The relationship between the direct domestic water consumption and dwelling characteristics of two neighbourhoods in Groningen.

A Bachelor Thesis for Spatial Planning and Design by Bregtje van Uffelen

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Date	-	January 15th, 2021
Word count	-	6829

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ABSTRACT

The aim of this research is to find out which dwelling characteristics influence direct domestic water consumption (DDWC) in Groningen. This leads to the research question: To what extent is DDWC in the neighbourhoods the Bloemenbuurt and the De Wijert in Groningen influenced by indoor- and outdoor dwelling characteristics? To answer this research-question a quantitative research method was used. Primary data was collected through a survey. This resulted in 67 useful responses, 30 responses from the Bloemenbuurt and 37 responses from the De Wijert. A two-sample t-test and several multiple linear regressions were conducted. The variables household size, dwelling typology, cistern type and garden size were found to have a significant linear relationship. However, the difference in the means of DDWC between the neighbourhoods was found to be insignificant. The explanation given for this is that the influence of dwelling characteristics exists but is small.

1. INTRODUCTION

1.1 BACKGROUND

The total water footprint of a citizen in the Netherlands is almost double of the average water footprint of a world citizen, approximately 2% of this is due to domestic water consumption [DWC] (Van Oel et al., 2009). Over the period 2003 to 2017 the average DWC per person in the Netherlands decreased 9%. However, the heat and drought in 2018 caused the average DWC per person to rise with 6,5% compared to 2017 (CBS, 2020b). The Intergovernmental Panel on Climate Change projections for Europe indicate that in the future there will be more extremes in weather patterns, meaning that there will be more droughts, heat waves and heavy precipitation events (Kovats et al. 2014). If the projections are correct it could mean an increase in DWC, as warm periods generally increase DWC (TNS Nipo, 2017). Like in the Netherlands in 2018 (CBS, 2020b). This might result in water demand complications.

The ministry of VROM [housing, spatial planning and the Environment] made two plans[1] in the 90s to reduce the growth of water use in homes by half in the next twenty years (CLO, 2002). Examples of the measures presented are metering, water-saving in new construction and water-saving in renovation (Tweede kamer der Staten-Generaal, 1995). Half way through the 90s, the tap water usage per head of the population within the Netherlands started decreasing due to these water-saving measures (CLO, 2019). However, simultaneously population- and production rates have been rising, causing the DWC to stay relatively stable (CLO, 2019).

Inhabitants of the Netherlands on average use 120 litres of water per day per person, for the entire area the local water company of Groningen provides to this average is lower; 115 (RTVNoord, 2020; Waterbedrijf Groningen, 2020). Looking at the geographical distribution within the Netherlands it seems that cities consume more water (TNS Nipo, 2017). Research into DWC on a smaller geographical scale than the national level has not been published in the Netherlands. According to Stoker et al. (2019) certain factors are known to influence the majority of cities when it comes to DWC. However, there is still a need for case-by-case research, thus a more local approach (Stoker et al. 2019). Often research into DWC is conducted in water scarce areas and many of the existing research has been conducted in Anglo-American cities (March & Saurí, 2010). This has resulted in a lack of research into DWC in the Netherlands and thus a research gap which this thesis tries to fill. Besides the lack of research there is also a lack of public data on a local level for DWC. This is interesting as for other consumption, like for example energy there is data on the distribution of usage per neighbourhood divided per dwelling typology (CBS, 2020a).

[1] Actieplan waterbesparing & Beleidsplan dink- en industriewatervoorzieningen

1.2 RESEARCH PROBLEM

The aim of this research is to find out which dwelling characteristics influence DWC in Groningen, the Netherlands. To investigate this, two neighbourhoods with similar socio-demographic characteristics but different dwelling characteristics were chosen. The city of Groningen was chosen for two reasons. The first reason is the restrictions on travelling with public transport caused by the current Covid-19 crisis. Neighbourhoods in Groningen are in close enough proximity to not have to use public transport to collect primary data. The second reason Groningen was chosen is that within the Netherlands little research had been conducted on DWC on a smaller scale than a national level. The relationship between DWC and dwelling characteristics is relevant. If the impacts of certain dwelling characteristics on DWC are substantial measures could be taken to restrict future housing developments that include dwelling characteristics which cause a high DWC. The research problem has led to the main research question:

> To what extent is direct domestic water consumption [DDWC] in the neighbourhoods the Bloemenbuurt and the De Wijert in Groningen influenced by indoor- and outdoor dwelling characteristics?

The main research question leads to the following sub-research questions:

1. Which dwelling characteristics do the neighbourhoods have?

2. Is there a relationship between the DDWC and indoor dwelling characteristics?

3. Is there a relationship between the DDWC and outdoor dwelling characteristics?

4. Do the neighbourhoods have the same socio-demographic make-up and does this impact the DDWC?

5. Is there a difference in DDWC between the neighbourhoods?

1.3 STRUCTURE

First, the theoretical framework will be discussed. Including literature which the conceptual model and the expectations are based on. Second, the research method, data collection, reliability of the data and the ethics will be explained in the methodology. Third, in the results section all sub-research questions will be answered. This follows the order socio-demographic characteristics, indoor dwelling characteristics, outdoor dwelling characteristics and then difference between the neighbourhoods. After which the conclusion ad discussion will reflect on the research, including the implications and limitations.

2. THEORETICAL FRAMEWORK

2.1 DIRECT DOMESTIC WATER CONSUMPTION

The Water Footprint Assessment Manual (Hoekstra et al., 2011) refers to the water consumption as both indirect- and direct water use due to human appropriation of green and blue water, which causes loss of water from the ground-surface water body. This is also depicted in Figure 1.

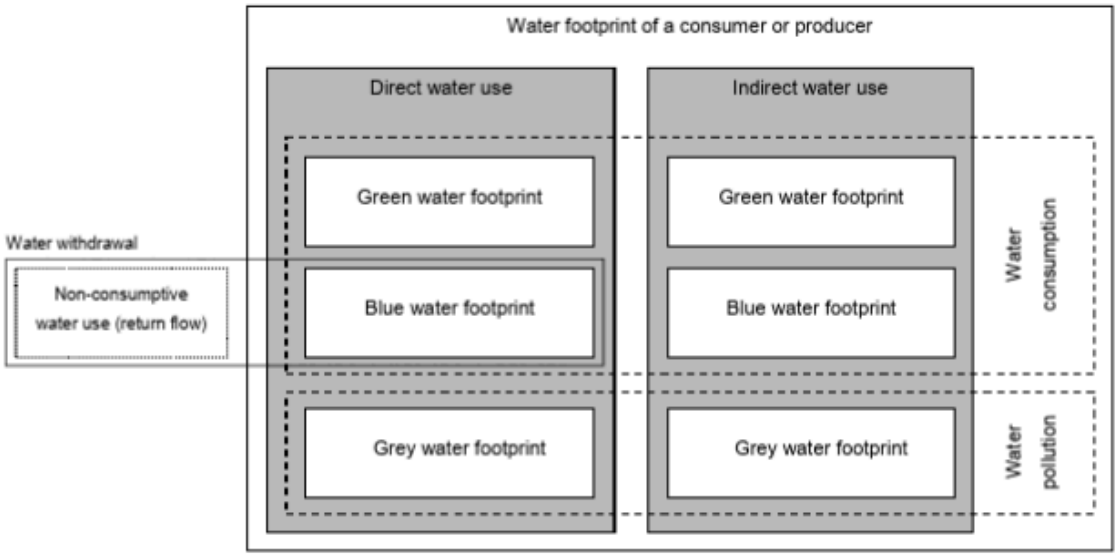

Figure 1. Definition of water consumption (Hoekstra et al., 2011, p. 3).

In the research by Gomez Llianos et al. (2020) a differentiation is made on direct- and indirect domestic water consumption. Direct domestic water consumption is defined as the volume of water directly consumed by daily habits. Indirect domestic water consumption is defined as activities, services and products and the water consumed to manufacture that product, service or activity (Gomez-Llianos et al., 2020). For this research, it was decided to only focus on the Direct Domestic Water Consumption [DDWC].

A division can also be made between indoor- and outdoor consumption (Domene & Saurí, 2006; Harlan et al., 2009; Sant'Ana & Mazzega, 2017). Outdoor features have a direct impact on outdoor consumption according to Sant'Ana & Mazzega (2017). The research by Harlan et al. (2009) used separate models. One including indoor dwelling characteristics to indicate indoor consumption, the other including outdoor dwelling characteristics to indicate outdoor consumption. The researches by Garcia et al. (2019) and TNS Nipo (2014, 2017) make a differentiation between household water consumption and per person water consumption. TNS Nipo (2014, 2017) identifies the consumption on a household level to be important for ownership characteristics, while the per person consumption is used for behavioural characteristics. According to Harlan et al. (2009) seasonal variability like temperature, precipitation and humidity differences influence DDWC. The significance of outdoor consumption is changed by seasonal variability. In summer, the effect of outdoor consumption is larger than in winter. While the influence on indoor consumption is similar in both winter and summer. The variables which influence DDWC according to literature were put into categories which will be discussed next.

2.2 INDOOR DWELLING CHARACTERISTICS

For the variable dwelling typology two researches agree that flats and apartments consume the least amount of water, while detached houses consume the most water. Units and semidetached housing have a large variability (Rathnayaka et al., 2014; Sant'Ana & Mazzega, 2017). Rathnayaka et al. (2014)

contributes the fact that apartments have a lower water consumption due to the low frequency of dishwashers and washing machines. The reason given for detached housing to have a larger consumption is presence of garden and garden size. Meaning that typology of dwelling and presence of a garden and garden size are interrelated. Sant'Ana & Mazzega (2017) states that the difference occurs only due to outdoor consumption. But it is argued that apartments have a higher water pressure which results in a higher indoor consumption in some usage. This means that there is disagreement on whether indoor consumption for apartments is higher or lower. Another variable which was found to influence DDWC is the number of bathrooms. According to Garcia et al. (2019) an increase in the number of bathrooms results in a higher DDWC.

For the variable dwelling age the findings were inconsistent. In the research by Rathanayaka et al. (2014) & Stoker et al. (2019) it was found that newer houses use more water, while the researches by Garcia et al. (2019), Guhathaka & Gober (2007) and Nauges & Thomas (2000) showed that older houses consume more water. The research by Rathanayaka et al. (2014) concluded in general that dwelling age is a poor predictor and that other causal factors could impact the data, such as renovations. The surface area was found to have a positive significant relationship to the DDWC by both Garcia et al. (2019) and Harlan et al. (2009). Thus, a larger surface area increases DDWC. A variable which was only described in the research by TNS Nipo (2017, 2014) is the toilet cistern type. An experiment found that amount of water used to flush the toilet differs per cistern type. The cistern directly above the toilet was found to use the most water, the built-in reservoir uses the least amount of water. While the cistern high above the toilet is in the middle. According to Rathanayaka et al. (2014) presence of a dishwasher was found to positively relate to DDWC, this means that if there is a dishwasher present it leads to a higher DDWC.

2.2 OUTDOOR DWELLING CHARACTERISTICS

Both the researches by Domene & Saurí (2006) and Harlan et al. (2009) indicated that the variable garden size influences DDWC. They agree that dwellings with larger irrigable gardens consume more water. However, in summer this has a larger effect than in winter. According to Domene & Saurí (2006) the garden design, so type of plants is more important than garden size. The research found that grass gardens is associated with a high DDWC. The research by Stoker et al (2019) found vegetation to be very significant. The research suggests it has a larger influence in summer, probably due to a rise in temperature. However, Rathnayaka et al. (2014) found species planted not to be a significant variable. Therefore, it can be stated that findings are inconsistent for species planted in the garden. Rathnayaka et al. (2014) states that the watering method influences DDWC. Drip irrigation and manual bucket watering were found to be the most efficient way of watering the garden. Spray gun, manual sprinklers and hose are less efficient irrigation methods.

2.3 SOCIO-DEMOGRAPHIC CHARACTERISTICS

Household size is the variable most found to influence DDWC. A larger household will have a higher household DDWC (Domene & Saurí (2006); Rathnayaka et al. (2014); Sant'Ana & Mazzega (2017); TNS Nipo (2017); Harlan et al. (2009); March & Saurí (2010)). According to TNS Nipo (2017, 2014) and Garcia et al. (2019) women consume more water. Several authors argue that age groups living in the household has an impact on DDWC. However, the findings are inconsistent. Children under 12 years old were found to significantly impact DDWC by Rathnayaka et al. (2014). Their presence increases the DDWC. According to March & Saurí (2010) the presence of older people reduces the DDWC, due to their anti-waste mind set. The research by TNS Nipo differed in different years. In 2017, the age group which consumed the most was found to be the age group 45-54-year-olds. While the research conducted in 2014 showed that 25-34-year-olds consumed the most water (TNS Nipo, 2014). The research by TNS Nipo was inconsistent again for the impact of income. In 2017 the lowest welfare group consumed the most amount of water, while in 2014 a lower welfare class consumed the most water while the highest welfare class consumed the least amount of water. The research by TNS Nipo is not academic, this could explain the inconsistency in findings as the other variables are not controlled for. Academic literature suggest that higher income groups result in a higher DDWC (Harlan et al., 2009; Sant'Ana & Mazzega,

2017.; March & Saurí, 2010). Education level of the water bill payer was found to influence DDWC by Garcia et al. (2019). According to this research, the higher the education level of the water-bill payer, the lower the household DDWC. People with a migration background were found to use more water per day than natives by the research of TNS Nipo (2014, 2017). The research classified immigrants as non- western immigrants from which (at least) one parent came from a non-western country.

2.3 CONCEPTUAL MODEL

Out of the discussed literature the conceptual model can be derived, which is depicted in Figure 2. Within the DDWC a distinction can be made between indoor- and outdoor DDWC, as Domene & Saurí, (2006), Harlan et al. (2009) and Sant'Ana & Mazzega (2017) do. A distinction is made between outdoor- and indoor dwelling characteristics as well. For which the outdoor dwelling characteristics influence the outdoor DDWC and indoor dwelling characteristics influence indoor DDWC. An extension from the model by Harlan et al. (2009) as this thesis considers more variables to fall into the categories. The seasonal variability affects both indoor- and outdoor DDWC, however it affects outdoor DDWC more. As was describe multiple times in the literature, consumption goes up in summer especially for outdoor uses. In existing literature, no distinction was made on indoor- and outdoor consumption considering the influence of socio-demographic characteristics. Thus, it influences the DDWC in its entirety. The DDWC can be either be on a household level or on a per person level, as described by TNS Nipo (2014, 2017). The household level shows the influence of dwelling characteristics, which this research focusses on.

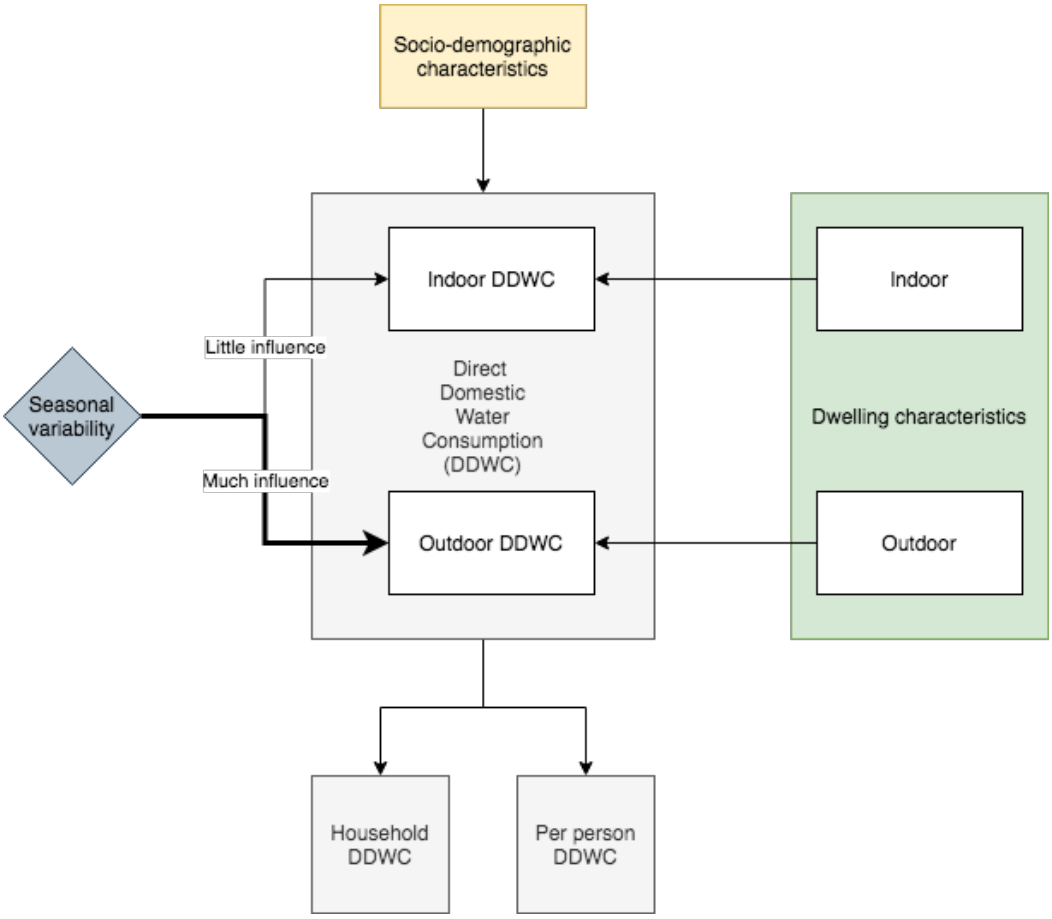

Figure 2. The conceptual model.

2.4 EXPECTATIONS

Concerning indoor dwelling characteristics, it is expected that:

1. there is a relationship between housing typology and household DDWC.
2. there is a positive linear relationship between surface area and DDWC
3. there is a positive linear relationship between number of bathrooms and household DDWC.
4. there is a relationship between household DDWC and the type of toilet cistern present in the homes.

For the outdoor dwelling characteristics, it is expected that:

1. there is a difference in household DDWC between the houses with a garden and the houses without a garden. The houses with the garden are expected to have a higher household DDWC.
2. there is a positive linear relations ship between garden size and DDWC.

For these expectations two assumptions are made. The first assumption is that respondents will show a similar socio-demographic neighbourhood make-up. The second assumption is that the respondents will have different dwelling characteristics.

3. METHODOLOGY

3.1 RESEARCH METHOD

To investigate the effect of dwelling characteristics on DDWC, two neighbourhoods with different dwelling characteristics but similar socio-demographic characteristics had to be chosen. The chosen neighbourhoods are the De Wijert and the Bloemenbuurt, the location of the neighbourhoods is depicted in Figure 3.[2] The dwelling characteristics which the neighbourhoods were selected on are dwelling typology, presence of a garden, size of the garden and dwelling age. Toilet cistern type, surface area and number of bathrooms were not considered for the selection as it cannot easily be found for all neighbourhoods. The housing typologies of the neighbourhoods is depicted in Figures 4 and 5, a classification system for the maps is added in Appendix 1.

The Bloemenbuurt has a majority of row housing, De Wijert has a majority of flats / tenement housing. Resulting in the De Wijert to have less gardens. However, when a garden is present it is a large garden, while the Bloemenbuurt mainly has smaller gardens. The majority of the Bloemenbuurt was built between 1919-1928 whilst the majority of De Wijert was built between 1959-1962 (Gemeente Groningen, N/A; Jansen, 1999). This means that both neighbourhoods were built before the new measures to reduces water consumption.

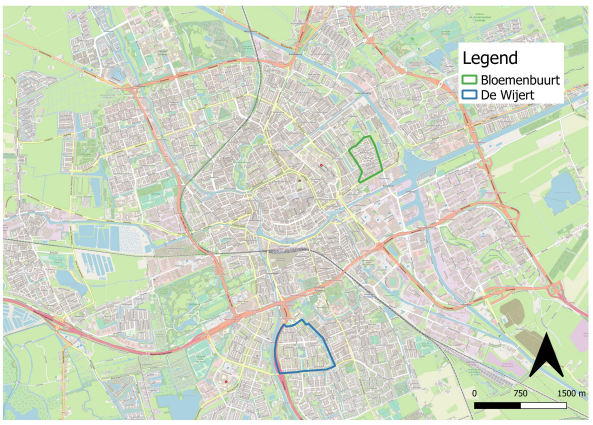

Figure 3. Geographical location of the neighbourhoods.

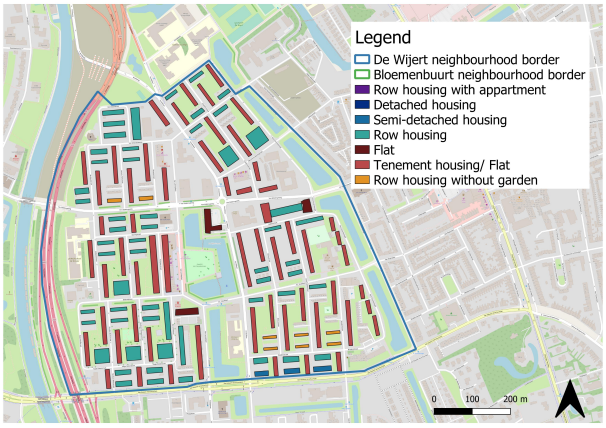

Figure 4. Housing typologies of the De Wijert.

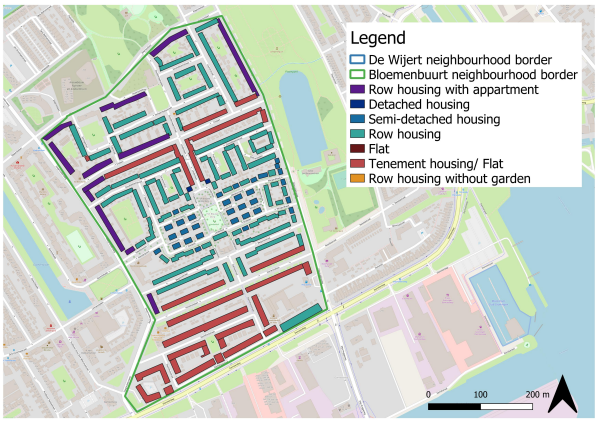

Figure 5. Housing typologies of the Bloemenbuurt.

[2] GIS map was made using the map from Nationaal Geo Register from 2018 as the neighbourhood boundaries.

The socio-demographic characteristics which the neighbourhood choice was based on are average household size, gender, income, age, migration background and education level of the water-bill payer. The characteristics of the neighbourhoods is depicted in Table 1. Secondary data on socio-demographic neighbourhood characteristics is available from the Central Bureau for Statistics [CBS].

Table 1. Socio-demographic characteristics according to the census data of the neighbourhoods (CBS, 2017, 2018a, 2018b).

	BLOEMENBUURT	DE WIJERT
AVERAGE HOUSEHOLD SIZE	1.6	1.5
% WOMEN	50.8%	50.1%
% OF 0-14-YEAR-OLDS	13.9%	13.4%
% OF 15-24-YEAR-OLDS	14%	14.4%
% OF 25-44-YEAR-OLDS	41.9%	36.8%
% OF 45-64-YEAR-OLDS	23.2%	20.9%
% OF 65 +-YEAR OLDS	6.8%	14.5%
AVERAGE INCOME PER EARNER X1000	22.5	25.5
AVERAGE INCOME PER PERSON X1000	18.8	21.3
% MIGRATION BACKGROUND	29.5%	33.5%
% EDUCATION LEVEL LOW	23%[3]	25%
% EDUCATION LEVEL MID	41%	39%
% EDUCATION LEVEL HIGH	36%	36%

Primary data had to be collected for the dwelling characteristics, the socio-demographic characteristics and the DDWC. To analyse the data, several multiple linear regressions and two-sample t-test were conducted in SPSS. The p-value of 0.05 was used as a significance level for all tests. Several categorical variables had to be transformed into binary variables to include them in the regression model. In Appendix 7 an explanation for how all transformed variables were recoded is included.

Considerations were given to the requirements of multiple linear regression regarding multi-collinearity as well as the normal distribution of residuals. When residuals showed to not have a normal distribution, influential outliers were excluded and normality of the residuals was tested again. If this made the residuals normally distributed the model excluding outliers was used. If not the first model was used, however the reliability of the model is compromised. Interpretations regarding the strength of the relationship are based on the Measure of Association value (Venhorst, 2019).

3.2 DATA COLLECTION

The data was collected using a survey with 27 questions, which can be found in Appendix 2. Questions Q11, Q12, Q13, Q14, Q15, Q19, Q20, Q21 are aimed at collecting data for the dwelling characteristics. Questions Q5, Q6, Q7, Q8, Q9, Q10 are aimed at collecting data for the socio-demographic household composition.

[3] Data on education level was only available on district for the Bloemenbuurt, therefore data for the district was used.

For the DDWC, the local water company was contacted to get access to data. At first, the water company seemed willing to cooperate to provide data. However, it decided it was not willing to distribute data, neither on a detailed level or neighbourhood level. Thus, the only option to gather data on DDWC was through the neighbourhood residents. Therefore, respondents were limited to the water-bill payers of the neighbourhoods so survey respondents could look up their annual statement, which depicts household water usage for the year it is measured for. Q3 and Q4 are aimed at collecting the DDWC data. Q4 asks about the period the consumption was measured for, it was added for two reasons. The first reason is to indicate whether the respondents actually looked up the annual statement. The second reason is that it shows whether the data is all from the same time period. The periods range from 2018 to 2020. It can be either measured for the whole year or a part of the year. The data which was asked for is recalculated by the water company for the whole year, so when the respondents did not live in the residence for the whole year they could be included.

The survey was available through the online tool Qualtrics. The instrument was distributed through flyers, depicted in Appendix 3. To enable as many residents as possible to respond both the survey and the flyer were available in Dutch and English. A total of 3400 flyers were distributed, of which 2400 flyers were distributed in the De Wijert. More flyers were distributed in the De Wijert due to a slow response rate. The sampling distribution pattern is depicted in Appendix 4.

3.3 RELIABILITY OF THE DATA

Period of the annual statement (Q4) was used as a data reliability check for the DDWC data. The annual water statement has an end date of 1-1-[year]. Therefore, if the respondent did not take 1-1-[year] (or 31-12-[year]) as the last part of the period the data is classified as incorrect, an overview is given in Appendix 5. For the surface area of the dwelling (Q12) several respondents indicated uncertainty, by a question mark. This indicates unreliability of this data, which has to be taken into account for the interpretation. For the dwelling typology (Q11), the respondents had to classify their own housing typology. From the data, it became clear that the definition within the De Wijert for the same housing typology differed between respondents. Also, nine respondents filled in the “other” option for housing typology. Therefore, two new housing categories were created: corner house and apartment. As the apartment category was created flat and tenement housing were recategorized into this category, as these two categories were the problem in the De Wijert. For the socio-demographic household composition, it was not specified that the composition should be from the time period the DDWC was measured for. This non-sampling error impacts the reliability of the data, as it could mean the household composition has changed.

3.4 ETHICAL CONSIDERATIONS

In the survey introduction, the respondents were informed that the survey is voluntary and can be ended at every moment. For all questions, except the first two, the respondent can skip the question when they do not wish to answer it. Two questions were considered sensitive, the background question (Q8) and the income question (Q9). For these questions, an option was added for the respondent to indicate unwillingness to answer. After the thesis has been finished and graded the data will be deleted from all locations which it has been stored on, this because the water consumption of households is private data. For the distribution of the survey the measures regarding Covid-19 were considered. Therefore, the flyers were distributed in mail boxes so social distancing could be achieved.

4. RESULTS

The total number of responses is 152. However, several responses were incomplete or incorrect and had to be deleted. An overview of the 85 deleted responses can be found in Appendix 6. The total number of useful responses is 67. 37 of these responses are from De Wijert and 30 responses are from the Bloemenbuurt. Even though for both neighbourhoods a sufficient number of cases (30) is reached, there is still a high chance of variability as the chance for variability is higher the lower the number of cases are (Burt et al., 2009). The per person DDWC is m^3/person/year. The household DDWC is m^3/household/year.

4.1 SOCIO-DEMOGRAPHIC CHARACTERISTICS

The majority of the respondents' socio-demographic characteristics per neighbourhood were not the same as to what the census data indicated. The variables: household size, migration background and income level were different than expected from the census data. This suggests that due to the small sample size it is not a completely representative sample of the population, however the period difference has to be considered. In Appendix 12 and Figure 6 the respondents' socio-demographic characteristics per neighbourhood are depicted. Only the different socio-demographic characteristics are discussed further.

The difference in mean household size is contrary to the census data. The mean household size of the De Wijert is the larger than the Bloemenbuurt. The residents of the De Wijert have higher income levels than the residents of the Bloemenbuurt, which was expected. However, the difference is larger than the census data indicated. The percentage of respondents from the De Wijert that fall into the two highest income categories is a lot bigger than the Bloemenbuurt. The majority of the households of the respondents do not have a migration background. However, more people in the households of the Bloemenbuurt have a migration background than in the De Wijert. This is contradictory to what the census data indicated.

The percentage of the respondents from the Bloemenbuurt with a high education level is higher, while the percentage of the respondents that has a medium education level is higher in the De Wijert. The percentage of respondents in the two highest categories balance each other out. Between the neighbourhoods the percentage of age groups 65+ and 45-64-year-olds differ the most. The De Wijert has a larger group of 65+ while the Bloemenbuurt has a larger group of 45-64-year-olds. Even though this is in line with the census data, it is still an important difference to note.

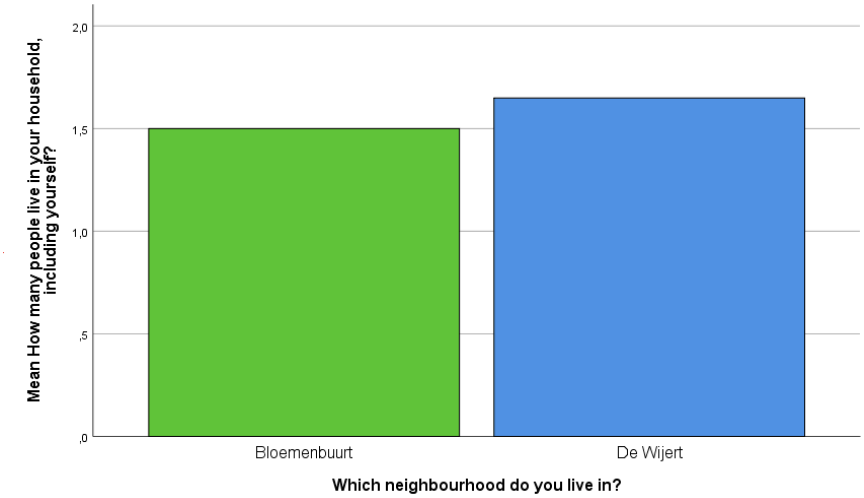

Figure 6. Mean household size per neighbourhood.

For the socio-demographic characteristics a multiple linear regression was conducted, the output can be found in Appendix 8. All socio-demographic variables were entered into the model and the stepwise

method was used. The R^2 of the model is 0.467, this means that it explains 46.7% of the variance. Only the variable household size is significant, which has a strong positive linear relationship. This means the larger the household size, the larger the DDWC. This is consistent with the existing literature (Domene & Saurí (2006); March & Saurí (2010); Rathnayaka et al. (2014); Sant'Ana & Mazzega (2017); TNS Nipo (2017); Harlan et al. (2009)). This seems logical as it is the characteristic which was found most in the literature to have an influence on DDWC. As only the variable household size was found to be significant only this socio-demographic variable will be added to the other models to account for the influence it has. As discussed, the household size is larger in the De Wijert. This means that the De Wijert has an increased DDWC compared to the Bloemenbuurt when considering the socio-demographic characteristic.

Other socio-demographic characteristics were not found to influence DDWC. This is inconsistent with the existing literature about those characteristics. There are three reasons which might explain why these variables were not found to have a significant linear relationship. First, the standardized residuals of the model were not normally distributed. This impacts the reliability of the model. Second, the reliability of the data is compromised, as was explained in the methodology section. This could cause the socio-demographic characteristics and DDWC not to line up, thus to not show a significant linear relationship. Third, both the socio-demographic characteristics and DDWC were measured on a household level. Therefore, the usage patterns of one group might be impacted by the presence of the other residents in the same household.

4.2 DWELLING CHARACTERISTICS

The dwelling characteristics of the neighbourhoods are different in the case of some dwelling characteristics, however not for all dwelling characteristics. Figures 7 to 12 depict the respondents' dwelling characteristics for each neighbourhood. The dwelling characteristics number of bathrooms, surface area of the house and presence of a dishwasher are relatively equal between the neighbourhoods. Dwelling characteristics which are different between the neighbourhoods are: housing typology, toilet cistern type, presence of a garden and garden size. The most interesting findings will be further discussed.

As expected the Bloemenbuurt has a majority of row housing, while De Wijert has a majority of apartments. However, unexpected was the share of respondents from the Bloemenbuurt that live in apartments. This is approximately 30% which is a quite substantial number. The presence of a garden is higher in the Bloemenbuurt, which is logical if it is considered that the majority of the respondents from the De Wijert live in an apartment. The garden sizes differ between the neighbourhoods but also within the Bloemenbuurt. The biggest group within the Bloemenbuurt is the smallest garden, between 0 and 20 m^2. While for the De Wijert this is a larger garden, between 41 and 60 m^2. That the surface area is similar between the neighbourhoods is interesting considering the difference in housing typologies. In the De Wijert the row housing has the largest surface area but for the Bloemenbuurt the apartments and semi-detached housing have the largest surface area. The order of the toilet cistern types from most to least present in both neighbourhoods is: cistern directly above the toilet, built-in toilet cistern and cistern high above the toilet. What stands out the most is that the share of cisterns directly above the toilet is way larger in the Bloemenbuurt, just over 60%.

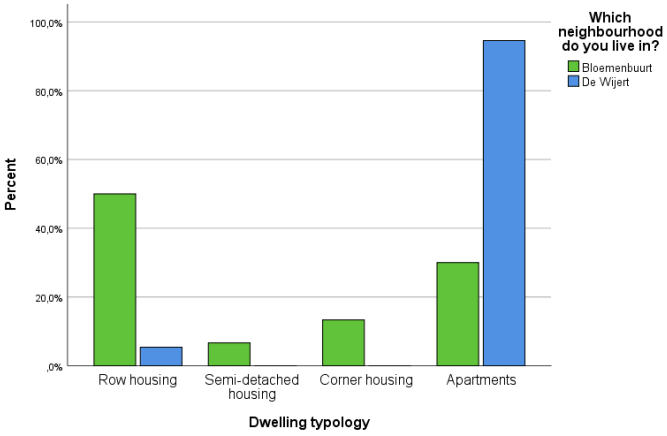

Figure 7. Percentage of each housing type within each neighbourhood.

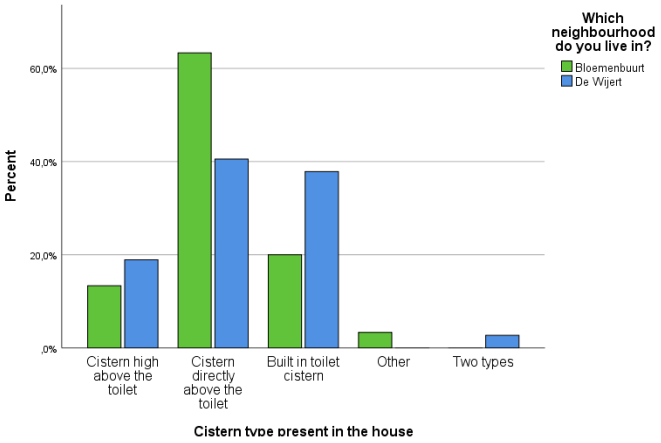

Figure 8. Percentage of each type of toilet cistern within each neighbourhood.

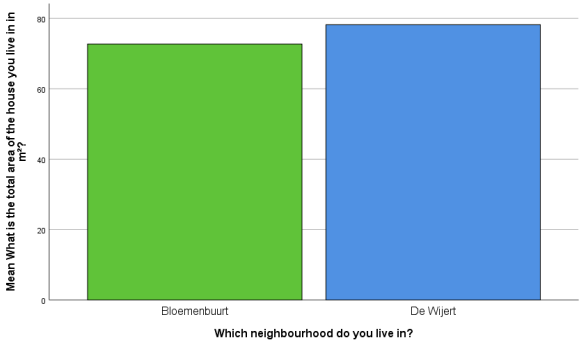

Figure 9. Mean surface area per neighbourhood.

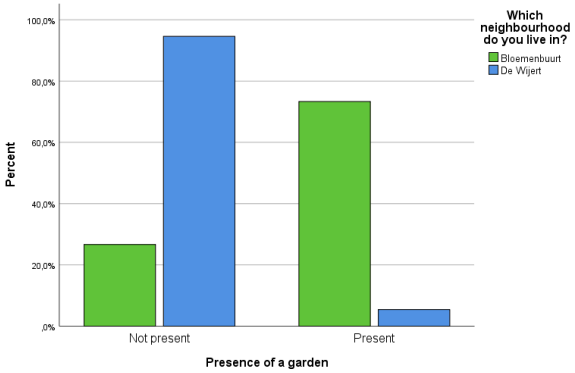

Figure 10. Presence of a garden percentage per neighbourhood.

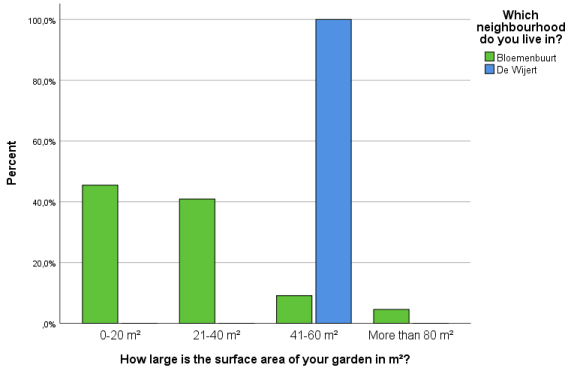

Figure 11. Surface area of the garden percentage per neighbourhood.

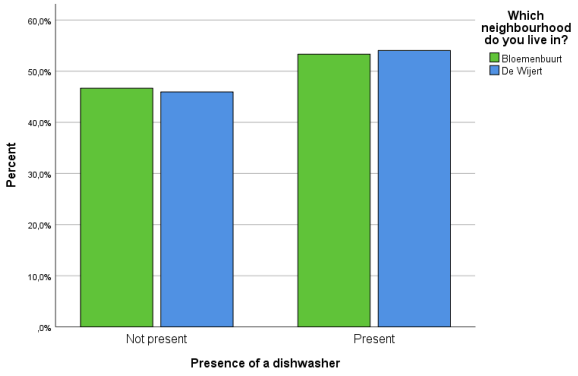

Figure 12. Presence of a dishwasher percentage per neighbourhood.

4.2.1 INDOOR DWELLING CHARACTERISTICS AND THEIR EFFECT

A multiple linear regression was conducted, including household size and all indoor dwelling characteristic (except for number of bathrooms due to a lack of differences between cases). The output can be found in Appendix 9. Two cases were taken out as they were influential outliers. The model was significant and explained 70.7% of the variance (an R^2 of 0.707). Adding the indoor dwelling characteristics explained 12.9% (R^2 change of 0.129). The significant variables are apartment, cistern built-in and cistern directly above the toilet. Insignificant variables are surface area of the house and presence of a dishwasher. The significant variables will be discussed first.

Apartment was tested against row housing. It had a weak positive linear relationship. This suggests that apartments consume more than row housing. Rathnayaka et al. (2014) and Sant'Ana & Mazzega (2017) agreed that apartments would have a lower consumption than detached housing, due to a lack of outdoor consumption with apartments. The findings of this research do not agree with this theory as apartments have a higher consumption than row housing. However, this thesis compares to row housing rather than detached housing, which might explain some difference in the findings. The two researches disagreed however on indoor consumption of apartments. Rathnayaka et al. (2014) found apartments to have lower indoor consumption. Sant'Ana & Mazzega (2017) argued apartments to have a higher indoor consumption. The findings of this research indicate a higher indoor consumption for apartments. This means that the findings of this thesis align more with the findings by Sant'Ana & Mazzega (2017).

The variables cistern built-in and cistern directly above the toilet were tested against cistern high above the toilet. Both variables were significant and had a moderate negative linear relationship. Meaning that a cistern high above the toilet results in a higher DDWC than built-in cisterns and cisterns directly above the toilet. This again differs from existing literature. The experiment by TNS Nipo (2014, 2017) indicated from highest to lowest DDWC: cistern directly above the toilet, cistern high above the toilet and built-in cistern. This means it was expected that cistern directly above the toilet would have a positive relationship, which was not the case. It has to be noted that both for this thesis and for the research by TNS Nipo (2014, 2017) there are small group sizes. For TNS Nipo this is only for the group cistern high above the toilet. The difference between the researches might be the effect of variability of small group size. Distribution of water saving buttons was also considered as a possible explanation for this difference. As depicted in Figure 13, only a small share of the toilet cistern type high above the toilet has a water saving button. Which might influence the DDWC of this cistern type.

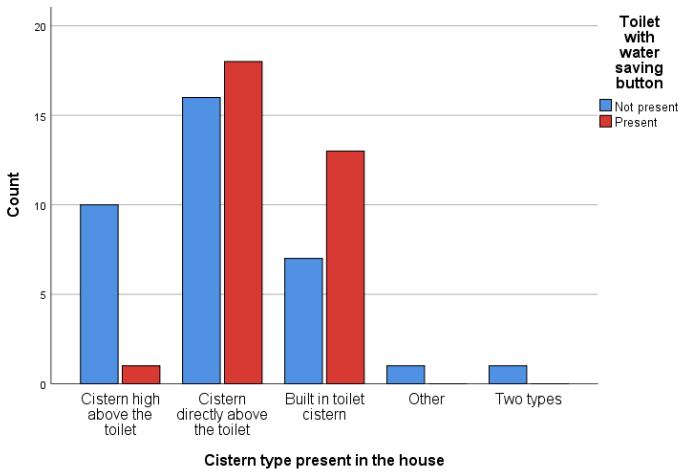

Figure 13. Number of water saving buttons per type of toilet cistern.

According to Harlan et al. (2009) the surface area is significant independent of household size. The findings of this thesis do not show this effect, as there is no significant linear relationship. In the methodology, it was explained that reliability of the surface area data is compromised. This could have affected the results. Presence of a dishwasher was found to be insignificant and the relationship negative. This is contradictory to the research by Rathanayaka et al. (2014), which found presence of a dishwasher to have a positive linear relationship. A reason for this difference cannot be given. Speculations can be made that water saving developments have been made in dishwashers since the research by Rathanayaka et al. (2014) was conducted. But this cannot be substantiated, as very little is known about the types or age of dishwashers used in the samples of both researches.

4.2.2 OUTDOOR DWELLING CHARACTERISTICS AND THEIR EFFECT

Only 22 respondents have a garden, thus only a small number of respondent have outdoor consumption. Again, a multiple linear regression was conducted including household size, size of the garden and species planted in the garden. The output can be found in Appendix 10. The R^2 change is 0.09 when the variables size of the garden and species planted in the garden were added, this mean the model explained 9% more of the variance. One of the categories of garden size, 61-80 m^2, was significant. It is a weak positive linear relationship. It was compared to the smallest category, meaning that the big garden has a higher DDWC than the small garden. This is consistent with the findings by Domene & Saurí (2006) and Harlan et al. (2009). None of the other bigger garden sizes are significant, they do however all indicate a positive effect. The findings do not indicate that the vegetation is more important than the garden size, which the research by Domene & Saurí (2006) indicated. As no significant linear relationship was found. Due to the small number of cases in this regression model the result is not really reliable.

4.3 DIFFERENCE BETWEEN THE NEIGHBOURHOODS

In Figures 14 and 15 the mean DDWC per neighbourhood is depicted, both on household- and per person level. In both cases the De Wijert has a higher DDWC. However, the difference between the neighbourhoods on a per person level is smaller than the difference on a household level.

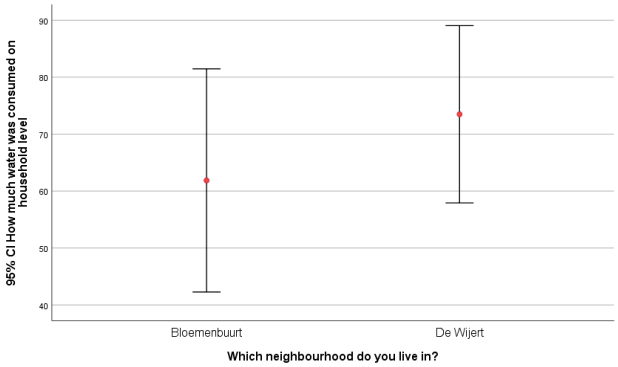

Figure 14. Mean household DDWC for each neighbourhood.

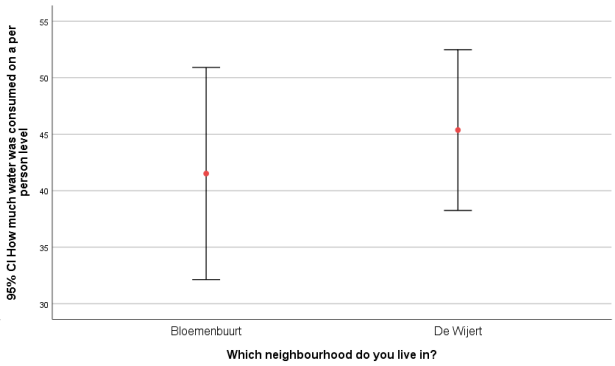

Figure 15. Mean per person DDWC for each neighbourhood.

To test whether the difference for household DDWC is significant between the neighbourhoods the two-sample t-test was conducted. The output of the test is depicted in Appendix 11. The test is insignificant, as the significance level is 0.363. This means that the mean household DDWC is equal between the Bloemenbuurt and the De Wijert. This result is interesting, as it was expected there would be a significant difference in DDWC between the neighbourhoods due to the different dwelling characteristics. Three options are explored to explain why this is the case.

The first option is that the dwelling characteristics for the neighbourhoods were not different enough. Even though not all dwelling characteristics were different between the neighbourhoods the dwelling characteristics which were found to have a significant linear relationship were quite different between the neighbourhoods. Therefore, it does not seem very plausible this causes the difference not to occur. The second option, is that the influence of dwelling characteristics is small. This did seem to be the case. Adding indoor characteristics added 12.9% to the R^2, while the addition of outdoor characteristics added 9% to the R^2. Additionally, all relationships of dwelling characteristics that were significant had a weak or moderate relationship. The significant socio-demographic variable however was found to have a strong relationship. This brings us to the third option; the socio-demographic characteristics were to different and thus had an influence. Household size was the only significant variable found for the socio-demographic characteristics, thus this would suggest that only household size influenced the results. Household size was larger in the De Wijert, with a 0.15 difference. Meaning that the DDWC would be higher in the De Wijert, this is the case and the difference in mean per person DDWC is smaller than mean household DDWC. However, household size was controlled for by adding it to all models. Therefore, option two seems to be the most logical explanation for the lack of difference in DDWC between the neighbourhoods.

5. CONCLUSION AND DISCUSSION

To conclude, the main research question "To what extent is DDWC in the neighbourhoods the Bloemenbuurt and the De Wijert in Groningen influenced by indoor- and outdoor dwelling characteristics?" can be answered as the following. The effect dwelling characteristics have on DDWC seems to be small. Adding indoor characteristics to the regression model added 12.9% to the R^2, while the addition of outdoor characteristics added 9% to the R^2. Additionally, all relationships of dwelling characteristics that were significant had a weak or moderate relationship. Indoor dwelling characteristics which were found to have a significant linear relationship are housing typology and toilet cistern type. For outdoor dwelling characteristics only garden size was found to have a significant linear relationship. The household size had strong positive linear relationship, which is a socio-demographic variable. The household size was slightly bigger in the De Wijert. Though the De Wijert has a higher mean DDWC, it is a statistically insignificant difference between the mean DDWC of the two neighbourhoods.

There are several implications to this research. The reliability of two of the linear regression models can be questioned. Also, non-sampling errors occurred which impacted the reliability of the data for the socio-demographic characteristics and the surface area of the house. Additionally, there are several limitations to the research. The sample size is rather small, increasing the chance of variability (Burt et al., 2009). This causes the data not to be very generalizable. Another limitation of the research is that a lot of usage related variables were not considered. For example, number of showers taken and length of shower. The lack of public and precise data on DDWC can be partially to blame for this. Now, only data with a large period range can be used. This means that also the effect of seasonal variability can hardly be researched. Future research could also include an in-depth study, in which for a day several households track the water use of each appliance through a diary while simultaneously the DDWC at the meter is measured. For future research, it might be interesting to compare dwellings made after and before the implemented national policy on water use reduction to see the effects and where additional improvements can still be made. Additionally, the effect of cistern types should be further researched to confirm their impact on DDWC. As this would be solvable for both newly built and older housing.

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APPENDIX 1 - CLASSIFICATION SYSTEM FOR THE MAP

Density	Housing typology	Requirements	Example picture[4]
Low density housing	Row housing	- Two entire walls attached to two entire walls of other houses - Has a private garden. - Has no extra front door.	
	Row housing with apartment	- Two entire walls attached to two entire walls of other houses. - Has a private garden. - Has an extra front door.	
	Row housing without own garden	- Two entire walls attached to two entire walls of other houses. - Does not have a private garden.	
	Detached housing	-Not one entire wall of the house is attached to another house.	
	Semi-detached housing	-One entire wall is attached to one entire wall of another house.	

[4] Google street view was used for the pictures (Google Maps, 2021).

High density housing	Flat	- Communal entrance. - Higher than five floors.	
	Flat/ tenement housing	- Communal entrance. - Lower than five floors.	

APPENDIX 2 - DATA COLLECTION INSTRUMENT

APPENDIX 2.1 - DATA COLLECTION INSTRUMENT IN ENGLISH

First, I would like to thank you for participating in this research. I am a Spatial Planning and Design student at the Rijksuniversiteit Groningen and this research is for my Bachelor Thesis. The research is about which dwelling characteristics influence domestic water consumption. For this two neighbourhoods shall be researched and compared, the Bloemenbuurt and the de Wijert. Therefore, I am looking for inhabitants of these neighbourhoods that pay the water bill and are willing to fill in this survey.

The survey will take approximately 10 minutes of your time and is voluntary therefore it is possible to leave the survey at any time. The answers to the survey are anonymous and will only be used for this research. If you are interested in the findings of this research you can email me, after which the findings will be sent to you when the Thesis is completed.

If you have questions or remarks about the survey you can contact a.b.van.uffelen@student.rug.nl

Again, thank you for your participation.

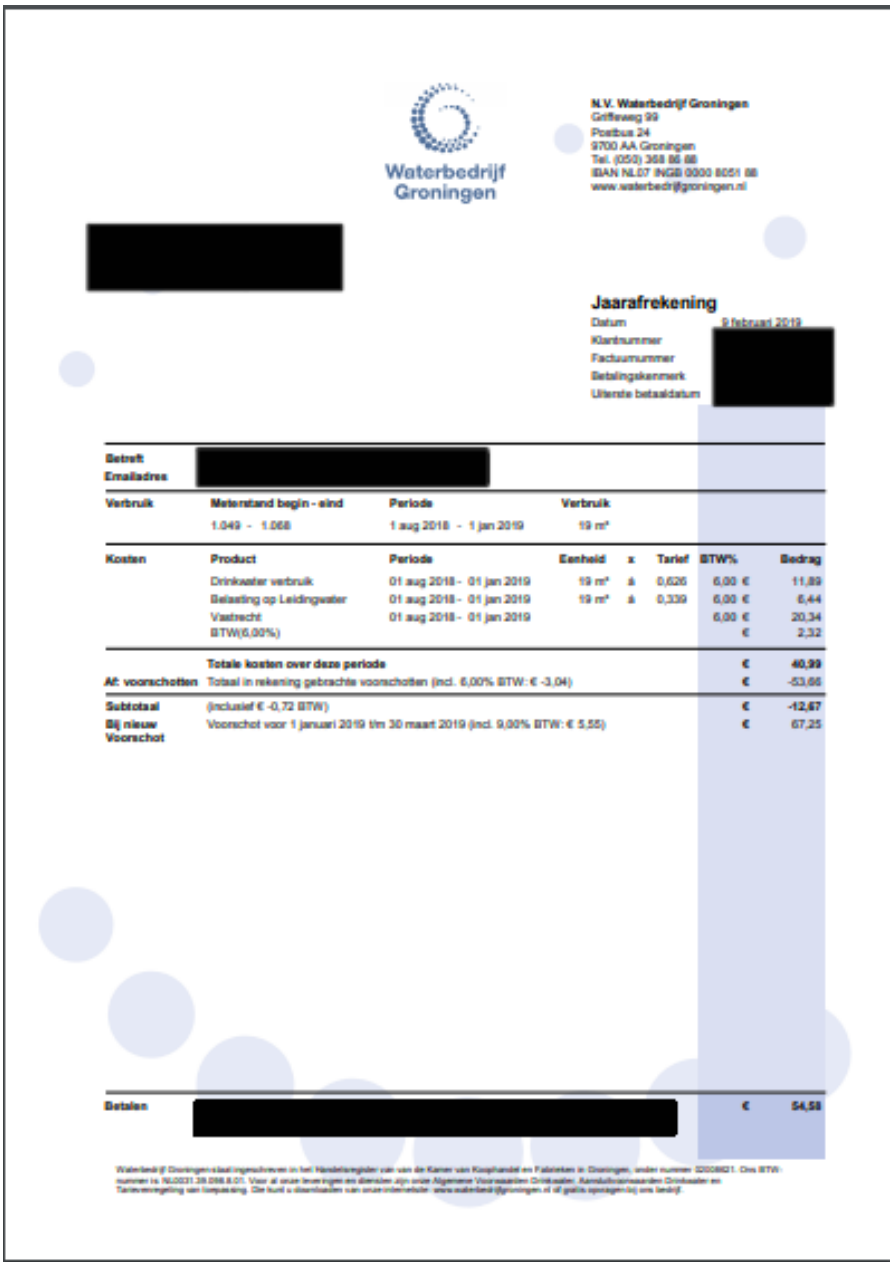
Kind regards,

Bregtje van Uffelen

1. Which neighbourhood do you live in? (MULTIPLE CHOICE)
    - Bloemenbuurt
    - De Wijert
    - Other (TO END OF SURVEY)

2. Are you the one that pays the water bill in your household? (Select "No" if you transfer money to someone who pays the water bill) (MULTIPLE CHOICE)
    - Yes
    - No (TO END OF SURVEY)

Every year after handing in your meter readings you receive the annual statement by Waterbedrijf Groningen, which shows your water use. In this annual statement, you can see how much water you have used calculated for the whole year, see the example [Omgerekend naar een heel jaar]. This annual statement is emailed to you and is on the site of Waterbedrijf Groningen if you log in for your water use (https://waterbedrijfgroningen.nl/klantenservice/verbruik-inzien/).



Waterbedrijf Groningen

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Griffeweg 99
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9700 AA Groningen
Tel. (050) 368 86 88
IBAN NL07 INGB 0000 8051 88
www.waterbedrijfgroningen.nl

[redacted]

Jaarafrekening

Datum	9 februari 2019
Klantnummer	[redacted]
Factuurnummer	
Betalingskenmerk	
Uiterste betaaldatum	

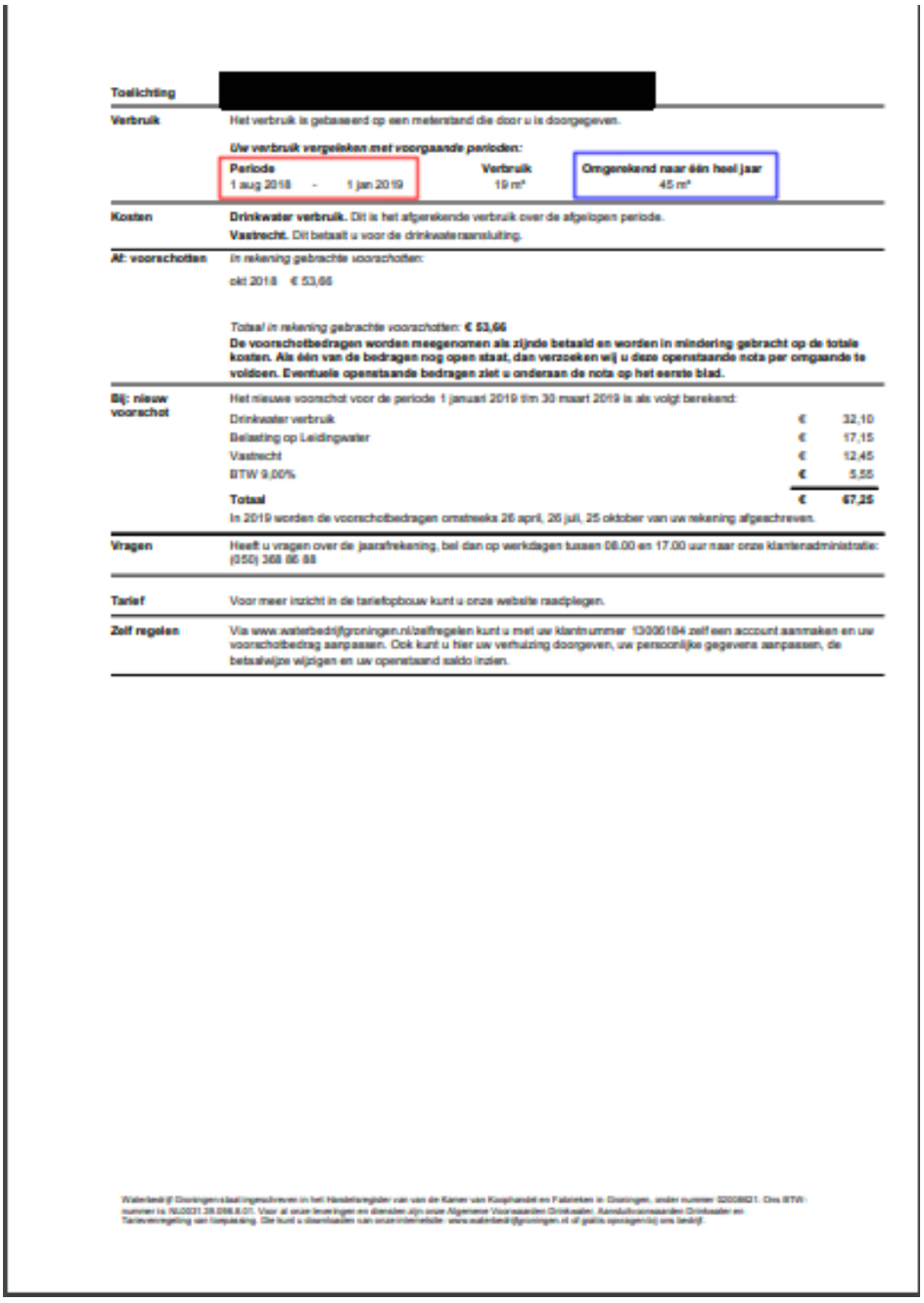
Betreft [redacted]
Emailadres

Verbruik	Meterstand begin - eind	Periode	Verbruik
	1.049 - 1.068	1 aug 2018 - 1 jan 2019	19 m³

Kosten	Product	Periode	Eenheid	x	Tarief	BTW%	Bedrag
	Drinkwater verbruik	01 aug 2018 - 01 jan 2019	19 m³	á	0,626	6,00 €	11,89
	Belasting op Leidingwater	01 aug 2018 - 01 jan 2019	19 m³	á	0,339	6,00 €	6,44
	Vastrecht	01 aug 2018 - 01 jan 2019				6,00 €	20,34
	BTW(6,00%)					€	2,32
	Totale kosten over deze periode					**€**	**40,99**
Af: voorschotten	Totaal in rekening gebrachte voorschotten (incl. 6,00% BTW: € -3,04)					**€**	-53,66
Subtotaal	(inclusief € -0,72 BTW)					**€**	**-12,67**
Bij nieuw Voorschot	Voorschot voor 1 januari 2019 t/m 30 maart 2019 (incl. 9,00% BTW: € 5,55)					**€**	67,25

Betalen [redacted] **€ 54,58**

Waterbedrijf Groningen staat ingeschreven in het Handelsregister van de Kamer van Koophandel en Fabrieken in Groningen, onder nummer 02036021. Ons BTW-nummer is NL0031.38.086.B.01. Voor al onze leveringen en diensten zijn onze Algemene Voorwaarden Drinkwater, Aansluitvoorwaarden Drinkwater en Tariefvereffening van toepassing. Die kunt u downloaden van onze internetsite: www.waterbedrijfgroningen.nl of gratis opvragen bij ons bedrijf.



Toelichting [redacted]

Verbruik Het verbruik is gebaseerd op een meterstand die door u is doorgegeven.

Uw verbruik vergeleken met voorgaande perioden:

Periode	Verbruik	Omgerekend naar één heel jaar
1 aug 2018 - 1 jan 2019	19 m³	45 m³

Kosten **Drinkwater verbruik.** Dit is het afgerekende verbruik over de afgelopen periode.
Vastrecht. Dit betaalt u voor de drinkwateraansluiting.

Af: voorschotten *In rekening gebrachte voorschotten:*

okt 2018 € 53,66

Totaal in rekening gebrachte voorschotten: **€ 53,66**
De voorschotbedragen worden meegenomen als zijnde betaald en worden in mindering gebracht op de totale kosten. Als één van de bedragen nog open staat, dan verzoeken wij u deze openstaande nota per omgaande te voldoen. Eventuele openstaande bedragen ziet u onderaan de nota op het eerste blad.

Bij: nieuw voorschot Het nieuwe voorschot voor de periode 1 januari 2019 t/m 30 maart 2019 is als volgt berekend:

Drinkwater verbruik	€	32,10
Belasting op Leidingwater	€	17,15
Vastrecht	€	12,45
BTW 9,00%	€	5,55
Totaal	**€**	**67,25**

In 2019 worden de voorschotbedragen omstreeks 26 april, 26 juli, 25 oktober van uw rekening afgeschreven.

Vragen Heeft u vragen over de jaarafrekening, bel dan op werkdagen tussen 08.00 en 17.00 uur naar onze klantenadministratie: (050) 368 86 88

Tarief Voor meer inzicht in de tariefopbouw kunt u onze website raadplegen.

Zelf regelen Via www.waterbedrijfgroningen.nl/zelfregelen kunt u met uw klantnummer 13/006184 zelf een account aanmaken en uw voorschotbedrag aanpassen. Ook kunt u hier uw verhuizing doorgeven, uw persoonlijke gegevens aanpassen, de betaalwijze wijzigen en uw openstaand saldo inzien.

Waterbedrijf Groningen is ingeschreven in het Handelsregister van de Kamer van Koophandel en Fabrieken in Groningen, onder nummer 02000821. Ons BTW-nummer is: NL0031.39.098.B.01. Voor al onze leveringen en diensten zijn onze Algemene Voorwaarden Drinkwater, Aansluitvoorwaarden Drinkwater en Tariefvereffening van toepassing. Die kunt u downloaden van onze internetsite: www.waterbedrijfgroningen.nl of gratis opvragen bij ons bedrijf.

3. How much water have you used "Omgerekend naar één heel jaar" according to the last annual statement you have received? (The place of this information is indicated with blue on the example)
   (OPEN ANSWER)

4. From when until when was the period it was measured for? (The place of this information is indicated in red in the example)
   (OPEN ANSWER)

5. What is your household size, including yourself? (MULTIPLE CHOICE)
   - 1
   - 2
   - 3

- 4
- 5
- 6
- Other (OPEN ANSWER)

6. How many women live in your household? (MULTIPLE CHOICE)
    - 0
    - 1
    - 2
    - 3
    - 4
    - 5
    - 6
    - Other (OPEN ANSWER)

7. How many people live in your household per age category? (*CAN ADD NUMBERS TO EACH CATEGORY*)

0 - 14-year-olds	(OPEN ANSWER)
15-24-year-olds	(OPEN ANSWER)
25- 44-year-olds	(OPEN ANSWER)
45- 64-year-olds	(OPEN ANSWER)
65-year-old or older	(OPEN ANSWER)
Total	(AUTOMATICALLY ADJUSTS)

8. Of how many people in your household have both parents and themselves been born in a western country? (MULTIPLE CHOICE)
    - 0
    - 1
    - 2
    - 3
    - 4
    - 5
    - 6
    - Other (OPEN ANSWER)
    - I do not want to say / I don't know

9. What is the monthly net income of your household? (MULTIPLE CHOICE)
    - €0-€2000
    - €2000-€4000
    - €4000-€6000
    - More than €6000
    - I do not want to answer this question

10. What is your highest reached diploma?
    - Basisonderwijs / vmbo-b/k / vmbo-g/t / avo onderbouw / mbo 1
    - Mbo 2 / mbo 3 / mbo 4 / havo / vwo / propedeuse hbo / propedeuse wo
    - Hbo / wo / postacademisch / doctoraat

11. Which housing typology do you live in? (MULTIPLE CHOICE)

- Flat
- Tenement house
- Row housing
- Semi-detached housing
- Detached housing
- Other (OPEN ANSWER)

12. What is the surface area of the house you live in in m^2?
    - (OPEN ANSWER)

13. How many bathrooms do you have in your house? (MULTIPLE CHOICE)
    - 1
    - 2
    - 3
    - 4
    - more than 4

14. Which type of toilet cistern do the toilets have in your house? (*CAN ADD NUMBERS TO EACH CATEGORY*)

Cistern high above the toilet	(OPEN ANSWER)
Cistern directly above the toilet	(OPEN ANSWER)
Build in cistern	(OPEN ANSWER)
Other	(OPEN ANSWER)
Total	(AUTOMATICALLY ADJUSTS)

15. Which water saving appliances do you have in your house? (MULTIPLE ANSWER)
    - Dual-flush toilet (*SHOW Q16*)
    - Compost toilet
    - Water saving shower head
    - Washing machine with economy button (*SHOW Q17*)
    - Rain barrel (*SHOW Q18*)
    - Other (OPEN ANSWER)

16. ONLY IF ANSWER TO Q15 = "Dual flush toilet": How often do you use the water saving option on your toilet? (MULTIPLE CHOICE)
    - Never
    - Once in a while
    - Often
    - Always

17. ONLY IF ANSWER TO Q15 = "Washing machine with economy button": How often do you use the economy button of your washing machine? (MULTIPLE CHOICE)
    - Never
    - Once in a while
    - Often
    - Always

18. ONLY IF ANSWER TO Q15 = "Rain barrel": What do you use the water from your rain barrel for? (MULTIPLE ANSWER)

- Watering the garden/ plants
- Flushing the toilet
- Watering pets
- Washing the car
- Washing the windows
- Other (OPEN ANSWER)

19. Select what is present in your household (MULTIPLE ANSWER)
    - A garden (*SHOW Q20 – Q24*)
    - One or more cars (*SHOW Q25*)
    - A bathtub (*SHOW Q26*)
    - A dishwasher (*SHOW Q27*)
    - An (inflatable) swimming pool

20. ONLY IF ANSWER TO Q19 = "A garden": What is the surface area of your garden in m^2? (MULTIPLE CHOICE)
    - 0-20 m^2
    - 21-40 m^2
    - 41-60 m^2
    - 61-80 m^2
    - More than 80 m^2

21. ONLY IF ANSWER TO Q19 = "A garden": Which of the following options best describes your garden? (MULTIPLE CHOICE)
    - Mainly paved
    - Mainly grass
    - Mainly plants
    - Half paved, half plants
    - Half paved, half grass
    - Half plants, half grass

22. ONLY IF ANSWER TO Q19 = "A garden": How do you water your garden? (MULTIPLE CHOICE)
    - I never water my garden (*SKIP Q23 – Q24*)
    - Manually, with a bucket or a watering can
    - Sprinklers
    - A hose
    - Drip irrigation
    - Other (OPEN ANSWER)

23. ONLY IF ANSWER TO Q19 = "A garden" AND ANSWER TO Q22 IS NOT "I never water my garden" : How often is your garden watered in the winter? (MULTIPLE CHOICE)
    - Never
    - Weekly
    - Several times a week
    - I do not know

24. ONLY IF ANSWER TO Q19 = "A garden" AND ANSWER TO Q22 IS NOT "I never water my garden: How often is your garden watered in summer? (MULTIPLE CHOICE)

- Never
- Weekly
- Several times a week
- I do not know

25. ONLY IF ANSWER TO Q19 = “One or more cars”: How often do you wash your car? (MULTIPLE CHOICE)
    - Never
    - Monthly
    - Weekly
    - Several times a week

26. ONLY IF ANSWER TO Q19 = “A bathtub”: How often is the bath used in your home? (MULTIPLE CHOICE)
    - Never
    - Monthly
    - Weekly
    - Several times a week
    - Every day
    - I do not know

27. ONLY IF ANSWER TO Q19 = “A dishwasher”: How often is the dishwasher used in your home? (MULTIPLE CHOICE)
    - Never
    - Monthly
    - Weekly
    - Several times a week
    - Every day
    - I do not know

END OF SURVEY MESSAGE
Bedankt voor het invullen van de enquête! Voor vragen of opmerkingen over de enquête kunt u mailen naar a.b.van.uffelen@student.rug.nl

Thank you for filling in the survey! For questions or remarks about the survey you can email a.b.van.uffelen@student.rug.nl

APPENDIX 2.2 - DATA COLLECTION INSTRUMENT IN DUTCH

Allereerst bedankt voor uw deelname aan dit onderzoek. Ik ben een student Spatial Planning and Design aan de Rijksuniversiteit Groningen en dit onderzoek is voor mijn Bachelor Thesis / Scriptie. Het onderzoek gaat over welke huiseigenschappen invloed hebben op het huishoudelijk waterverbruik. Hiervoor worden twee buurten onderzocht en vergeleken, de Bloemenbuurt en de Wijert. Daarom ben ik op zoek naar bewoners van deze buurten die de waterrekening betalen en deze enquête in willen vullen.

De enquête vraagt ongeveer 10 minuten van uw tijd en is vrijwillig dus op elk moment is het mogelijk om met de enquête te stoppen. De antwoorden van de enquête zijn anoniem en zullen alleen gebruikt worden voor dit onderzoek. Mocht u interesse hebben in de uitkomsten van het onderzoek is het mogelijk om mij te mailen dat u de uitkomsten zou willen ontvangen als de scriptie af is.

Mocht u vragen of opmerkingen hebben over de enquête kunt u contact opnemen via a.b.van.uffelen@student.rug.nl

Nogmaals bedankt voor uw deelname aan het onderzoek.

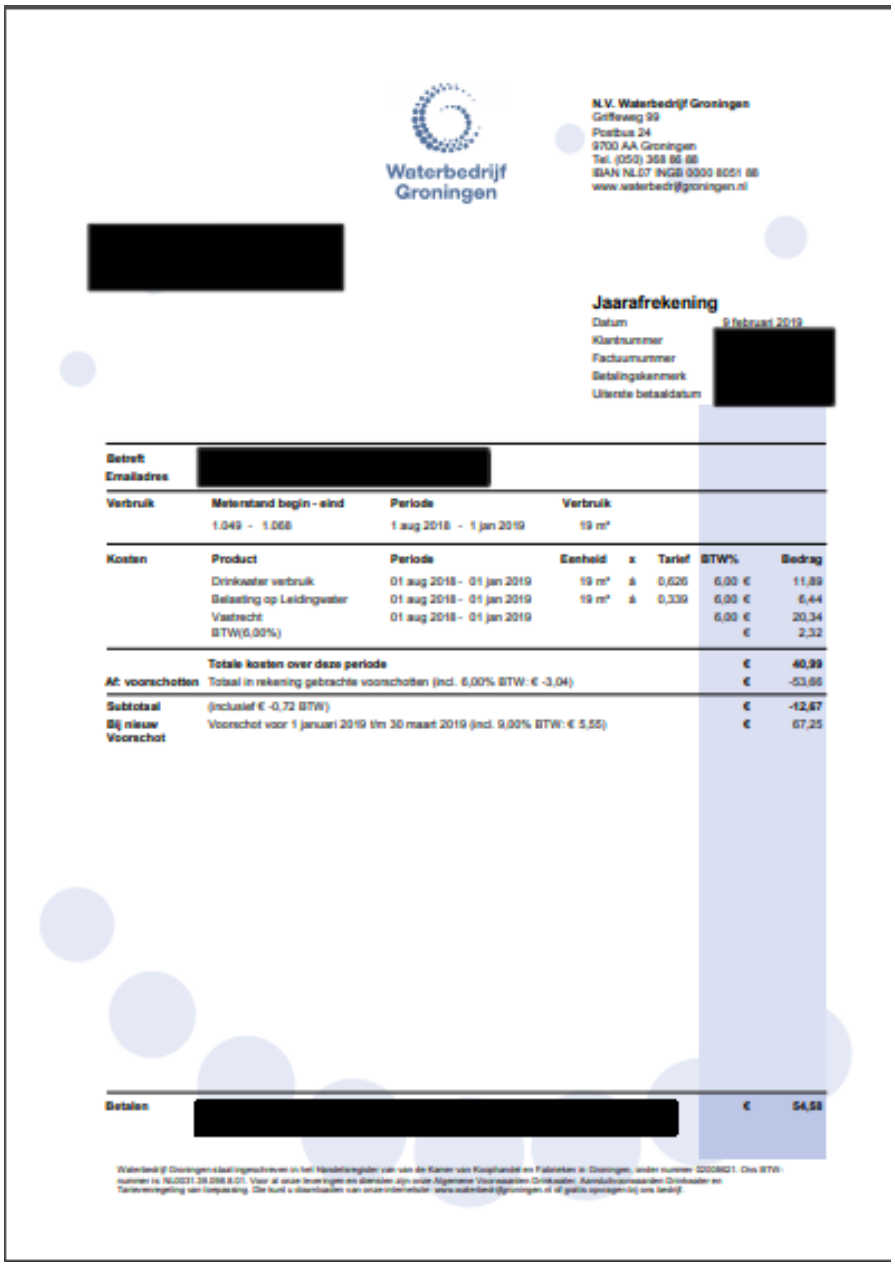
Met vriendelijke groet,

Bregtje van Uffelen

1. In welke buurt woont u in? (MULTIPLE CHOICE)
    - Bloemenbuurt
    - De Wijert
    - Anders (TO END OF SURVEY)

2. Bent u degene die de weterrekening betaald in uw huishouden? (selecteer “Nee” als u geld overmaakt naar iemand die de rekening betaald) (MULTIPLE CHOICE)
    - Ja
    - Nee (TO END OF SURVEY)

    Elk jaar krijgt u een jaarafrekening van uw waterverbruik van het Waterbedrijf Groningen nadat u uw meterstanden door heeft gegeven. In de jaarafrekening staat hoeveel water u omgerekend naar een heel jaar verbruikt, zie ook het voorbeeld. Deze jaarafrekening wordt altijd gemaild naar u en staat ook op de site van Waterbedrijf Groningen als u inlogt voor uw waterverbruik (https://waterbedrijfgroningen.nl/klantenservice/verbruik-inzien/).



Waterbedrijf Groningen

N.V. Waterbedrijf Groningen
Griffeweg 99
Postbus 24
9700 AA Groningen
Tel. (050) 368 86 88
IBAN NL07 INGB 0000 8051 88
www.waterbedrijfgroningen.nl

[redacted]

Jaarafrekening

Datum	9 februari 2019
Klantnummer	[redacted]
Factuurnummer	
Betalingskenmerk	
Uiterste betaaldatum	

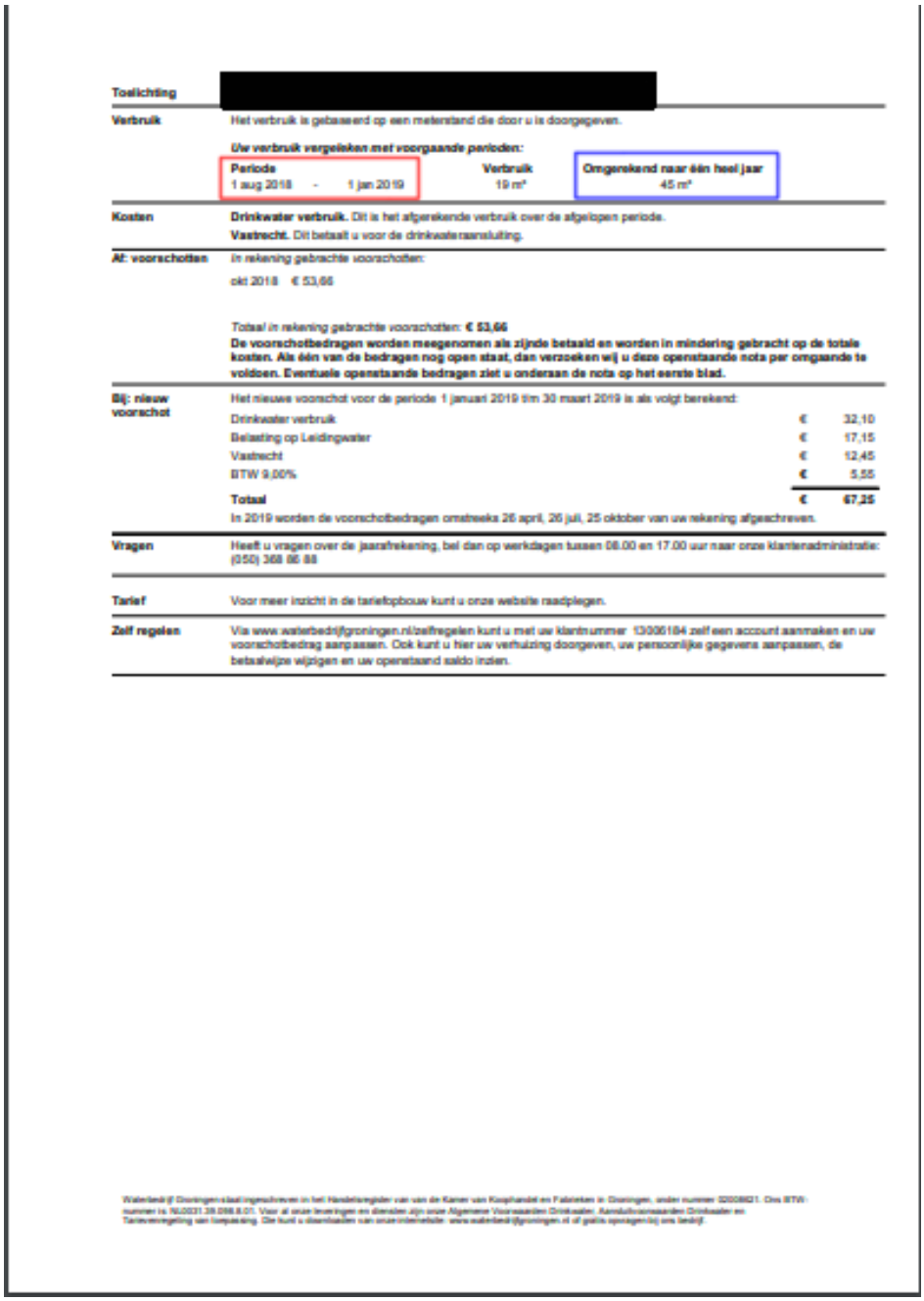
Betreft [redacted]
Emailadres

Verbruik	Meterstand begin - eind	Periode	Verbruik
	1.049 - 1.068	1 aug 2018 - 1 jan 2019	19 m³

Kosten	Product	Periode	Eenheid	x	Tarief	BTW%	Bedrag
	Drinkwater verbruik	01 aug 2018 - 01 jan 2019	19 m³	á	0,626	6,00 €	11,89
	Belasting op Leidingwater	01 aug 2018 - 01 jan 2019	19 m³	á	0,339	6,00 €	6,44
	Vastrecht	01 aug 2018 - 01 jan 2019				6,00 €	20,34
	BTW(6,00%)					€	2,32
	Totale kosten over deze periode					**€**	**40,99**
Af: voorschotten	Totaal in rekening gebrachte voorschotten (incl. 6,00% BTW: € -3,04)					**€**	-53,66
Subtotaal	(inclusief € -0,72 BTW)					**€**	**-12,67**
Bij nieuw Voorschot	Voorschot voor 1 januari 2019 t/m 30 maart 2019 (incl. 9,00% BTW: € 5,55)					**€**	67,25

Betalen [redacted] **€ 54,58**

Waterbedrijf Groningen staat ingeschreven in het Handelsregister van van de Kamer van Koophandel en Fabrieken in Groningen, onder nummer 02009821. Ons BTW-nummer is NL0031.39.098.B.01. Voor al onze leveringen en diensten zijn onze Algemene Voorwaarden Drinkwater, Aansluitvoorwaarden Drinkwater en Tariefvereffening van toepassing. Die kunt u downloaden van onze internetsite: www.waterbedrijfgroningen.nl of gratis opvragen bij ons bedrijf.



Toelichting [redacted]

Verbruik Het verbruik is gebaseerd op een meterstand die door u is doorgegeven.

Uw verbruik vergeleken met voorgaande perioden:

Periode	Verbruik	Omgerekend naar één heel jaar
1 aug 2018 - 1 jan 2019	19 m³	45 m³

Kosten **Drinkwater verbruik.** Dit is het afgerekende verbruik over de afgelopen periode.
Vastrecht. Dit betaalt u voor de drinkwateraansluiting.

Af: voorschotten *In rekening gebrachte voorschotten:*

okt 2018 € 53,66

Totaal in rekening gebrachte voorschotten: **€ 53,66**
De voorschotbedragen worden meegenomen als zijnde betaald en worden in mindering gebracht op de totale kosten. Als één van de bedragen nog open staat, dan verzoeken wij u deze openstaande nota per omgaande te voldoen. Eventuele openstaande bedragen ziet u onderaan de nota op het eerste blad.

Bij: nieuw voorschot Het nieuwe voorschot voor de periode 1 januari 2019 t/m 30 maart 2019 is als volgt berekend:

Drinkwater verbruik	€	32,10
Belasting op Leidingwater	€	17,15
Vastrecht	€	12,45
BTW 9,00%	€	5,55
Totaal	**€**	**67,25**

In 2019 worden de voorschotbedragen ongeveer 26 april, 26 juli, 25 oktober van uw rekening afgeschreven.

Vragen Heeft u vragen over de jaarafrekening, bel dan op werkdagen tussen 08.00 en 17.00 uur naar onze klantenadministratie: (050) 368 88 88

Tarief Voor meer inzicht in de tariefopbouw kunt u onze website raadplegen.

Zelf regelen Via www.waterbedrijfgroningen.nl/zelfregelen kunt u met uw klantnummer 13/306184 zelf een account aanmaken en uw voorschotbedrag aanpassen. Ook kunt u hier uw verhuizing doorgeven, uw persoonlijke gegevens aanpassen, de betaalwijze wijzigen en uw openstaand saldo inzien.

Waterbedrijf Groningen staat ingeschreven in het Handelsregister van van de Kamer van Koophandel en Fabrieken in Groningen, onder nummer 02008021. Ons BTW-nummer is NL0031.39.098.B.01. Voor al onze leveringen en diensten zijn onze Algemene Voorwaarden Drinkwater, Aansluitvoorwaarden Drinkwater en Tarievenregeling van toepassing. Die kunt u downloaden van onze internetsite: www.waterbedrijfgroningen.nl of gratis opvragen bij ons bedrijf.

3. Hoeveel water heeft u "Omgerekend naar één heel jaar" verbruikt volgens de laatste jaarafrekening die u heeft ontvangen? (Blauw omlijnt in het voorbeeld)
(OPEN ANSWER)

4. Van wanneer tot wanneer liep de periode? (Rood omlijnt in het voorbeeld)
(OPEN ANSWER)

5. Uit hoeveel mensen bestaat uw huishouden, uzelf meegerekend? (MULTIPLE CHOICE)
   - 1
   - 2
   - 3
   - 4
   - 5

- 6
- Anders namelijk (OPEN ANSWER)

6. Hoeveel vrouwen wonen in uw huishouden? (MULTIPLE CHOICE)
   - 0
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - Anders namelijk (OPEN ANSWER)

7. Hoeveel mensen van elke leeftijdscategorie wonen in uw huishouden? (ratio, people can write how many per category)

0 - 14 jaar	(OPEN ANSWER)
15-24 jaar	(OPEN ANSWER)
25- 44 jaar	(OPEN ANSWER)
45- 64 jaar	(OPEN ANSWER)
65 jaar of ouder	(OPEN ANSWER)
Total	(AUTOMATICALLY ADJUSTS)

8. Van hoeveel mensen uit uw huishouden zijn beide ouders en zijzelf in een westelijk land geboren? (MULTIPLE CHOICE)
   - 0
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - Anders namelijk (OPEN ANSWER)
   - Wil ik niet zeggen / Weet ik niet

9. Wat is het maandelijks netto-inkomen van uw huishouden? (MULTIPLE CHOICE)
   - 0-2000
   - 2000-4000
   - 4000-6000
   - Meer dan 6000
   - Wil ik niet zeggen

10. Wat is uw hoogst behaalde diploma? (MULTIPLE CHOICE)
    - Basisonderwijs / vmbo-b/k / vmbo-g/t / avo onderbouw / mbo 1
    - Mbo 2 / mbo 3 / mbo 4 / havo / vwo / propedeuse hbo / propedeuse wo
    - Hbo / wo / postacademisch / doctoraat

11. In wat voor type huis woont u in? (MULTIPLE CHOICE)
    - Flat

- Portiekwoning
- Rijtjeshuis
- Half vrijstaand huis
- Vrijstaand huis
- Anders namelijk (OPEN ANSWER)

12. Wat is het oppervlakte van het huis waarin u woont in m^2?
    (OPEN ANSWER)

13. Hoeveel badkamers heeft u in uw huis? (MULTIPLE CHOICE)
    - 1
    - 2
    - 3
    - 4
    - Meer dan 4

14. Welk type stortbak hebben de WC's in uw huis? (can add a number to the amount they have of each)

Stortbak hoog in de wc	(OPEN ANSWER)
Stortbak direct boven de wc	(OPEN ANSWER)
Ingebouwde stortbak	(OPEN ANSWER)
Anders	(OPEN ANSWER)
Total	(AUTOMATICALLY ADJUSTS)

15. Welke van de volgende waterbesparende apparaten heeft u? (MULTIPLE ANSWER)
    - Toilet met waterbesparende knop (*SHOW Q16*)
    - Composttoilet
    - Waterbesparende douchekop
    - Wasmachine met spaarstand *(SHOW Q17)*
    - Regenton *(SHOW Q18)*
    - Anders namelijk (OPEN ANSWER)

16. ONLY IF ANSWER TO Q15 = "toilet met waterbesparende knop": Hoe vaak gebruikt u de waterbesparende knop van het toilet? (MULTIPLE CHOICE)
    - Nooit
    - Af en toe
    - Vaak
    - Altijd

17. ONLY IF ANSWER TO Q15 = "Wasmachine met spaarstand": Hoe vaak gebruikt u de spaarstand van uw wasmachine? (MULTIPLE CHOICE)
    - Nooit
    - Af en toe
    - Vaak
    - Altijd

18. ONLY IF ANSWER TO Q15 = "Regenton": Waar gebruikt u uw regenton voor? (MULTIPLE ANSWER)
    - Planten/ tuin water geven

- Wc doorspoelen
- Huisdieren water geven
- Auto wassen
- Ramen wassen
- Anders namelijk (OPEN ANSWER)

19. Selecteer wat er aanwezig is in uw huishouden (MULTIPLE ANSWER)
    - Een tuin *(SHOW Q20 – Q24)*
    - Eén of meerdere auto's (S*HOW Q25*)
    - Een bad (*SHOW Q26*)
    - Een vaatwasser (*SHOW Q27*)
    - Een (opblaasbaar) zwembad

20. ONLY IF ANSWER TO Q19 = "Een tuin": Hoe groot is uw tuin in m^2? (MULTIPLE CHOICE)
    - 0-20 m^2
    - 21-40 m^2
    - 41-60 m^2
    - 61-80 m^2
    - Meer dan 80 m^2

21. ONLY IF ANSWER TO Q19 = "Een tuin": Welke van de volgende opties beschrijft uw tuin het beste? (MULTIPLE CHOICE)
    - Voornamelijk betegeld
    - Voornamelijk gras
    - Voornamelijk planten
    - Half betegeld, half planten
    - Half gras, half betegeld
    - Half planten, half gras

22. ONLY IF ANSWER TO Q19 = "Een tuin": Hoe geeft u uw tuin water? (MULTIPLE ANSWER)
    - Ik geef mijn tuin nooit water (DO NOT SHOW Q23, Q24)
    - Handmatig met de gieter of een emmer
    - Sproeiers
    - Een tuinslang
    - Druppelirrigatie
    - Anders namelijk (OPEN ANSWER)

23. ONLY IF ANSWER TO Q19 = "Een tuin" AND ANSWER TO Q22 IS NOT "Ik geef mijn tuin nooit water": Hoe vaak besproeit u uw tuin in de zomer? (MULTIPLE CHOICE)
    - Nooit
    - Wekelijks
    - Meerdere keren per week
    - Weet ik niet

24. ONLY IF ANSWER TO Q19 = "Een tuin" AND ANSWER TO Q22 IS NOT "Ik geef mijn tuin nooit water: Hoe vaak besproeit u uw tuin in de winter? (MULTIPLE CHOICE)
    - Nooit
    - Wekelijks
    - Meerdere keren per week

- Weet ik niet

25. ONLY IF ANSWER TO Q19 = “Eén of meerdere auto’s”: Hoe vaak wast u uw auto? (MULTIPLE CHOICE)
    - Nooit
    - Maandelijks
    - Wekelijks
    - Meerder keren per week

26. ONLY IF ANSWER TO Q19 = “Een bad”: Hoe vaak wordt het bad gebruikt in uw huis? (MULTIPLE CHOICE)
    - Nooit
    - Maandelijks
    - Wekelijks
    - Meerdere keren per week
    - Elke dag
    - Weet ik niet

27. ONLY IF ANSWER TO Q19 = “Een vaatwasser”: Hoe vaak wordt de vaatwasser gebruikt in uw huis? (MULTIPLE CHOICE)
    - Nooit
    - Maandelijks
    - Wekelijks
    - Meerdere keren per week
    - Elke dag
    - Weet ik niet

END OF SURVEY MESSAGE
Bedankt voor het invullen van de enquête! Voor vragen of opmerkingen over de enquête kunt u mailen naar a.b.van.uffelen@student.rug.nl

Thank you for filling in the survey! For questions or remarks about the survey you can email a.b.van.uffelen@student.rug.nl

APPENDIX 3 - FLYER FOR SURVEY DISTRIBUTION

Geachte heer of mevrouw,

Bent u bewoner van de Wijert en bent u degene die de waterrekening betaalt in uw huishouden? Dan ben ik naar u op zoek!
Voor mijn bachelor scriptie ben ik onderzoek aan het doen naar welke huiseigenschappen invloed hebben op het huishoudelijk waterverbruik. Om mijn vraag te beantwoorden heb ik uw hulp nodig, ik heb namelijk data nodig over het waterverbruik in uw buurt en daar is geen publieke data over. Zou u zo vriendelijke willen zijn om mijn enquête in te vullen?
Het zal maximaal 10 minuten duren.

De enquête is op twee manieren te vinden:
Optie 1: Ga naar de volgende site: tiny.cc/waterverbruik_huis

Optie 2: Als u een smartphone of tablet heeft kunt u de QR-code scannen rechts op de pagina. Dit doet u door op uw smartphone uw camera te pakken en te richten op de QR-code. Dan wordt u vanzelf geleid naar de enquête.

Voor vragen kunt u contact met mij opnemen via
a.b.van.uffelen@student.rug.nl

Ben u niet degene die de waterrekening betaald in uw huishouden maar wilt u toch helpen? Zou u dan deze enquête door willen sturen naar degene die wel de waterrekening betaald in uw huishouden?

Geachte heer of mevrouw,

Bent u bewoner van de Wijert en bent u degene die de waterrekening betaalt in uw huishouden? Dan ben ik naar u op zoek!
Voor mijn bachelor scriptie ben ik onderzoek aan het doen naar welke huiseigenschappen invloed hebben op het huishoudelijk waterverbruik. Om mijn vraag te beantwoorden heb ik uw hulp nodig, ik heb namelijk data nodig over het waterverbruik in uw buurt en daar is geen publieke data over. Zou u zo vriendelijke willen zijn om mijn enquête in te vullen?
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Voor vragen kunt u contact met mij opnemen via
a.b.van.uffelen@student.rug.nl

Ben u niet degene die de waterrekening betaald in uw huishouden maar wilt u toch helpen? Zou u dan deze enquête door willen sturen naar degene die wel de waterrekening betaald in uw huishouden?

Dear Madam or Sir,

Are you a resident of the de Wijert and do you pay the water bill in your household? Than I am looking for you!

For my Bachelor Thesis, I am conducting research into which dwelling characteristics influence domestic water use. To answer my question I need your help, I need data about water usage in your neighbourhood and there is no public data for this. Would you be so kind to fill in my survey? I will take a maximum of 10 minutes of your time.

The survey can be found in two ways:
Option 1: Go to the following website: tiny.cc/waterverbruik_huis

Option 2: If you own a smartphone or tablet you can use the QR-code on the right side of the page. If you aim the camera of your smartphone or tablet to the QR-code you will be redirected to the survey.

If you have questions about the survey you can contact me via a.b.van.uffelen@student.rug.nl

Are you not the person paying the water bill in your household but do you still want to help? Could you send this survey through to the person paying the water bill in your household?

Dear Madam or Sir,

Are you a resident of the de Wijert and do you pay the water bill in your household? Than I am looking for you!

For my Bachelor Thesis, I am conducting research into which dwelling characteristics influence domestic water use. To answer my question I need your help, I need data about water usage in your neighbourhood and there is no public data for this. Would you be so kind to fill in my survey? I will take a maximum of 10 minutes of your time.

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If you have questions about the survey you can contact me via a.b.van.uffelen@student.rug.nl

Are you not the person paying the water bill in your household but do you still want to help? Could you send this survey through to the person paying the water bill in your household?

Geachte heer of mevrouw,

Bent u bewoner van de Bloemenbuurt en bent u degene die de waterrekening betaalt in uw huishouden? Dan ben ik naar u op zoek!
Voor mijn bachelor scriptie ben ik onderzoek aan het doen naar welke huiseigenschappen invloed hebben op het huishoudelijk waterverbruik. Om mijn vraag te beantwoorden heb ik uw hulp nodig, ik heb namelijk data nodig over het waterverbruik in uw buurt en daar is geen publieke data over. Zou u zo vriendelijke willen zijn om mijn enquête in te vullen?
Het zal maximaal 10 minuten duren.

De enquête is op twee manieren te vinden:
Optie 1: Ga naar de volgende site: tiny.cc/waterverbruik_huis

Optie 2: Als u een smartphone of tablet heeft kunt u de QR-code scannen rechts op de pagina. Dit doet u door op uw smartphone uw camera te pakken en te richten op de QR-code. Dan wordt u vanzelf geleid naar de enquête.

Voor vragen kunt u contact met mij opnemen via
a.b.van.uffelen@student.rug.nl

Ben u niet degene die de waterrekening betaald in uw huishouden maar wilt u toch helpen? Zou u dan deze enquête door willen sturen naar degene die wel de waterrekening betaald in uw huishouden?

Geachte heer of mevrouw,

Bent u bewoner van de Bloemenbuurt en bent u degene die de waterrekening betaalt in uw huishouden? Dan ben ik naar u op zoek!
Voor mijn bachelor scriptie ben ik onderzoek aan het doen naar welke huiseigenschappen invloed hebben op het huishoudelijk waterverbruik. Om mijn vraag te beantwoorden heb ik uw hulp nodig, ik heb namelijk data nodig over het waterverbruik in uw buurt en daar is geen publieke data over. Zou u zo vriendelijke willen zijn om mijn enquête in te vullen?
Het zal maximaal 10 minuten duren.

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Voor vragen kunt u contact met mij opnemen via
a.b.van.uffelen@student.rug.nl

Ben u niet degene die de waterrekening betaald in uw huishouden maar wilt u toch helpen? Zou u dan deze enquête door willen sturen naar degene die wel de waterrekening betaald in uw huishouden?

Dear Madam or Sir,

Are you a resident of the Bloemenbuurt and do you pay the water bill in your household? Than I am looking for you!

For my Bachelor Thesis, I am conducting research into which dwelling characteristics influence domestic water use. To answer my question I need your help, I need data about water usage in your neighbourhood and there is no public data for this. Would you be so kind to fill in my survey? I will take a maximum of 10 minutes of your time.

The survey can be found in two ways:
Option 1: Go to the following website: tiny.cc/waterverbruik_huis

Option 2: If you own a smartphone or tablet you can use the QR-code on the right side of the page. If you aim the camera of your smartphone or tablet to the QR-code you will be redirected to the survey.

If you have questions about the survey you can contact me via a.b.van.uffelen@student.rug.nl

Are you not the person paying the water bill in your household but do you still want to help? Could you send this survey through to the person paying the water bill in your household?

Dear Madam or Sir,

Are you a resident of the Bloemenbuurt and do you pay the water bill in your household? Than I am looking for you!

For my Bachelor Thesis, I am conducting research into which dwelling characteristics influence domestic water use. To answer my question I need your help, I need data about water usage in your neighbourhood and there is no public data for this. Would you be so kind to fill in my survey? I will take a maximum of 10 minutes of your time.

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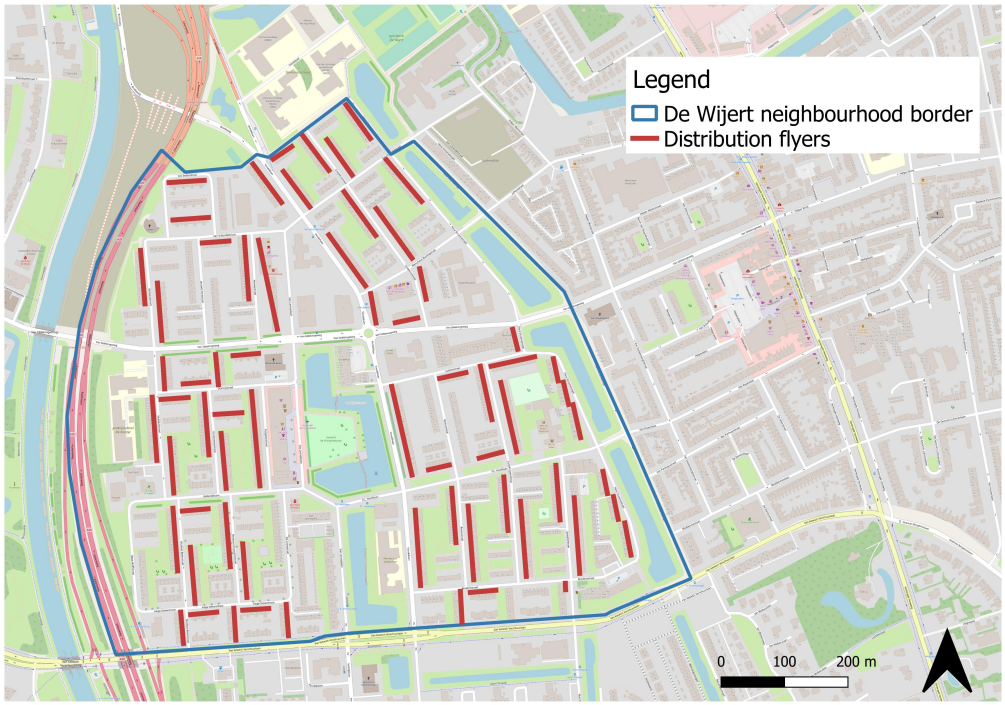
If you have questions about the survey you can contact me via a.b.van.uffelen@student.rug.nl

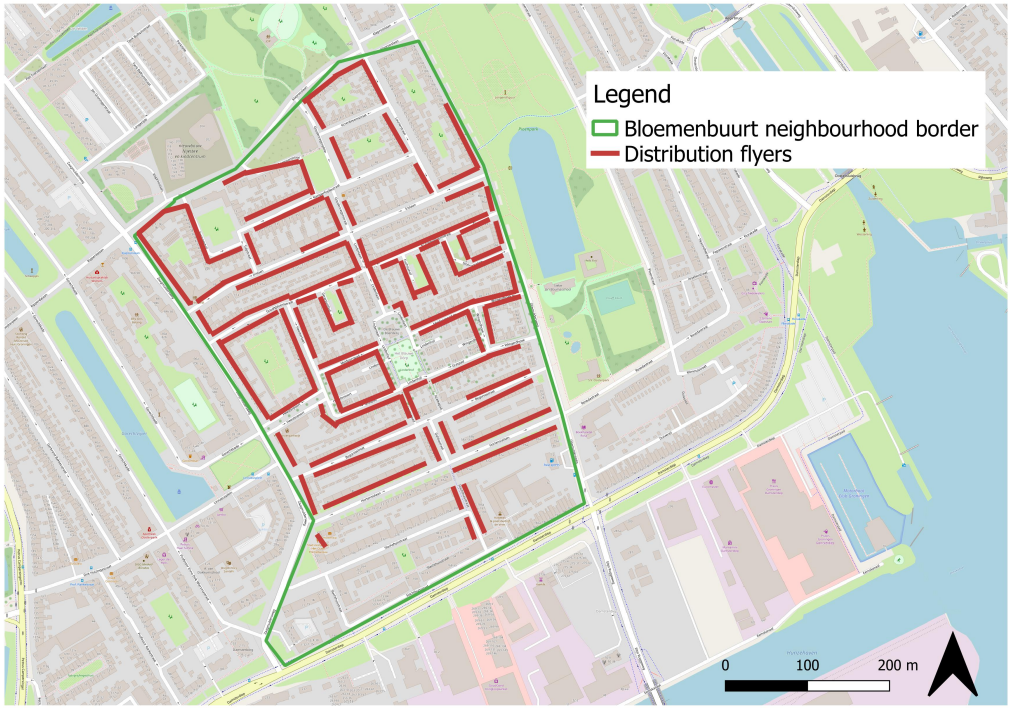
Are you not the person paying the water bill in your household but do you still want to help? Could you send this survey through to the person paying the water bill in your household?

APPENDIX 4 - FLYER DISTRIBUTION

Dates: 4, 17, 18, 20, 23 November 2020. 2 December 2020
Total amount: 2400
Location: De Wijert (See map)



Dates: 5, 18 November 2020. 4, 5, 13 December 2020.
Total amount: 1200
Location: Bloemenbuurt (See map)



APPENDIX 5 - CLASSIFICATION SYSTEM (IN)CORRECT DATA

Classified as correct data:

1-1-2019 - 1-1-2020
1-1-2019 - 31-12-2019
[date within 2019] - 1-1-2020
[date within 2019] - 31-12-2019
1-1-2018 - 1-1-2019

Classified as incorrect data:

Sept-sept [NO YEAR AND WRONG END DATE]
Okt-okt [NO YEAR AND WRONG END DATE]
Maart tot maart [NO YEAR AND WRONG END DATE]
1 jan 1 jan [NO YEAR]
2019-2020 [NO DATE]
11-12-19 tot 13-12-19 [WRONG END DATE]
1 jan 20202 t/m 21 april 2020 [WRONG END DATE]
1 Jan 2020 [NO START DATE]
31 December 2019 [NO START DATE]

APPENDIX 6 - UNUSED RESPONSES

Reason	Response ID	Total number
Own tries	1. R_20MsaBRBXLKtS1Q 2. R_3O0b8dpApqamEAF 3. R_28BUrBWcKxV3Qia 4. R_21tBRyvGhTWnNYe	4
Missing data for the question on water consumption (Q3)	1. R_271Xlcprrj4maVr 2. R_2b0MJ0PPCS3LfnD 3. R_V596t1lu5LYEWjf 4. R_1q8nApqjC9sPxHf 5. R_1OP7PP6Ao219Aol 6. R_3q7jx85BOQljm3m 7. R_2EvkX46r8aZjYOD 8. R_2R4T7reieeenN47 9. R_3nA6qnSJB738db5 10. R_vxeTWrzWAYYVcbv 11. R_pz0Xtga0CDrmMcF 12. R_UmftxT5f9oWkySl 13. R_2X6RMLWM0VKFdan 14. R_2qfVi9DrFrnYyAf 15. R_1DBv5Ig16aVJscV 16. R_22yHi1lw6FVzV2o 17. R_u2KaGSAjMkklpXH 18. R_1fiSKuWVTvPr84B 19. R_pcq9lpuhPeCA9Y5 20. R_3DnmIoDlnA3HXn8 21. R_2BlMHeninrXGvu1 22. R_pQWPPgfdFyg66VX 23. R_3j2o1DPiDIYCsUt 24. R_2EcbpmithWiYN65 25. R_1l3RmXgaCfSZBxh 26. R_27r3E6Je58XP9bG 27. R_SB6M2XSoolRqJod 28. R_1j7X12ayyjhEt98 29. R_3nUdXcUgG4uXTVq 30. R_2YgnAYQFVonlDQw 31. R_w6FQ0SZl5cwNQZz 32. R_2uxR9oOfXtvooLp 33. R_1Qcnvdt28Qw9NqN 34. R_28YfAAEPh1Wh3Zg 35. R_1jqTmBHQ9183AnS 36. R_1GUjZweP4Zy1Kfi 37. R_2sXgBJeqhHLhDIa 38. R_3fVtQJqR80mAQoK 39. R_7R4qstxrg7iI3RL 40. R_WptG0dWmBcDgdPP 41. R_3HG1lUKL77rAJ2Y	65

	42. R_1NDFUuHjqFjK3eP 43. R_27e7sipAeTbstv7 44. R_1EiKfFfT4grcV43 45. R_3hACv3ww0em3wbT 46. R_2rr8Dvl4VTP2fNl 47. R_vuCpoAybrRv1U09 48. R_1E4NOSObKOK4tBU 49. R_0jltFXxWc7tSc01 50. R_2tFk1qJiK4dQcEa 51. R_1OGMVwj8kY2AjaZ 52. R_3sbpHgnpMhEGtRv 53. R_1kT61g150yowS0e 54. R_10SNrW3S3e13Abu 55. R_3QEKWDfBpF33l7C 56. R_2CJsjDcJvUj98Qt 57. R_1Lv3adO8jCfM3nW 58. R_3CDuegWLB1zjqJJ 59. R_3PZjy1eS1SyoZEu 60. R_swbpNxLBC4xD6VP 61. R_2zkL2tEqXoH6pl9 62. R_25HJbWDrMGC5XjV 63. R_2R3KG9OUWsCSOOH 64. R_1ozozkwOdphzHCq 65. R_sNnyVxDE9Kg4XFT	
Seemingly incorrect data	1. R_20Msl5HXWulOsko 2. R_2CdeAet17mZPgwR 3. R_1GI9hnI5oVdCTWd 4. R_DSQX5foafybq8ZH 5. R_3gXfLZzJNDbOO7o 6. R_cOqKdGTcqgDx7H3 7. R_272VuPay5tWgYFK 8. R_1op7ol3H11wgN34 9. R_3qTAOB1hrxmSBic 10. R_31BeYLqFU23yGKb 11. R_3I0l71nEcbHayLj 12. R_2PySckUXXUU69UV 13. R_29bIjoHESABNpu1 14. R_33sF76kdCwoTJSe 15. R_3ikZl1qHjY5vB9M 16. R_3HG59k9fyWjRrmi	16
		85

APPENDIX 7 - TRANSFORMATION OF THE VARIABLES

Variable.	Reason it was recoded.	What was done.
Background	Now had people born in western country, while we needed people born in non-western country.	Accounting for I do not wish to answer Recode into different variables> Variable 9 = missing system Variable 8 = missing system Missing system =missing system All other value(s) = copy old values Accounting for 0 as the first variable Compute variable> (Newly computed) Background - 1 From western background to non-western background Compute variable> Household Size – (newly computed) Background
Cistern type	Categorical variable needs to become binary Multiple linear regression	Insert variable Manually entering the type of cistern Making it binary Recode into different variables> 4 (other) = missing systems 5 (two types) = missing systems Variable x =1 All other value(s) =0

Education level	Categorical variable needs to become binary for Multiple linear regression	Recode into different variables> Variable x =1 All other value(s) =0
Garden size (surface area of garden)	Categorical variable needs to become binary for Multiple linear regression	Recode into different variables> Systems missing = systems missing Variable x =1 Else=0
Garden vegetation	Categorical variable needs to become binary for Multiple linear regression	Recode into different variables> Systems missing = systems missing Variable x =1 Else=0

Housing typology	New categories. Categorical variable needs to become binary for Multiple linear regression.	<u>To create new categories:</u> Creating two new categories; corner housing & Apartments. Manually adding the categories to respondents that filled in the "other" option. Recode into different variables> Variables "Flats" and "tenement housing" = "Apartments" "Row housing" = "Row housing" "Semi-detached housing" = "Semi-detached housing" "Detached housing" = "Detached housing" "Corner housing" = "Corner housing" <u>To make binary:</u> Recode into different variables> Variable x =1 Else=0
Income level	Categorical variable needs to become binary for Multiple linear regression.	Recode into different variables> 5 (I do not wish to answer) = missing systems Variable x =1 Else=0
Per person DDWC	To go from household DDWC to per person DDWC.	Compute new variable> household DDWC / household size
Presence of a dishwasher	For the bar chart.	Recode into different variables>

		Variable 1 = 1 missing systems = 0
Presence of a garden	Binary variable. Not present needs to become 0 not missing systems.	Recode into different variables> Variable 1 = 1 missing systems = 0
Presence of a dishwasher	For the bar chart.	Recode into different variables> Variable 1 = 1 missing systems = 0
Number of women	For the variable to be discrete ratio data.	Compute new variable> Women-1

APPENDIX 8 - MULTIPLE LINEAR REGRESSION FOR SOCIO-DEMOGRAPHIC CHARACTERISTICS

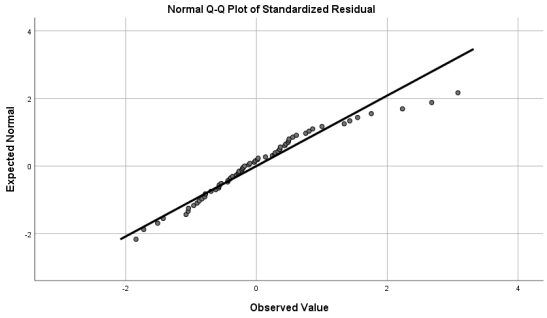
APPENDIX 8.1 - NORMALITY TEST FOR THE STANDARDIZED RESIDUALS

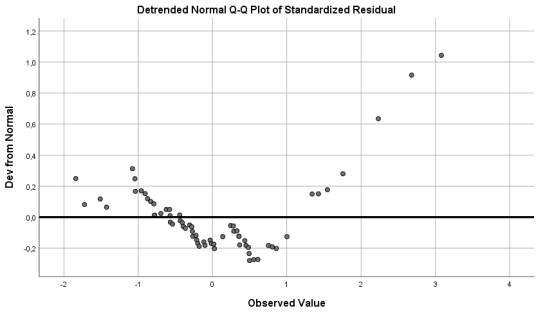
The sig. of Shapiro-Wilk is below 0.05, namely 0.009. Thus, it is significant, meaning the H0 that the residuals are normally distributed is rejected.

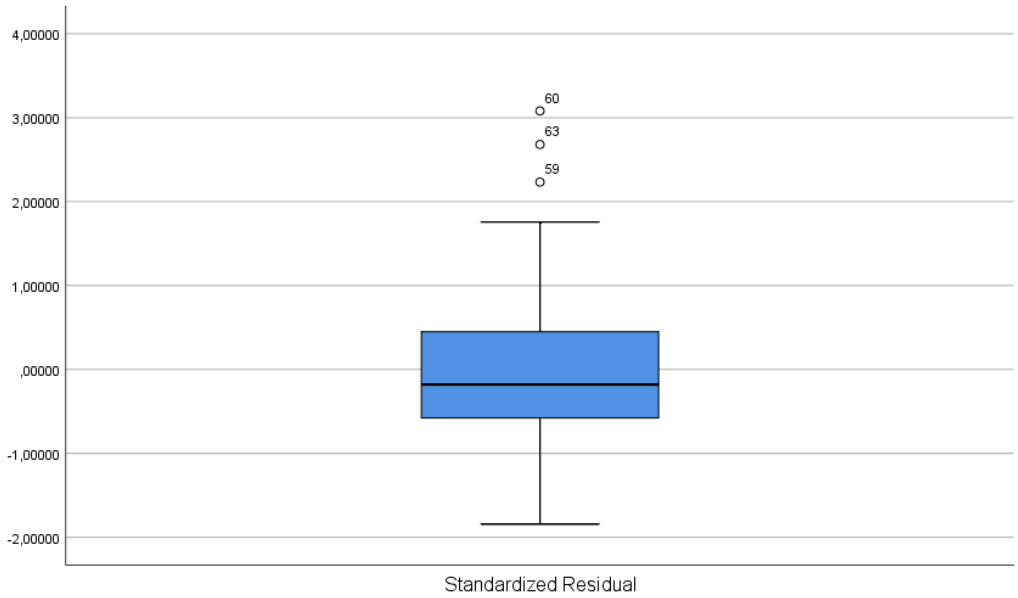
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	,102	65	,092	,949	65	,009

a. Lilliefors Significance Correction







APPENDIX 8.2 - OUTPUT

For this model, the stepwise option was used. As education level and income are categorical variables, it was made binary and one category of each variable was excluded from the model. For the variable income level the lowest category (0-2000) is excluded. For the variable education level the highest category of education level is excluded.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	How many people live in your household, including yourself?	.	Stepwise (Criteria: Probability-of-F-to-enter <= ,050, Probability-of-F-to-remove >= ,100).

a. Dependent Variable: How much water was consumed on household level

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,684[a]	,467	,458	37,734

a. Predictors: (Constant), How many people live in your household, including yourself?

b. Dependent Variable: How much water was consumed on household level

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	73701,334	1	73701,334	51,762	,000[b]
	Residual	84007,420	59	1423,855		
	Total	157708,754	60			

a. Dependent Variable: How much water was consumed on household level

b. Predictors: (Constant), How many people live in your household, including yourself?

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	3,251	10,287		,316	,753		
	How many people live in your household, including yourself?	40,670	5,653	,684	7,195	,000	1,000	1,000

a. Dependent Variable: How much water was consumed on household level

Excluded Variables[a]

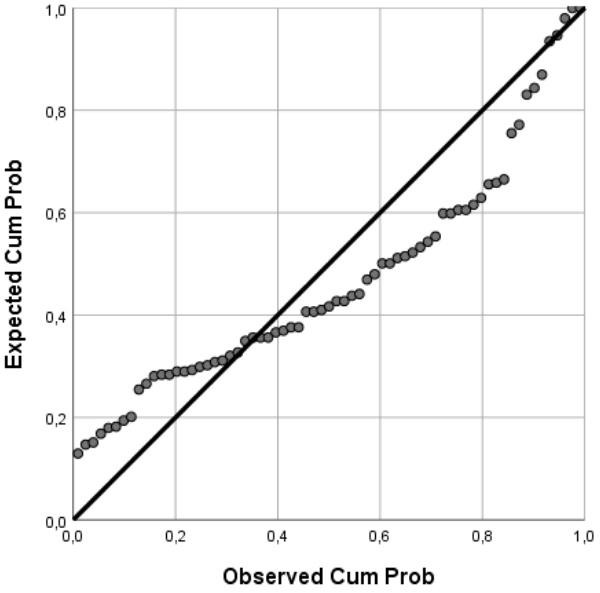
Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	Number of women in the household	,031[b]	,251	,803	,033	,596	1,678	,596
	How many people of each age category live in your household? - 0 - 14 year	-,008[b]	-,083	,934	-,011	,920	1,086	,920
	How many people of each age category live in your household? - 15-24 year	-,104[b]	-,772	,444	-,101	,499	2,003	,499
	How many people of each age category live in your household? - 25- 44 year	,141[b]	1,347	,183	,174	,818	1,223	,818
	How many people of each age category live in your household? - 45- 64 year	-,097[b]	-1,022	,311	-,133	,999	1,001	,999
	How many people of each age category live in your household? - 65 year or older	,002[b]	,023	,981	,003	,999	1,001	,999
	Number of people with a migration background in the household (recoded than minus 1)	-,112[b]	-,891	,376	-,116	,574	1,743	,574
	2000-4000	,093[b]	,964	,339	,126	,979	1,022	,979
	4000-6000	-,072[b]	-,741	,462	-,097	,977	1,024	,977
	6000 or more	-,055[b]	-,575	,568	-,075	,996	1,004	,996
	Low Education level	,053[b]	,526	,601	,069	,910	1,099	,910
	Medium Education level	,048[b]	,487	,628	,064	,958	1,044	,958

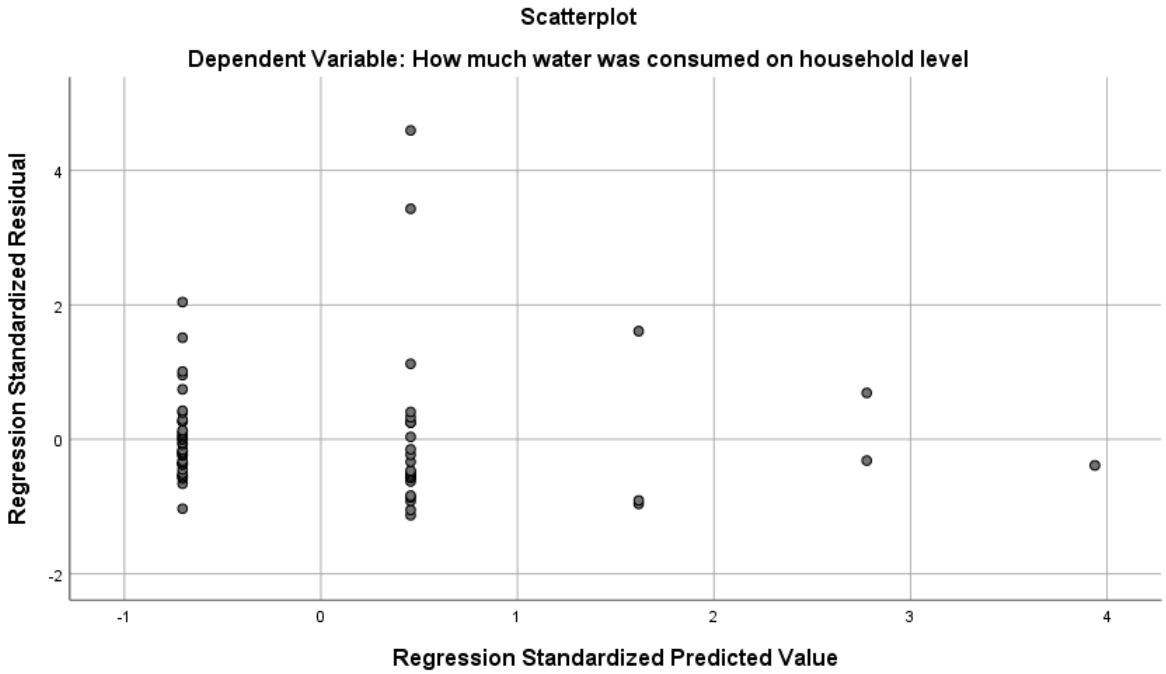
a. Dependent Variable: How much water was consumed on household level

b. Predictors in the Model: (Constant), How many people live in your household, including yourself?

Normal P-P Plot of Regression Standardized Residual

Dependent Variable: How much water was consumed on household level




Scatterplot
Dependent Variable: How much water was consumed on household level
Regression Standardized Residual
Regression Standardized Predicted Value
4
2
0
-2
-1
0
1
2
3
4

APPENDIX 9 - MULTIPLE LINEAR REGRESSION FOR INDOOR DWELLING CHARACTERISTICS

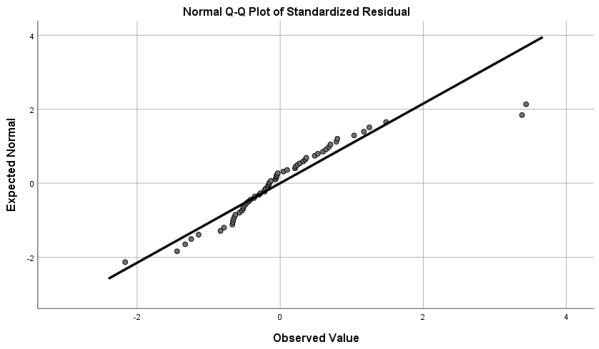
APPENDIX 9.1 - NORMALITY TEST FOR THE STANDARDIZED RESIDUALS INCLUDING INFLUENTIAL OUTLIERS

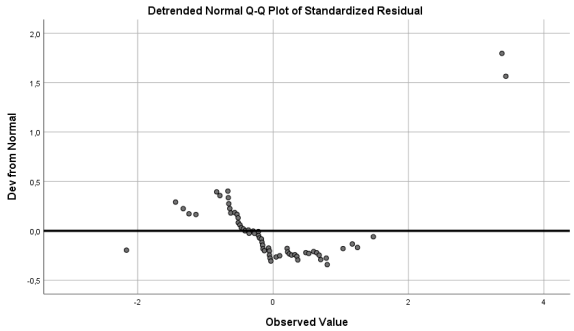
The sig. of Shapiro-Wilk is below 0.05, namely 0.000. Thus, it is significant, meaning the H0 that the residuals are normally distributed is rejected.

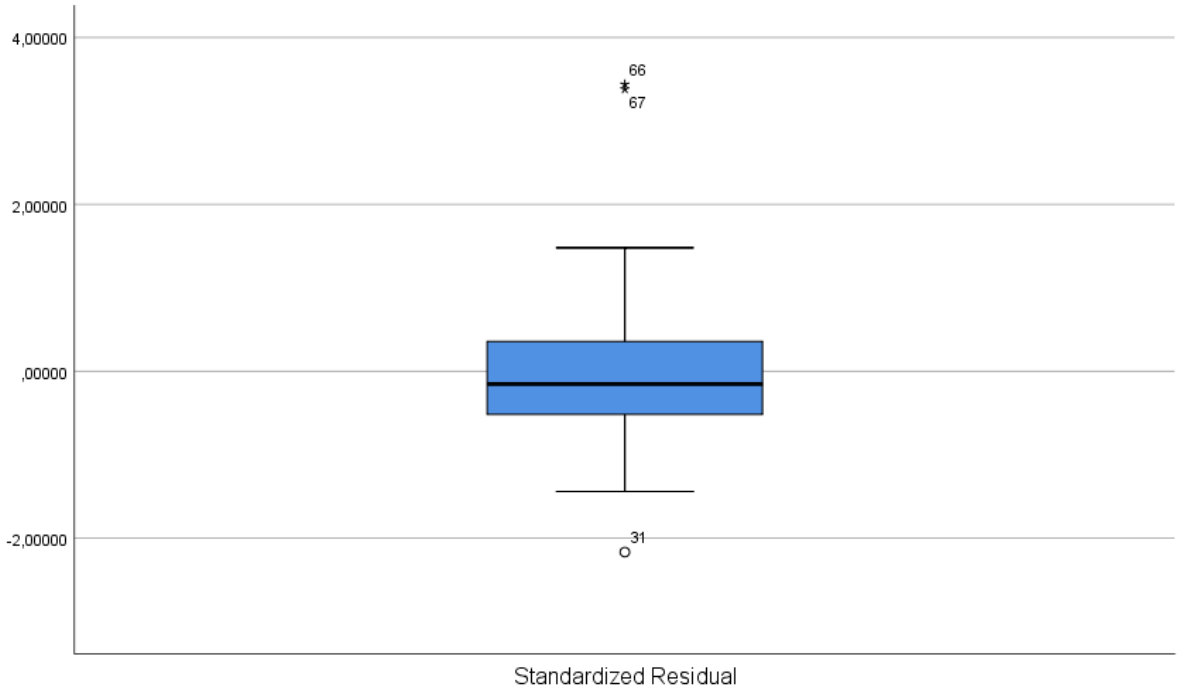
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	,131	60	,012	,882	60	,000

a. Lilliefors Significance Correction







APPENDIX 9.2 - NORMALITY TEST FOR THE STANDARDIZED RESIDUALS EXCLUDING INFLUENTIAL OUTLIERS

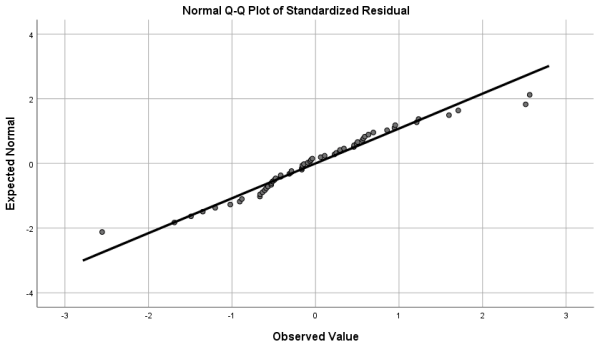
The influential outliers, cases 66 and 67, were excluded. The sig. of Shapiro-Wilk is above 0.05, namely 0.145. Thus, it is insignificant, meaning the H0 that the residuals are normally distributed can be accepted.

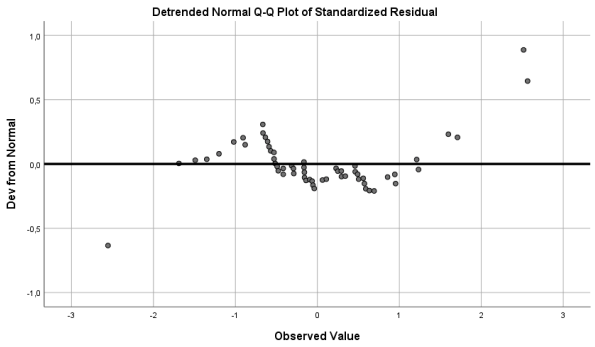
Tests of Normality

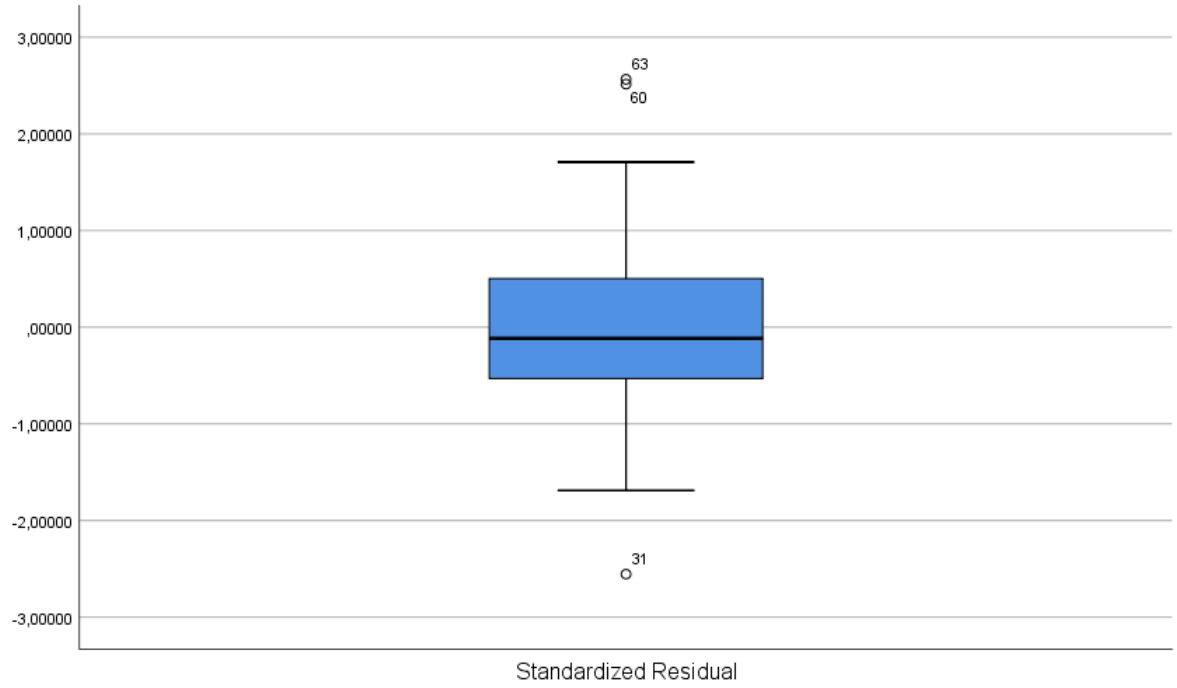
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	,098	58	,200*	,970	58	,163

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction







APPENDIX 9.3 - OUTPUT

As the residuals did become normally distributed when the influential outliers were excluded, the output excludes the influential outliers. In this model, the variable household size is also included to function as a control variable. Two categorical variables were included in this model. For toilet cistern type, the category cistern high above the toilet was excluded. For the housing typology, the category row housing was excluded. To get the R^2 change the R^2 of model 1 was subtracted from the R^2 of model 2.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	How many people live in your household, including yourself?[b]	.	Enter
2	Semi-detached, Presence of a dishwasher, Cornerhousing, What is the total area of the house you live in in m²?, Toilet Cistern directly above the toilet, Apartments, Toilet Cistern built in[b]	.	Enter

a. Dependent Variable: How much water was consumed on household level

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,760[a]	,578	,570	24,726
2	,840[b]	,705	,657	22,076

a. Predictors: (Constant), How many people live in your household, including yourself?

b. Predictors: (Constant), How many people live in your household, including yourself?, Semi-detached, Presence of a dishwasher, Cornerhousing, What is the total area of the house you live in in m²?, Toilet Cistern directly above the toilet, Apartments, Toilet Cistern built in

c. Dependent Variable: How much water was consumed on household level

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	46813,270	1	46813,270	76,571	,000[b]
	Residual	34236,661	56	611,369		
	Total	81049,931	57			
2	Regression	57170,786	8	7146,348	14,664	,000[c]
	Residual	23879,145	49	487,329		
	Total	81049,931	57			

a. Dependent Variable: How much water was consumed on household level

b. Predictors: (Constant), How many people live in your household, including yourself?

c. Predictors: (Constant), How many people live in your household, including yourself?, Semi-detached, Presence of a dishwasher, Cornerhousing, What is the total area of the house you live in in m²?, Toilet Cistern directly above the toilet, Apartments, Toilet Cistern built in

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	7,028	7,075		,993	,325		
	How many people live in your household, including yourself?	35,847	4,097	,760	8,750	,000	1,000	1,000
2	(Constant)	9,431	15,906		,593	,556		
	How many people live in your household, including yourself?	40,518	4,117	,859	9,843	,000	,789	1,267
	What is the total area of the house you live in in m²?	,033	,168	,017	,194	,847	,759	1,317
	Semi-detached	7,726	17,231	,038	,448	,656	,850	1,177
	Cornerhousing	21,989	13,650	,149	1,611	,114	,702	1,424
	Apartments	19,768	7,583	,248	2,607	,012	,663	1,507
	Toilet Cistern directly above the toilet	-23,453	8,859	-,314	-2,647	,011	,429	2,332
	Toilet Cistern built in	-34,121	9,538	-,428	-3,577	,001	,419	2,385
	Presence of a dishwasher	-6,441	6,388	-,085	-1,008	,318	,849	1,178

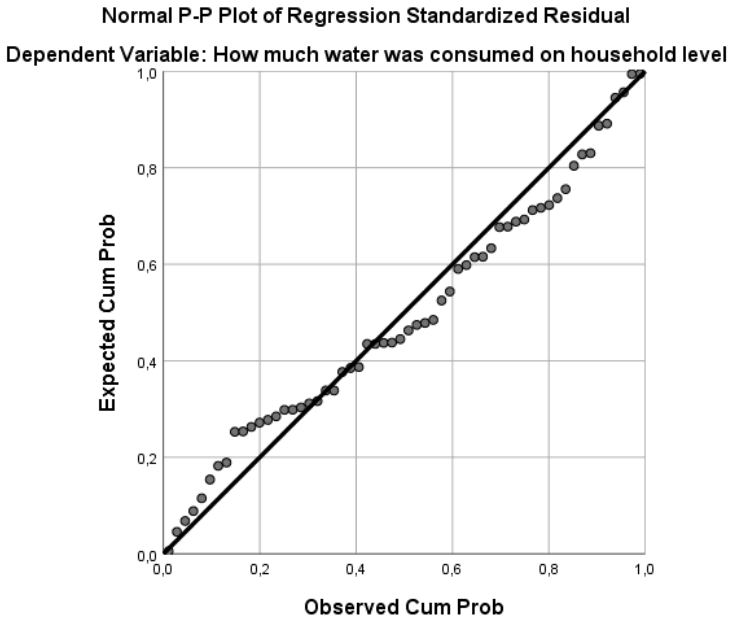
a. Dependent Variable: How much water was consumed on household level

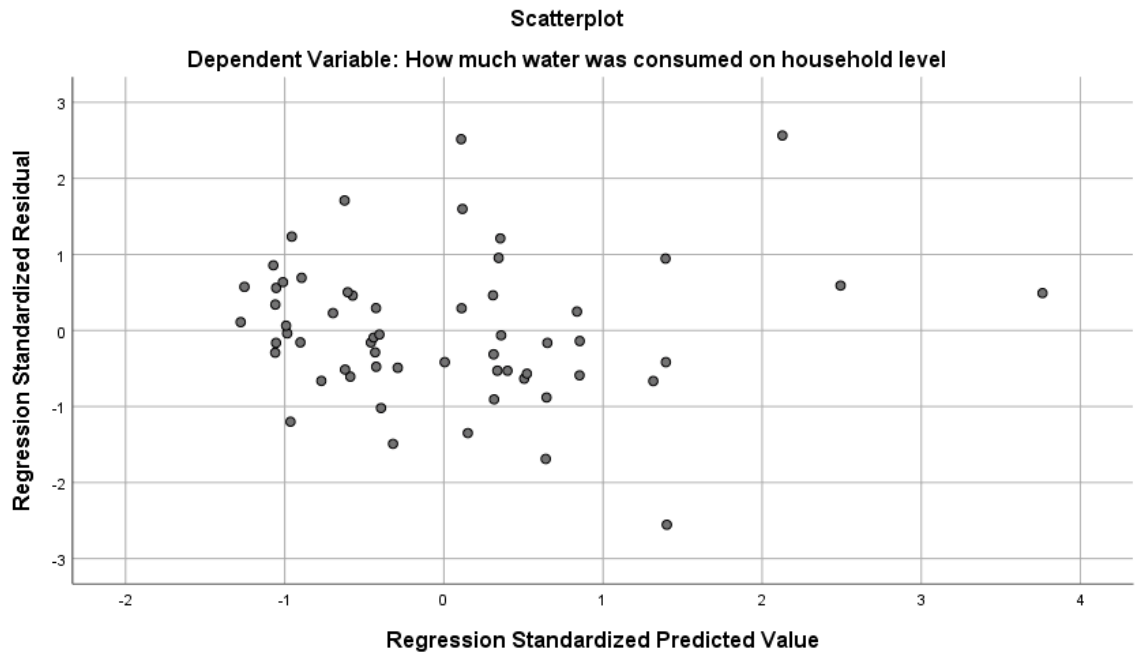
Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	What is the total area of the house you live in in m²?	,007[b]	,076	,940	,010	,911	1,098	,911
	Semi-detached	-,034[b]	-,393	,696	-,053	1,000	1,000	1,000
	Cornerhousing	-,028[b]	-,321	,750	-,043	,990	1,010	,990
	Apartments	,202[b]	2,397	,020	,308	,983	1,018	,983
	Toilet Cistern directly above the toilet	-,056[b]	-,627	,533	-,084	,969	1,032	,969
	Toilet Cistern built in	-,164[b]	-1,851	,070	-,242	,927	1,079	,927
	Presence of a dishwasher	-,025[b]	-,291	,772	-,039	,997	1,003	,997

a. Dependent Variable: How much water was consumed on household level

b. Predictors in the Model: (Constant), How many people live in your household, including yourself?


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: How much water was consumed on household level
Expected Cum Prob
Observed Cum Prob
0,0
0,2
0,4
0,6
0,8
1,0


Scatterplot
Dependent Variable: How much water was consumed on household level
Regression Standardized Residual
Regression Standardized Predicted Value
3
2
1
0
-1
-2
-3
-2
-1
0
1
2
3
4

APPENDIX 10 - MULTIPLE LINEAR REGRESSION FOR OUTDOOR DWELLING CHARACTERISTICS

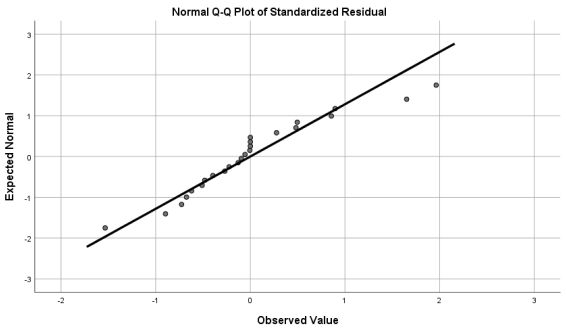
APPENDIX 10.1 - NORMALITY TEST FOR THE STANDARDIZED RESIDUALS

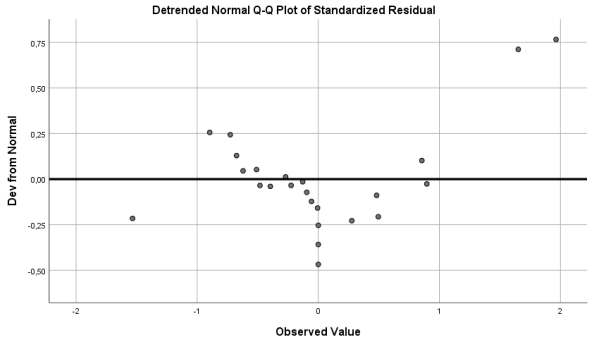
No influential outliers were found. The Shapito-Willk is above 0.05, namely 0.161. This means the test is insignificant, the H0 that the residuals are normally distributed is excepted.

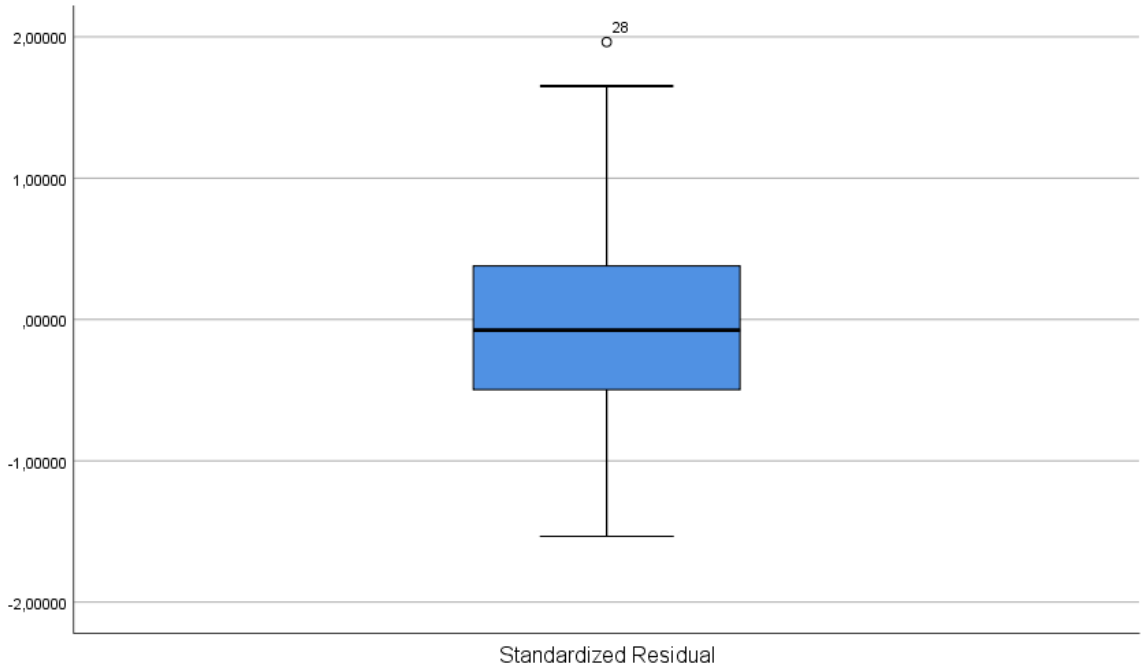
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	,208	24	,008	,940	24	,161

a. Lilliefors Significance Correction







APPENDIX 10.2 - OUTPUT

In this model, the variable household size is also included to function as a control variable. Two categorical variables were included in this model. For garden sizes, the smallest category was excluded 0-20 m^2. For type of vegetation in the garden, the category mainly grass van excluded. To get the R^2 change the R^2 of model 1 was subtracted from the R^2 of model 2.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	How many people live in your household, including yourself?[b]	.	Enter
2	Mainly tiles, 41-60 m2, Half plants half grass, 80+ m2, Mainly plants, 21-40 m2, Half tiles half grass, Half tiles half plants[b]	.	Enter

a. Dependent Variable: How much water was consumed on household level

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,911[a]	,829	,821	12,427
2	,958[b]	,919	,866	10,745

a. Predictors: (Constant), How many people live in your household, including yourself?

b. Predictors: (Constant), How many people live in your household, including yourself?, Mainly tiles, 41-60 m2, Half plants half grass, 80+ m2, Mainly plants, 21-40 m2, Half tiles half grass, Half tiles half plants

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16477,616	1	16477,616	106,703	,000[b]
	Residual	3397,342	22	154,425		
	Total	19874,958	23			
2	Regression	18258,621	9	2028,736	17,572	,000[c]
	Residual	1616,338	14	115,453		
	Total	19874,958	23			

a. Dependent Variable: How much water was consumed on household level

b. Predictors: (Constant), How many people live in your household, including yourself?

c. Predictors: (Constant), How many people live in your household, including yourself?, Mainly tiles, 41-60 m2, Half plants half grass, 80+ m2, Mainly plants, 21-40 m2, Half tiles half grass, Half tiles half plants

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1,431	5,198		,275	,786		
	How many people live in your household, including yourself?	32,133	3,111	,911	10,330	,000	1,000	1,000
2	(Constant)	3,421	11,185		,306	,764		
	How many people live in your household, including yourself?	32,579	3,108	,923	10,481	,000	,749	1,336
	Mainly tiles	-10,097	11,781	-,170	-,857	,406	,148	6,762
	Mainly plants	-9,964	14,021	-,115	-,711	,489	,224	4,470
	Half tiles half plants	-9,746	11,882	-,160	-,820	,426	,153	6,522
	Half tiles half grass	-12,290	17,001	-,118	-,723	,482	,218	4,590
	Half plants half grass	12,229	16,418	,085	,745	,469	,447	2,237
	80+ m2	4,097	11,781	,028	,348	,733	,868	1,152
	41-60 m2	22,922	8,654	,297	2,649	,019	,462	2,162
	21-40 m2	5,771	6,216	,097	,928	,369	,531	1,883

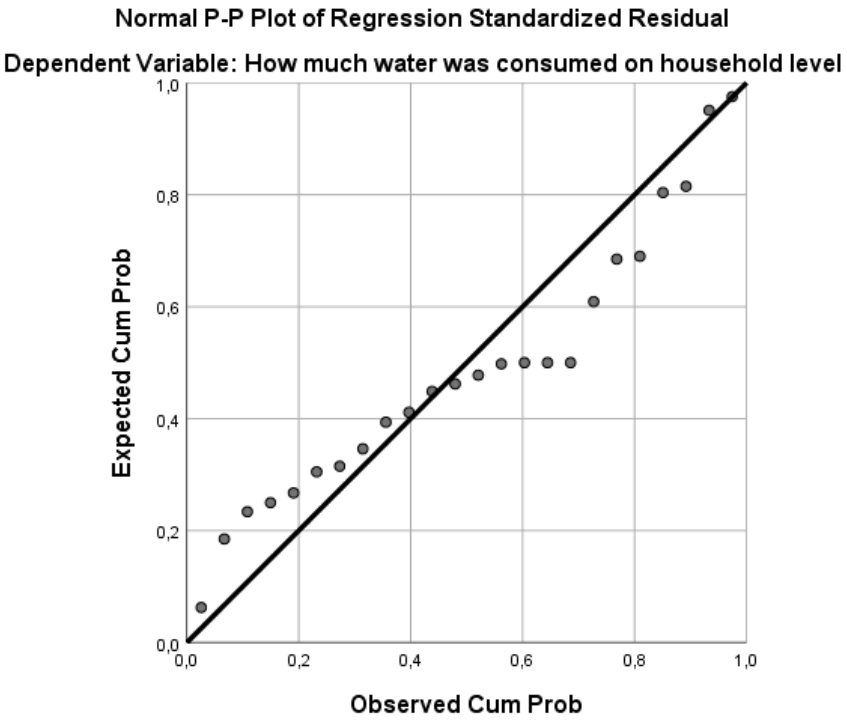
a. Dependent Variable: How much water was consumed on household level

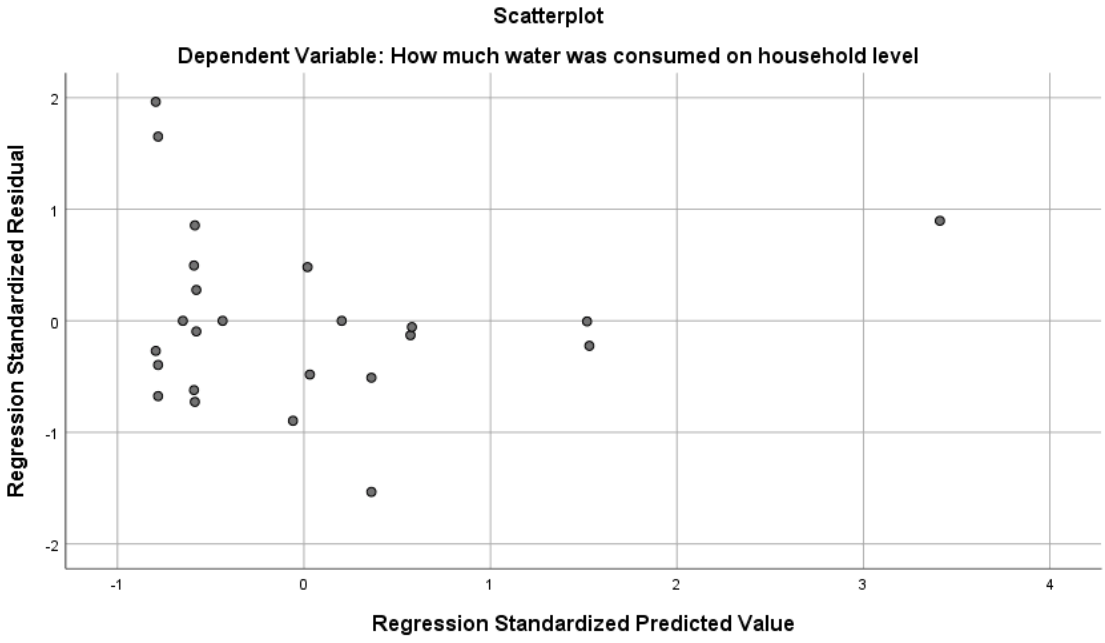
Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	Mainly tiles	-,086[b]	-,969	,343	-,207	1,000	1,000	1,000
	Mainly plants	-,021[b]	-,235	,817	-,051	,997	1,003	,997
	Half tiles half plants	-,052[b]	-,582	,567	-,126	,995	1,005	,995
	Half tiles half grass	,169[b]	1,866	,076	,377	,852	1,174	,852
	Half plants half grass	,150[b]	1,772	,091	,361	,986	1,014	,986
	80+ m2	-,026[b]	-,289	,776	-,063	,986	1,014	,986
	41-60 m2	,233[b]	3,061	,006	,555	,974	1,026	,974
	21-40 m2	,024[b]	,261	,797	,057	,950	1,053	,950

a. Dependent Variable: How much water was consumed on household level

b. Predictors in the Model: (Constant), How many people live in your household, including yourself?


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: How much water was consumed on household level
Expected Cum Prob
Observed Cum Prob
0,0
0,2
0,4
0,6
0,8
1,0


Scatterplot
Dependent Variable: How much water was consumed on household level
Regression Standardized Residual
Regression Standardized Predicted Value
2
1
0
-1
-2
-1
0
1
2
3
4

APPENDIX 11 - INDEPENDENT SAMPLES TEST FOR THE NEIGHBOURHOODS

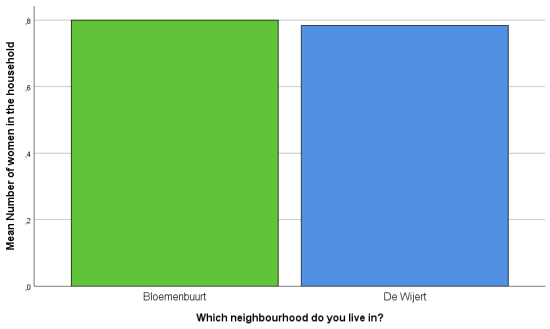
In the table, the independent Samples Test for the household DDWC is depicted. For this, all 30 cases for the Bloemenbuurt and 37 cases for the De Wijert were included. As this is above 30 cases per population the test could be conducted, due to the central limit theorem. As the Levene's Test is very significant, the two-tailed significance for "Equal variances assumed" is looked at to indicated whether the two samples T-test is significant. The sig. is 0.341, this is above 0.05. Thus, the H0 (in the population the mean household DDWC is equal between the Bloementbuurt and the De Wijert) is accepted

Group Statistics

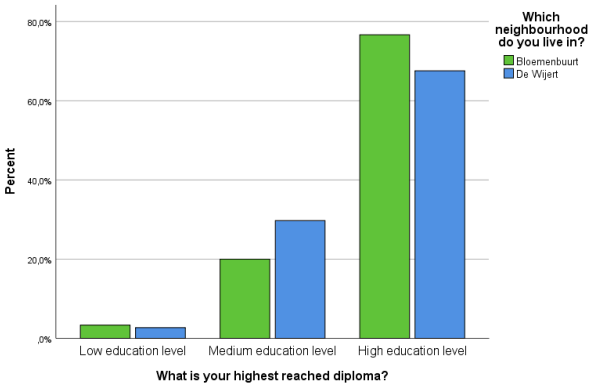
	Which neighbourhood do you live in?	N	Mean	Std. Deviation	Std. Error Mean
How much water was consumed on household level	Bloemenbuurt	30	61,87	52,474	9,580
	De Wijert	37	73,49	46,691	7,676

Independent Samples Test

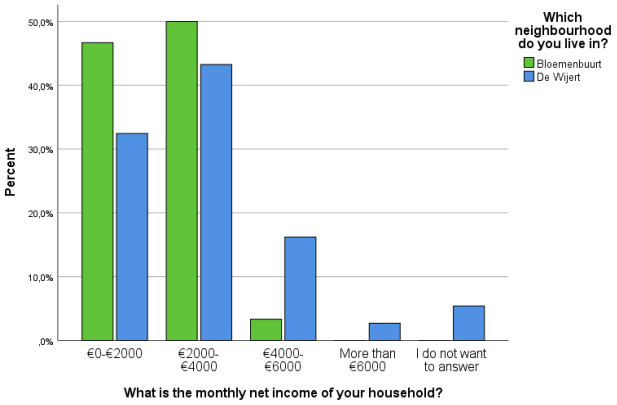
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
How much water was consumed on household level	Equal variances assumed	,032	,858	-,958	65	,341	-11,620	12,126	-35,836	12,597
	Equal variances not assumed			-,947	58,698	,348	-11,620	12,276	-36,187	12,947



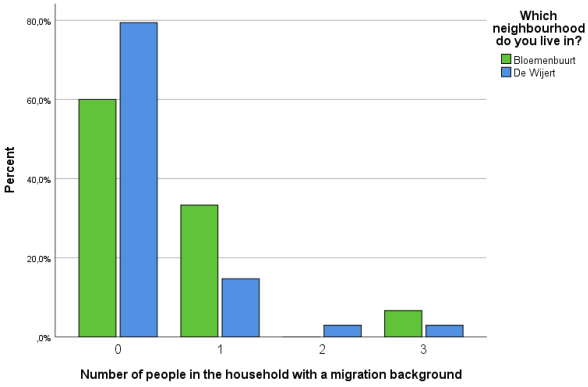
Mean number of women per household per neighbourhood.



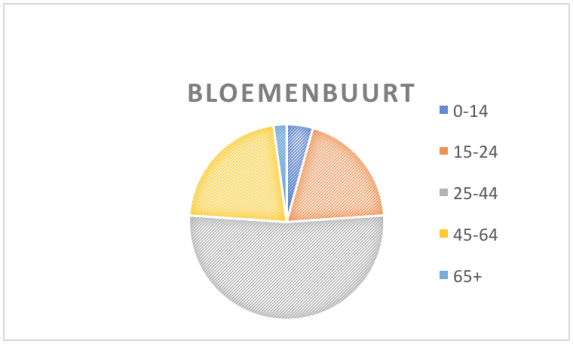
The respondents' education level in percentage per neighbourhood.



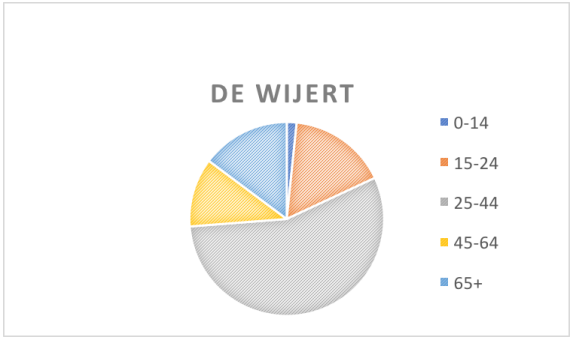
The respondents' monthly net household income in percentage per neighbourhood.



The number of people in the respondents' household with a migration background in percentage per neighbourhood.



Age groups of all households in percentage from the Bloemenbuurt.



Age groups of all households in percentage from De Wijert.