.800	410	15
Dish washer (new < 5 years)	16	253	4.048	30	1
Dish washer (old > 5 years)	50	653	32.650	240	9
Dish washing by hand	35	565	19.775	145	5
Shower	36	3.089	111.204	818	29
Bath	76	196	14.896	110	4
Cleaning teeth (running water)	5,2	599	3.115	23	1
Cleaning teeth (tap switch off)	1,7	6.411	10.899	80	3
Toilette flush (Eco)	3	4.972	14.916	110	4
Toilette flush (normal)	7	7.085	49.595	365	13
Washing car	100	27	2.700	20	1
<b>direct water total</b>			<b>336.142</b>	<b>2.472</b>	<b>88</b>
Water Consumption (indirect)		Water consumption over the total periode			Water consumption per day
Consumption category	Consumption per use (in l)	Total amount of marks	Total water consumption	Litre/capita	Litre/capita
Coffee (cup)	132	2.577	340.164	2.501	89
Tea (cup)	27	1.635	44.145	325	12
Milk Products	1.675	1.057	1.770.056	13.015	465
Eggs	196	1.446	283.416	2.084	74
Fruits (kg)	1.000	583	583.000	4.288	153
Vegetables (kg)	300	466	139.800	1.028	37
Meat products (kg)	7.220	410	2.958.395	21.753	777
Cereal products (kg)	1.600	627	1.002.720	7.373	263
<b>indirect water total</b>			<b>7.121.796</b>	<b>52.366</b>	<b>1.870</b>
Water Consumption (indirect)		Water consumption over the total periode			Water consumption per day
Water category (additional)	Consumption per use (in l)	Total amount of marks	Total water consumption	Litre/capita	Litre/capita
Jeans (per piece)	8.000	749	5.992.000	44.059	1.574
Pool	1.000	4	4.000	29	1