SCOREwater

Smart City Observatories implement REsilient Water Management

DELIVERABLE D4.9

PUBLIC AWARENESS CAMPAIGN GUIDELINE

PUBLIC AWARENESS CAMPAIGN GUIDELINE TO AVOID UNFLUSHABLES, FATS, OILS AND GREASE (FOG) AND OTHER IMPROPER WASTE ENTERING WASTEWATER SYSTEMS

Dissemination level	Public
Type	Report
Issued by	IERMB
Contributing project partners	ICRA, BCASA
Author(s)	Mar SATORRAS, MS; Elena DOMENE, ED; Maria José CHESA, MJC; Lluís COROMINAS, LC
Reviewed by	Pieter de Jong, Torsten Kooistra, Christa Törn-Lindhe
Keywords	behavioural change, gender analysis, public awareness campaigns, sewer system, wastewater
Number of pages	61
Number of annexes	1
Date:	2022-04-29
Version:	V 1
Deliverable number	D4.9
Work Package number:	WP 4
Status:	Delivered
Approved by coordinator (IVL)	2022-04-29

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Copyright notices

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

REVISION HISTORY

Version	Reason for changes	Name	Date
1	Original release to EU	Mar SATORRAS; Elena DOMENE	2021-4-29

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

CONTENT

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

LIST OF FIGURES

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

LIST OF TABLES

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

ABBREVIATIONS

Abbreviation	Definition
BCASA	Barcelona Cicle de l'Aigua S.A.
CKAN	Comprehensive Kerbal Archive Network
CSO	Combined Sewer Overflows
FOG	Fats, Oils and Grease
ICRA	Institut Català de Recerca de l'Aigua
IERMB	Institute of Regional and Metropolitan Studies of Barcelona
ICT	Information and Communications Technology
IoT	Internet of Things
IWSFG	International Water Services Flushability Group
LHS	Lifestyles Habits Surveys
SDG	Sustainable Development Goals
SES	Socio-Economic Status
SME	Small and Medium-sized Enterprise
WBE	Wastewater-based Epidemiology
WHO	World Health Organization

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

PROJECT ABSTRACT

SCOREwater focuses on enhancing the resilience of cities against climate change and urbanization by enabling a water smart society that fulfils SDGs 3, 6, 11, 12 and 13 and secures future ecosystem services. We introduce digital services to improve management of wastewater, stormwater and flooding events. These services are provided by an adaptive digital platform, developed and verified by relevant stakeholders (communities, municipalities, businesses, and civil society) in iterative collaboration with developers, thus tailoring to stakeholders' needs. Existing technical platforms and services (e.g. FIWARE, CKAN) are extended to the water domain by integrating relevant standards, ontologies and vocabularies, and provide an interoperable open-source platform for smart water management. Emerging digital technologies such as IoT, Artificial Intelligence, and Big Data is used to provide accurate real-time predictions and refined information.

We implement three large-scale, cross-cutting innovation demonstrators and enable transfer and upscale by providing harmonized data and services. We initiate a new domain "sewage sociology" mining biomarkers of community-wide lifestyle habits from sewage. We develop new water monitoring techniques and data-adaptive storm water treatment and apply to water resource protection and legal compliance for construction projects. We enhance resilience against flooding by sensing and hydrological modelling coupled to urban water engineering. We will identify best practices for developing and using the digital services, thus addressing water stakeholders beyond the project partners. The project will also develop technologies to increase public engagement in water management.

Moreover, SCOREwater will deliver an innovation ecosystem driven by the financial savings in both maintenance and operation of water systems that are offered using the SCOREwater digital services, providing new business opportunities for water and ICT SMEs.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

EXECUTIVE SUMMARY

The main goal of this report is to translate SCOREwater outcomes into novel public awareness campaigns to reduce the disposal of fats, oils and greases (FOG) and the flushing of wet wipes and other unflushables into urban sewers, as well as to promote the responsible consumption of antibiotics and healthier and sustainable habits to reduce sewer maintenance problems, odours and blockages and minimize wastewater pollution ultimately posing risks to human health and the environment. This deliverable, included in SCOREwater WP4 on *Large Scale Demonstrations*, builds on the different activities conducted in Barcelona to raise public awareness (namely, subtask 4.2.5 *Raising public awareness in Barcelona*).

To achieve this goal, this report is developed in five steps. First, we conduct a review of the literature on household waste disposal practices in the toilet and the kitchen, as well as health-related practices, to focus on their implications for sewers and wastewater. This section also includes SCOREwater facts and figures obtained from Subtask 4.2.2 *Mining lifestyle habits from sewage chemical monitoring* (ICRA, SCAN, BCASA) and Subtask 4.2.4. *Lifestyle habits survey* (IERMB, ICRA) to provide grounded empirical data about how household habits impact sewerage parameters. Second, we provide a review of the public interventions to address the challenges faced by current wastewater systems and in particular the campaigns developed in recent years related to the challenges of FOG, unflushables and other improper waste impacting sewer and aquatic systems. The lenses of gender analysis are incorporated as a transversal analytical category in both sections, for instance by emphasizing gendered practices or how gender stereotypes are challenged or reproduced through these campaigns. Third, we list a collection of recommended habits to avoid water pollution and promote correct operation of urban wastewater systems. Fourth, a general model of campaigning is proposed to encourage proper disposal of waste and avoid water pollution in sewerage systems. Finally, a first draft of the SCOREwater Public Awareness Toolkit (SPAT) is presented.

Research within this deliverable supports SDGs 3 (good health and well-being), 6 (clean water and sanitation), 12 (responsible production and consumption) and 17 (partnerships for the goals). This deliverable contributes to SCOREwater project KPI 6 (i.e., in Barcelona, reduce the release of wet wipes and discharge of oils, greases, and antibiotics into the sewer systems).

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

1. INTRODUCTION

Inappropriate disposal of waste in sewerage systems and consequent blockages and other maintenance problems are still a major problem for the water industry and our planetary health. In particular, improper waste causes sewer network maintenance problems, sewer odours, blockages and increase the impact of combined sewer overflows (CSO)[1]. Stopping pollution at source is the more effective way to avoid improper sewage debris entering the aquatic environment. Educational and public awareness campaigns try to improve disposal of improper waste, but there is still a lack of understanding of the complex set of socio-cultural factors associated with disposal behaviours and other household practices impacting sewerage systems.

To inform such interventions, this deliverable reviews and proposes novel public awareness campaigns on sustainable and healthy household habits, including the proper disposal of waste (unflushables, FOG, antibiotics, etc.), to encourage the public to reduce waste and pollution entering sanitation and water systems. Specifically, the general model of public awareness campaign developed incorporates the lessons learned from previous campaigns and the case study of Barcelona, such as the serious game piloted in schools, and translates these outcomes into novel awareness campaigns.

This deliverable contributes to the fourth Expected Impact (EI4) envisioned by the SCOREwater project which aims to enhance public awareness and engagement for water-friendly behaviour and a climate resilient society. Public awareness and engagement initiatives created by the SCOREwater project rely on a combination of strategies. In the case of Barcelona, the project partners Institute of Regional and Metropolitan Studies of Barcelona (IERMB), Barcelona Cicle de l'Aigua (BCASA), and the Institut Català de Recerca de l'Aigua (ICRA), which is the coordinator of the Catalan cluster, have raised public awareness on sustainable household habits, including proper disposal of waste (subtasks 4.2.3 *Mining sewer maintenance information and citizen engagement through interoperable apps* and 4.2.5 *Raising public awareness in Barcelona*), and have designed a serious game to be used in primary schools from Barcelona to engage students in good sewage usage (see D7.9 *Serious gaming*). The general goal of the SCOREwater Barcelona case study is to innovate in the digitalization of water services by demonstrating how sensing the sewer system of Barcelona can provide information at the neighbourhood scale on health status, dietary habits, and household waste management practices. This information will be used to: 1) reduce the discharge of antibiotics into the environment; 2) promote healthier and sustainable habits; 3) prevent damaging discharges of wet wipes, FOGs and other improper waste into the sewer system; and thus 4) decrease sewer maintenance costs and environmental impacts.

The document is structured as follows. First, the theoretical grounding for the research is provided through a literature review on household waste disposal practices and health-related habits and their implications for urban wastewater. Second, a benchmarking of novel campaigns to encourage proper disposal of waste and minimize impacts on wastewater systems, ecosystems and public health is made. The lens of gender analysis are incorporated as a transversal analytical category in both sections, for instance by emphasizing gendered practices or how gender stereotypes are challenged or reproduced through these campaigns. Third, a collection of recommended habits to avoid water pollution and promote the correct operation of urban wastewater systems is presented. Afterwards, based on previous information, a general model of campaigning to encourage proper disposal of waste and avoid water pollution in the sewerage system is proposed. This will also rely on the experience gained during pilot activities with a novel serious game in primary schools in Barcelona to engage students and promote changes in their habits impacting the sewerage and the environment. Finally, a first draft of the SCOREwater Public Awareness Toolkit (SPAT) is presented.

[1] Combined sewer overflows (CSOs) refer to untreated wastewater and stormwater that exceeds the capacity of the sewer system or the treatment plant and is discharged directly to nearby streams, rivers and other water bodies (EPA 2022). CSO usually take place during heavy rainfall events or snowmelt with the intention of preventing spills and flooding at undesirable locations or overloading of waste water treatment plants. A range of actions from policy, planning and legislation, have been proposed to ensure that overflows from collecting systems are managed in a sustainable manner (see EurEau 2016).

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

This Public Awareness Campaign Guideline should be developed in coordination with ongoing tasks conducted in the Barcelona case study within the SCOREwater project, including the D4.10 *Description and main achievements for the case study of Barcelona*, the rest of the actions planned in Subtask 4.2.5, as well as the testing of a serious game in schools. These tasks will be developed during the following months as D4.10 is due in M44 and the testing of the serious game in schools will take place during the second trimester of 2022. It is important to remark that some of the tasks related to Subtask 4.2.5 *Raising public awareness in Barcelona* such as the design of the public exhibition have not been fully completed yet and that the final version of the SCOREwater Public Awareness Toolkit (SPAT) will be included in D4.10 to be delivered in M44, December 2022.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

2. DISPOSAL PRACTICES IN HOUSEHOLDS AND THEIR IMPLICATIONS FOR URBAN WASTEWATER

Research has started to disentangle how lifestyle habits and conditions (e.g., environmental behaviour, pharmaceuticals consumption, diet, health risk factors and socio-economic status) affect urban wastewater quality and sewerage systems and ultimately our planetary health. For instance, some health-related habits such as the consumption of antibiotics have direct implications on urban wastewater management by introducing new pollutants in water which demand innovation in treatment techniques (Hassan et al. 2021). Moreover, the interaction between different household practices can produce cumulative effects and pose complex infrastructural and environmental challenges. For instance, the combination of the disposal of fats, oils and greases (FOGs) down the kitchen sink and the disposal of wet wipes in toilets contribute to the formation of significant blockages on sewers, known also as "fatbergs" (Wallace et al. 2017). Thus, the routinary way in which households use and, importantly, throw away basic products such as food, pharmaceuticals, or hygiene products has direct implications for wastewater systems and sanitation facilities which pose more challenges and risks for our environment and public health.

Wastewater in households generally flow from the WC, shower and/or bathtub, the washing machine, the kitchen sink, and the dishwasher (Butler et al., 1995; Friedler et al. 2013). The main contributors to domestic wastewater are generally the effluents emanating from the toilet, being the WC the largest source of solids load followed by the kitchen sink and the dishwasher (Ashley et al. 2004a; Friedler 2004). Importantly, the type and quantity of domestic wastewater inputs determines the problems caused in sewers, which widely vary over space and time. Mattson et al. (2015), for instance, identified how three recent changes in households – namely, the rising levels of inputs of fat, oil and grease (FOG), the installation of low-flush toilets (LFTs), and the introduction of kitchen sink food waste disposers (FWDs) – have impacted contemporary sewer systems particularly in the Global North.

This section summarizes how the relationships between lifestyle habits and urban wastewater have been approached both theoretically and empirically. First, we introduce the growing, but still scarce, literature uncovering how everyday household practices impact sewer performance and wastewater management (see sections 2.1, 2.2 and 2.3). A particular emphasis is placed on studies analysing these practices through the gender lens, for instance, by providing sex-disaggregated data. Secondly, by gaining insights from the case study developed in Barcelona in the context of the SCOREwater project, we show how tools such as the Lifestyles Habits Surveys (LHS) and Wastewater-based Epidemiology (WBE) can be used to collect quantitative data and better understand how these complex and changing relationships operate in practice (see sections 2.4 and 2.5).

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

2.1. TOILET PRACTICES: FLUSHING BEHAVIOUR & IMPACTS ON SEWER

The main contributors in terms of flow and pollution load to domestic wastewater are generally the toilet effluents and particularly the WC (Almeida et al. 1999; Butler et al. 1995). This is why policy actions to instigate behaviour changes affecting wastewater systems tend to focus on flushing practices in the bathroom. Although research has still to better understand the diverse and evolving cultures of flushability across geographies and social groups, the disposal of domestic waste via the toilet is a global problem affecting sanitation and water systems in many contexts (Alda-Vidal et al. 2020a).

Besides impacting ecosystems and human health with microplastics and other pollutants (see Orr and Karadagli 2020), flushed waste provokes sewer blockages (and fatbergs) which can cause sewer back-ups and overflows and increase operational costs in terms of labour, waste disposal and premature replacement of equipment such as pumps (EurEau 2014; Raja-Louisa 2019). For instance, the added cost in Europe, including waste disposal, can be assessed to 500-1,000 € million per year (EurEau 2014). In the UK, presumably the country where the practice of flushing solids down the toilet is more prevalent (Ashley et al. 2004b), the cost of fixing sewer blockages reaches 88 £ million per year and around half of these blockages are credited to products flushed via the toilet (WaterUK 2016). In the US, the National Association of Clean Water Agencies (NACWA) has estimated that wipes result in 441 $ million per year in additional operating costs for clean water utilities (NACWA 2020).

The disposal of flushable and unflushable products through the WC is thus habitual in many countries[2] and stems from the historical link associating health risks with human waste (Ashley et al. 2005). Flushable products are considered suitable materials for disposal via a toilet and drain line to an on-site treatment system or to a wastewater collection system and a wastewater treatment system because they will not materially adversely impact those systems or the downstream environment (IWSFG 2018). On the contrary, "unflushables" refer to a variety of household products that though possible to dispose of via the toilet are incompatible with most sewerage systems, and consequently contribute to an assortment of environmental problems (Alda-Vidal et al. 2020a). The most known unflushable products include wet wipes and menstrual absorbents, although the term also refers to other hygienic products (e.g., nappies, cotton buds, dental floss), waste (e.g., cigarettes, packaging), and even medical products (e.g., needles, medicines).

The type of waste flushed by individuals down the toilet can differ depending on the cultural, geographical and socio-economic context (Ashley et al. 2004b; Alda-Vidal et al. 2020a). Surveys about flushing practices, but also the analysis of samples from sewers or the waste found in beaches and marine ecosystems, provide evidence about the typology and quantity of unflushables (Joksimovic et al. 2020). For instance, in Ireland, the "Think Before You Flush" campaign (see section 3) ran a survey to better understand the flushing behaviours and compiled a list of the twelve most common items flushed down the toilet in error (An Taisce and Irish Water 2022). They call these items the Dirty Dozen, which includes: 1) cotton buds, 2) baby wipes, 3) facial wipes, 4) cleansing pads, 5) toilet roll tube, 6) medicines, 7) cigarettes, 8) plasters, 9) nappies, 10) tampons, 11) tampon applicator, and 12) sanitary pads. The analysis of wastewater samples in Germany showed significant variations in captured material composition, with paper (45%) and textiles (33%) being the largest fraction of captured solids, and concluded that wet wipes are a relevant category (Mitchell et al. 2017). Finally, a study by Water UK (2017), found that around 93% of the materials causing blockages in sewerage systems are wet wipes. Importantly, wet wipes and other hygienic products are often flushed due to lack of understanding, embarrassment, or the inappropriate labelling of the product (Cabrea and García 2019). This is why awareness raising campaigns and other interventions beyond infrastructural maintenance are key to address the challenge of the unflushables.

[2] However, is still relevant to consider the geographical and cultural differences. For instance, there are several European countries where toilet paper is not flushed down to the toilet (Belarus, Bosnia Herzegovina, Bulgaria, Cyprus, Greece, Macedonia or Moldova). Across the world, the practice to dispose of toilet paper in bins is also common in East Asia and central America and there are several countries that use water instead of toilet paper (to see how the Covid-19 pandemic could affect some of these practices, see Sun and Han 2021).

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Often unflushables are associated with women. For instance, some studies indicate that women use more quantity and diversity of hygienic products than men and therefore they are more responsible of the disposal of such products down the toilet (AEAS 2012; Ashley et al. 2005; Friedler et al. 1996). However, research focusing on menstrual hygiene products has argued that to better understand the gendered dimensions of flushing behaviours, practices of disposal should be approached beyond the individual (Alda-Vidal et al. 2020a; Hawkins et al. 2019; Jackson and Falmagne 2013). In other words, even in women willing to be environmentally responsible in relation to their choices of menstrual products and disposal practices, their decisions can be ultimately limited by other factors such as the societal requirements for discretion (making visible menstruation through reusable products or the disposal in open bins can be a source of embarrassment), but also the design, accessibility and availability of bins and bathroom facilities (Hawkins et al., 2019). Thus, interventions should consider the reasons given for disposal and washing practices by menstruators to design facilities and services which better suit the desired behaviours of both planners and those who menstruate (Robinson and Barrington 2021). Effective and sustainable menstrual management can also be limited by socio-economic factors shaping what has been called as "period poverty", i.e. when marginal women and girls cannot afford proper menstrual products (Moffat and Pickering, 2019). However, the intersection of gender and class with regard to menstrual management, and its ecological consequences, remains an underexplored issue in academic literature (Idem). Finally, men also use unflushable products, particularly wipes and incontinence pads (Alda-Vidal et al. 2020b; Zhou 2019; MPCA 2022). For all these reasons, scholars demand to be cautious to avoid disproportionately associating unflushables with particular groups (Alda-Vidal et al. 2020a, 2020b; Browne et al. 2020; Robinson and Barrington 2021). In this line, some water operators and public authorities are questioning established gendered roles in their campaigns. For instance, the communications toolkit from the Minnesota Pollution Control Agency (USA) recommends to actively engage men in wet wipes awareness campaigns (MPCA 2022), while campaigns such as Think Before You Flush (An Taisce and Irish Water), I ONLY WANT THE REAL SHIT (Berliner Wasserbetriebe) or #FatbergFreeNYC (New York City) avoid gender stereotypes by representing gender in more inclusive, diverse, and respectful ways or by developing gender neutral marketing (see sections 3.2 and 3.3).

2.2. KITCHEN PRACTICES: FOOD WASTE HABITS & IMPACTS ON SEWER

The second contributors in terms of flow and pollution load to domestic wastewater are generally the effluents from the kitchen sink and dishwashers (Ashley et al. 2004a, Friedler 2004). Thus, actions instigating behaviour changes in relation to sewer systems are also progressively including and promoting best practices in the kitchen. While research has addressed the infrastructural and technical aspects related to kitchen-related challenges for sewers, few social research studies have grasped the factors explaining why and how impactful food waste habits occur (for some exceptions, see Foden et al. 2017, 2018; Ibánez-Martín and Laet 2018; or Marvin and Medd 2006).

Food waste, and particularly rising levels of fats, oils, and grease (FOG), emanating from the kitchen sink considerably impact sewer performance causing blockages which lead to sewer overflows (CSOs), property flooding, and pollution of water bodies with sewage (Mattson et al. 2015, Wallace et al. 2017). Moreover, FOG deposits can accumulate in the sewer with unflushable waste, such as wet wipes, and produce what has been referred as "fatbergs". In the US, as much as 40-50% of the total number of sanitary sewer overflows are estimated to be caused by FOG deposits (Southerland, 2002). Internationally, FOG is estimated to be the root cause of 50-75% of all in-line sewer blockages (INCOVER 2019). Food waste diversion causes relevant impacts to the sewer system, although the deposition of solids, the formation of FOG-deposits, and the production of sulfide have been controversial issues for decades (Zan et al. 2022). Some studies have analyzed the case of food waste disposers (FWD), the electrical devises installed under the kitchen sink that grinds food waste into fine particles and releases them into the sewer system. FWDs are widely used in countries from the Global North such as the US, Canada, the UK, Australia, New Zealand and Japan (Iacovidou et al., 2012) and contribute to approximately the 20% of the suspended solids in domestic wastewater (Metcalf and Eddy, 2003). However, the impacts of FWD on sewers remain debated (Mattson et al. 2014a; Zan et al. 2022).

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Most FOG derive from used cooking oil. In Europe, the RecOil Project estimated that every month 2,5 L of used cooking oil are produced per person domestically (European Biomass Industry Association, EUBIA 2015). FOG-levels in urban wastewaters generally exhibit large variations which can be linked to differences in household practices such as the pouring of cooking oil down the kitchen sink instead of its collection into suitable containers (NCWRA, 2002). But FOGs not only originate from deep fat fryers, they are also present in salad dressing, sauces and even in dairy-based foods such as ice cream and coffees (Davis et al. 2011). Thus, dietary preferences also shape FOG disposal (Marvin and Medd 2006). Williams et al. (2012) estimated the FOG consumption per capita in developed countries as over 50 kg/annum compared to less than 20 kg/annum in less developed countries. However, the spread of western lifestyles in many parts of the world can accelerate the transition towards FOG-rich nutritional diets (Popkin 1999).

Household management of food waste also shapes what is poured down the kitchen sink. According to a recent review (Zan et al. 2022), food waste practices are directly related to demographic factors (e.g., gender, age, type of household and socioeconomic background), economic incentives (e.g., weight-based taxes on residual waste), personal habits and social norms, and environmental awareness.

Initiatives to reduce the effects of FOG waste on the sewer system prioritize prevention, by reducing FOG from diets or avoiding diversion of FOG to the sewer system by promoting their re-use (Arthur and Blanc 2013; Wallace et al. 2017). (Re)-used cooking oils should be afterwards recycled to produce biodiesel and other bio-products. Less preferred options include other recovery options (anaerobic digestion) and disposal (Wallace et al. 2017).

2.3. HEALTH-RELATED PRACTICES: USE AND DISPOSAL OF PHARMACEUTICALS & IMPACTS ON SEWER

Pharmaceuticals are released to the environment by various routes including municipal wastewater effluents, industrial discharge, urban runoff, precipitation, and landfill leaching (Wilkinson et al. 2017). In the case of antibiotics, urban wastewater seems to be the predominant route (Richardson and Kimura 2020). Thus, growing concerns about the release of pharmaceuticals on wastewater focus on their use and misuse and the inappropriate disposal of pharmaceuticals.

Pharmaceuticals can lead to adverse health and ecosystem impacts. For example, environmental exposure to antidepressants can produce behavioural changes, morphological anomalies, and change survival of fish populations (Sehonova et al. 2018), while antibiotics released in the environment increase antibiotic resistance bacteria (Wu et al. 2017). Long-term exposure to low-level concentrations of pharmaceuticals in the environment also produces effects on human health (Richardson and Kimura 2020). This is why several public health policies and strategies have been activated. For instance, the European Union Strategic Approach to Pharmaceuticals in the Environment proposes to (1) promote prudent use of pharmaceuticals, (2) support the development of pharmaceuticals that are less harmful for the environment, (3) improve environmental assessment, (4) improve the management of waste, (5) expand environmental monitoring, and (6) identify knowledge gaps (EU 2019). In the US, the Drug Enforcement Administration (DEA) has created the Take Back Day which encourages the public to remove unneeded medications from their homes as a measure of preventing medication misuse and opioid addiction. The resources provided help citizens dispose of unneeded medications in their home. For instance, they provide a database to find and locate an authorized collector close to their area.

Regarding urban wastewater effluents, two types of household practices shape the release of pharmaceuticals: the patterns of consumption of pharmaceuticals and the practices of disposal of pharmaceuticals. Rational use of medicines remains a global challenge due to their extensive overuse, underuse, or misuse. The WHO estimates that more than half of all medicines are prescribed, dispensed or sold inappropriately, and that half of all patients fail to take them correctly (WHO 2022). Similarly, inappropriate practices of disposal of pharmaceuticals are still extensively reported. For instance, a survey run in France found that 35 % of the French people dispose pharmaceuticals in the toilet, including the WC and toilet bins (CIEAU 2022).

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

The case of antibiotics has progressively captured policy attention in the last decades. The intensive use and misuse of antibiotics has resulted in antibiotic resistant bacteria (ARB) and antibiotic resistance genes (ARGs) impacting both the environment and human health (Richardson and Kimura 2020). To avoid antibiotics overuse, taking antibiotics "exactly as prescribed" (i.e., therapeutic adherence), is key to mitigating the emergence and spread of bacterial resistance to antibiotics (Llewelyn et al., 2017). As reviewed in D4.8 (Garcia-Sierra et al.,2022), adherence to antibiotic therapy is known to be a problem associated with chronic medication in patients with long-term pathologies (Martin et al., 2005). DiMatteo (2004a) found as many as 25% of patients were nonadherent. While demographic effects (i.e., patients' age, gender, education, and income/SES) on adherence play a small role; social support variables (i.e., family cohesiveness as opposed to family conflict/dysfunction) seem to play a strong significant role in increasing adherence behaviour (DiMatteo, 2004a; 2004b).

Importantly, different countries, men and women, and different groups in society, may be differently at risk of or impacted by antimicrobial resistance (AMR) (WHO, 2018). To address this global challenge, several campaigns at regional, national or international levels have disseminated information about this problem and shared best practices. As we will show in section 3.2, international campaigns lead by WHO such as the World Antimicrobial Awareness Week (WAAW) aim to increase awareness of global antimicrobial resistance and to encourage best practices among the general public, health workers and policy makers to avoid the further emergence and spread of drug-resistant infections.

2.4. INNOVATIVE METHODOLOGIES TO DISENTANGLE HOW HOUSEHOLD PRACTICES AFFECT WASTEWATER SYSTEMS

The content of solids in sewage is typically determined by collecting samples from sewers, blockages, or wastewater treatment plants, as well as collecting waste from beaches and rivers and conducting surveys on reported disposal practices (Alda-Vidal et al. 2020b). However, quantifying solids discharged into sewers is difficult because sample compositions vary greatly depending on the time and location of sample collection, as well as due to the difficulties in identifying the materials when they are partially degraded and mixed with sewage. Moreover, the relationship between the daily practices of citizens and the concentration of different elements in the sewer is complex. Wastewater-based Epidemiology (WBE) and Lifestyle Habits Surveys have emerged as effective tools to better understand these complex relationships. Both methodologies have been tested in the case study of Barcelona of the SCOREwater project.

The SCOREwater project aims to deploy new data-driven models for the maintenance of the sewer system (sewer hydraulics, retention, release) and to mine data on lifestyle habits and health status from the chemical and microbiological analysis of sewage samples as an input for the design of health and environmental campaigns. The case study of Barcelona aims to prove the feasibility of wastewater-based epidemiology (WBE) in a real case study. To do so, information from sensors, chemical analyses and other techniques, is correlated with non-wastewater-derived sources such as health records, medical prescriptions, and population surveys such as the Lifestyle Habits Survey (LHS). The main tasks of the project in Barcelona are the deployment of three monitoring stations in neighbourhoods with different socioeconomic status, information collection and deployment of new monitoring capabilities, surveys of disposal practices in households, and big data analytics and visualization. During the project, some of the materials producing blockages in the sewer systems and contaminating water will be monitored: oils and greases (real-time) and pharmaceuticals. More detailed information can be found in D4.6 (Zammit et al. 2020). Moreover, to better understand and track the inappropriate disposal of wet wipes, the SCOREwater project will adapt the approach already tested by BCASA in the Life Project iBATHWATER to monitor the presence of wet wipes in urban sewer systems.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

A complementary source of information is the SCOREwater Lifestyles Habits Survey (LHS), the outputs of which would serve to double validate those of the WBE study. The survey questionnaire included in its design validation questions matching the biomarkers analysed in wastewater samples from three communities monitored in Barcelona, regarding five main aspects: (1) health status and risk factors; (2) diet and vegetarianism; (3) adherence to medical therapy and OTC intake of pharmaceutical drugs; (4) household waste management; and (5) socio-economic status (SES) of inhabitants. The survey was administered between June 21 and July 14, 2021. A total of 1,004 interviews were performed in the three neighbourhoods: 354 in the Carmel low-SES area, 325 in the Poblenou middle-SES area, and 325 in the Sant Gervasi high-SES area. The sample design was made to be representative of the populations living within these sewersheds. More information can be found in D4.8 (Garcia-Sierra et al., 2022).

Results show differences between the populations of the three study areas in terms of health, health risk factors, and diet quality in the anticipated directions according to area-level SES status and for some variables (e.g., self-rated health and body mass index) also according to personal SES, namely following the social gradient. Antibiotic prescriptions were more common (significant) in the middle- and high-SES areas of Poblenou and Sant Gervasi, where people were also reported to have kept antibiotic leftovers and used them without prescription more frequently than residents in the low-SES area of Carmel. Regarding household waste management, one-use wet wipes were more frequently used in the low-and middle-SES areas of Carmel and Poblenou, respectively, and by young female adults (16–44 years). However, occasional inadequate disposal of those was more frequent in the high-SES area of Sant Gervasi.

The combined analysis of Wastewater-based Epidemiology (WBE) and Lifestyle Habits Surveys (LHS) is still in process and results of this analysis will be presented in D4.10 *Description and main achievements for the case study of Barcelona*.

2.5. SCOREWATER FACTS AND FIGURES TO INFORM THE DESIGN OF CAMPAIGNS TO PROPERLY DISPOSE OF WASTE AND AVOID WATER POLLUTION

This section will be fully developed once a correlation between the data on surveys and the monitoring stations is made. It will be completed in D4.10 *Description and main achievements for the case study of Barcelona*. Meanwhile, the main findings of the Lifestyles Habits Survey (LHS) concerning wastewater disposal practices in households are summarized here (detailed findings can be found in D4.8 (Garcia-Sierra et al., 2022)).

Household waste management

- Wet wipes were mainly used for personal care purposes (48%) or as a substitute for toilet paper (25%). Yet, wet wipes were significantly more used with children by young adults (16-44) and by those above mean personal-level SES in Poblenou (middle SES).
- Wet wipes were more used in low- and middle-SES areas of Carmel and Poblenou, respectively. Yet, occasional inadequate disposal was more frequent in the high-SES area of Sant Gervasi. A larger proportion of women in Carmel low-SES area used wet wipes every day or few times a week. In general terms, women used more wet wipes on a daily basis than men, but men flushed them down the toilet more often. Most seniors (65+ years) never used wet wipes compared to young adults (16-44 years).
- A larger and significant proportion of young female adults (16-44) of Carmel (low SES) and Poblenou (middle SES) reported never flushing hygiene products down the toilet compared to the same age group population of Sant Gervasi high-SES area.
- Occasional inadequate disposal of waste cooking oil was more frequent in Sant Gervasi (high-SES area) and Poblenou (middle SES), whereas it was never improperly disposed of by seniors (65+) at Carmel low-SES area; results being significantly different from other group categories.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Adherence to medical therapy

- More antibiotics were prescribed (past 12 months) in the middle- and high-SES areas of Poblenou and Sant Gervasi (significant), respectively, where people also reported to have kept antibiotics leftovers and used them without prescription more often in comparison to residents in the low-SES area of Carmel. Women and young adults (16-44 years) and adults (45-64) were more prone to keep antibiotics leftovers than other social groups. Adherence to antibiotics therapy was of 93% to 98% (non-significant).
- Gender differences were more notable in terms of long-term treatments (15+ days) with analgesics and sedatives; significantly more women in Carmel low-SES area were prescribed analgesics and sedatives compared to other categories. In contrast, there were significantly more men in Carmel, and to a lesser extent in Poblenou (middle-SES area), who never got prescribed sedatives.
- A relatively high proportion of adults (45-64 years) and seniors (65+ years) of Carmel (low-SES area) and Poblenou (middle SES) had received medical treatment with analgesics the past year, which might be influenced by the COVID-19 vaccination campaign.
- Age differences were the most notable in terms of therapy with hypotensives, namely occurrence increased with age in all three study areas.
- COVID-19 results did not show significant differences by study area, sex, or personal SES. Yet, a higher prevalence was recorded among young adults (16-44) and adults (45-64), compared to seniors (65+), coinciding with the fourth wave hitting the age groups not being vaccinated by June 2021.

All in all, relevant insights obtained from the analysis of wastewater samples can further help understand behaviour, as well as improve knowledge for the management of the water cycle by public authorities.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

3. INTERVENTIONS TO ENCOURAGE THE PUBLIC TO PROPERLY DISPOSE OF FATS, OILS AND GREASE (FOG), UNFLUSHABLES AND OTHER IMPROPER WASTE IN SEWERS

While previous section has focused on how and why impactful household disposal practices occur, this section is centered on what might be done to tackle these issues. Literature from both practitioners and scientific communities emphasize the need to develop and implement different interventions to address the challenges faced by current wastewater systems, ranging from infrastructural to legislative and behavioural response options (Alda-Vidal et al. 2020b; Arthur and Blanc 2013; WWAP 2017). Managerial options to handle specifically the negative impacts of domestic waste in sewers have also been divided depending on the sub-system targeted between measures directed at households and measures directed at sewers (Mattson et al. 2014b). Measures directed at households and commercial enterprises include strategies such as educational campaigns (websites, flyers, media, seminars, etc.), the installation of FOG collection systems (rendering containers), the installation of grease interceptors, or the creation of closed loop systems for water and wastewater in newly constructed residential areas. While measures directed at sewers include actions such as the introduction of microorganisms and enzymes in sewers to degrade FOG or the reduction of diameter to accommodate lower water consumption rates.

However, not all responses should be equally prioritized. Instead, policy recommendations highlight the need to prioritize the prevention of pollution (rather than its treatment) by addressing the causes of wastewater pollution (WWAP 2017). As Alda-Vidal et al. (2020b) recently argued while reflecting around the challenge of unflushables: "*it is insufficient to only consider how to design products and infrastructures capable of coping with unflushables. Though this can help, as long as existing sewage system remains in place we must also consider how to change the multiple cultural, political and material factors that shape how people routinely use and dispose of unflushable products*". Similarly, the Deputy Chief Executive at Water UK (the association representing all the water and wastewater companies in England, Wales, Scotland and Northern Ireland) claimed that, beyond regulation and enforcement, it is crucial to change attitudes amongst users (e.g., staff working in commercial kitchens, people living in their own homes) by focusing on education and awareness interventions (Mills 2010).

Building on previous knowledge and practices developed, this section aims to contextualize interventions willing to change impactful disposal habits and introduce and popularize alternative sustainable practices in households. To do so, we introduce research addressing these public interventions and particularly public awareness campaigns. Secondly, we observe previous campaigns to discuss what they are doing well and what could be done even better.

3.1. RESEARCH ON CAMPAIGNS

Previous research has classified public interventions to address domestic waste entering wastewater systems into four different models: 1) service provision, 2) individual action, 3) social norms and networks, and 4) socio-technical practices (see Table 1). While service provision represents the classic and prevailing model by which public authorities assume most responsibility through large investments on maintenance and new infrastructures, the model of individual action focusing on changing behaviours has progressively been mainstreamed and integrated in the wastewater sector as a key intervention.

Table 1. Existing models for managing unflushables, FOGs and other domestic waste entering sewerage systems. Source: adapted from Alda-Vidal et al. (2020b), Foden et al. (2018), and Hoolohan & Browne (2016).

Models	Responsible stakeholders	Focus of the intervention	Challenges
Service provision	Water companies and public authorities are service providers, responsible for managing unflushables and other waste, with	Interventions focus on reducing the damage caused by unflushables and other improper waste in the sewerage system.	Maintenance is expensive and unsustainable. There is also risk that undesirable practices are sustained as cultural conventions and infrastructural imaginaries remain unchallenged. In reality

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Models	Responsible stakeholders	Focus of the intervention	Challenges
	consumers paying the price.		responsibility is distributed across many actors, and holistic intervention action is needed.
Individual action	Individuals are responsible of making disposal decisions.	Interventions seek to change behaviour by offering information and behavioural cues (nudges).	While awareness is increasing of the challenges presented by certain waste products, this approach requires a substantial proportion of the population to alter their behaviour in order to be effective and overestimates the capacity people have to act in different ways. Additionally, this model risks blaming individuals for a systemic problem.
Social norms and networks	Individuals are responsible of making disposal decisions. However, this model acknowledges that social norms and networks influence people's decisions.	Interventions are designed to normalise desirable practices, for example by using champions and community groups. Interventions assume that people's decisions are influenced by what others think is normal and acceptable, and seek to change these perceptions.	Though valuably creating conversation around a taboo subject (e.g., menstrual hygiene management), this approach shares many of the challenges of Individual Action.
Socio-technical practices	Disposal practices are part of a wider complex socio-technical context.	Instead of focusing on a particular behaviour this strategy intends to effect change in the collective conventions, routines and infrastructures of consumption.	Not many interventions have been initiated within this area and further research and policy understanding is needed to develop interventions that address this problem.
Public policies and government	This model acknowledges that action should recognise the many actors that share responsibility for unflushables and other improper waste entering the sewer system, and particularly public authorities who have agency to lead and drive effective regulations and positive changes.	Interventions include public policies (e.g., ban plastic wipes, ban food waste disposals), regulations and standards (e.g., flushability standards), and appropriate governance structures guiding integrated action towards Planetary Health.	This approach shares many of the challenges of the Socio-technical practices model. For instance, there have been attempts to standardize the labelling of flushable products through guidelines and codes of practices; however, these are not as ambitious as many public actors would like.

Although, the models acknowledging social norms, the socio-technical context or focused on public policies promise a new avenue for managing the sewerage challenges associated to domestic waste and its consequences for the environment and public health, they have still been scarcely applied in practice and therefore the analysis of best practices and learnings remains limited. For this reason, this section pays particular attention to the individual action model with the goal to gain insights from successful campaigns and research analysing these awareness initiatives.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Different approaches have been taken to raise public awareness of the problems associated with the disposal of wet wipes, FOG and other improper waste entering sewerage systems. Arthur and Blanc (2013) classify these awareness initiatives into two main categories: a) general campaigns, and b) targeted campaigns. General campaigns are designed to encourage the public to properly dispose of FOGs, unflushables and other improper waste through increasing awareness of the consequences and damages caused by improper disposal. Some examples include "Nature Calls" (Scotland), Rien in het riool (The Netherlands), the Think Before you Flush (Ireland) or the "City to Sea" (UK) (see Table 2). In addition to general campaigns, many organisations have set up targeted campaigns designed to raise awareness either through specific events, at particular times of the year, or for particular groups (Arthur and Blanc 2013). Examples of targeted campaigns include "The Unmentionables" (UK Water), the "Periods for Future" (Austria) or the European Antibiotic Awareness Day. Conventional campaigns have progressively incorporated innovations such as digital tools (see Pawsey et al. 2018) and creative, emotional or arts-based strategies (see Curran et al. 2019, Michael 2020) to engage with citizens more effectively.

A few research has examined in detail the scope, the media used, or directly evaluated sewer-related campaigns (for some exceptions, see Alda-Vidal et al. 2020b, Mattson et al. 2014a; in the case of antibiotics awareness campaigns there is more research, see for instance Huttner et al. 2019, Keitoku et al. 2021, Mazińska et al. 2017, McNulty et al. 2010). Focusing on Sweden and Norway, Mattson et al. (2014a) found that 45% of the sewer operators or managers surveyed in Sweden and 52% in Norway stated that their municipalities had not conducted any form of educational campaign to highlight the problems caused by FOG in the sewer system. Most of the Swedish municipalities that had conducted campaigns did so by distributing pamphlets; while in Norway, the most common approach was to publish information on the municipality's homepage. Importantly, around one third of the respondents from sewer operators expressed doubts as to whether these campaigns actually had any real effect (Mattson et al. 2014a).

Most campaigns do not have (or at least publicly share) set clear expected impacts and evaluated their impact afterwards. There are some exceptions though. For instance, the program to reduce antibiotic use in Catalonia (see Table 2) included clear expected impacts, such as increase by 50% the number of patients with information about proper use of antibiotics and reduce by 50% the practice of antibiotics self-medication (CatSalut 2002). On the other hand, the program "Keep It Clear" from Anglian Water (see section 3.2.1) has evaluated their effectiveness to reach the targeted audience (e.g., number of participants, diversity of the audience), but also their impacts for instance by tracking average sewer blockages (e.g., they argue that in areas with the campaign sewer blockages reduced by 59%, while in towns without the campaign blockages increased by 6% in the same period) (Anglian Water 2022).

3.2. CAMPAIGNS TO ENCOURAGE PROPER DISPOSAL OF FOG, UNFLUSHABLES AND OTHER DOMESTIC WASTE

This section examines campaigns implemented by different institutions and water operators to raise public awareness on proper disposal of domestic waste entering wastewater systems. Particularly, the analysis is focused on campaigns promoting changes in household behaviours to reduce the impacts that unflushables, FOGs and food, and antibiotics generate on sewerage performance.

First, we present an exploration of diverse campaigns, with different sizes, formats, and geographical contexts. In total, we present 53 campaigns across 13 different countries. Table 2 summarizes the campaigns found during this explorative analysis by explaining the country, the promoter institution, the title of the campaign, the audience targeted and the year when it was implemented.

Secondly, we focus on ten outstanding campaigns which are showcased as best practices due to their ambition and scope, their novelty, or their capacity to combine different communication tools and media. Selected campaigns include three campaigns at the national scale, two campaigns created by associations of public operators (to be adapted afterwards by each local operator), three campaigns at the local level, and two international campaigns addressing the challenge of antibiotics. Next section continues the analysis by considering the campaigns through a gender perspective.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Table 2. Selection of campaigns willing to reduce domestic waste entering wastewater systems. Source: own elaboration.

Country	Promoter institution or operator	Name of the campaign	Audience	Year
Australia	Sydney Water	Protect your plumbing: "Its best to bin it"	General public	2021
Austria	Austrian federal provinces	Das WC ist kein mistkübel! (The toilet is not a garbage can!)	General public	2016-now
Austria	Ready for Red & Generation Blue	Periods for future: Protect water - use garbage cans	Children/Young	2020
Canada	Canadian Water and Wastewater Association (CWWA) and the Municipal Enforcement Sewer Use Group (MESUG)	Support and Funding for a Canadian Standard for Flushable Consumer Products	Wastewater utilities; policy-makers	2017-now
Canada	Hamilton City Council	Flushables - Own Your Throne	General public	2018
Canada	Hamilton City Council	Fats, Oils and Grease - Beware the Berg	General public	2022
Czech Rep.	Energie AG Bohemia	DO ODPADU (WASTE or What does not belong to the sewerage)	Children/Young	2014-now
Finland	Vesilaitosyhdistys (VVY)	Pytty (Do the right thing and protect the water environment!)	General public	2016-2021
France	Syndicat Interdépartemental pour l'Assainissement de l'Agglomération Parisienne (SIAAP)	Gestes et réflexes bleus (Blue gestures and reflexes)	General public	nd
Germany	Berliner Wasserbetriebe (BWB)	I ONLY WANT THE REAL SHIT	General public	2022
Germany	Berliner Wasserbetriebe (BWB)	Nur der Po gehört aufs Klo (Only the butt belongs in the toilet)	Children/Young	nd
Germany	South Brandenburg Waste Management Association (SBAZV)	Keine Abfälle ins Klo (No waste in the toilet)	General public	nd
Ireland	An Taisce & Irish Water	Think before you flush #ThinkB4UFlush	General public & targeted actions	2015-now
Netherlands	RIONED Foundation	Niet in het riool! (NIHR) (Not in the sewer)	General public	2015-now
Spain	Asociación Española de Abastecimientos de Agua y Saneamiento (AEAS)	No alimentes monstruo de las cloacas (Do not feed the sewer monster)	Wastewater utilities	2019
Spain	Asociación Española de Operadores Públicos de Abastecimiento y Saneamiento (AEOPAS)	#WCnoespapelera (WC is not a can)	Wastewater utilities; Children	2018-now
Spain	Aigües Públiques de Mallorca	No alimentis al monstre! (Do not feed the monster)	General public	2018
Spain	Canal Isabel II (Madrid)	#LasToallitasALaPapelera (Wipes in the can)	General public & children	2018-2019
Spain	Catalan government	#EstemCreantUnMonstre (We are creating a monster)	General public	2019
Spain	Empresa de Abastecimiento y Saneamiento de Aguas de Sevilla S.A. (EMASESA)	#LasToallitasAlCubo (Wipes in the can)	General public & children	2016-now
Sweeden	Göteborg City Council	Stoppa Fett Proppen (Stopping the grease)	General public	nd

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Sweeden	Stockholm Vatten Ochavfall	Stop the Monsters i avloppen (Stop the Monsters in the drain)	General public	2022
Sweeden	Ulricehamns Energi	Det är lätt att spola rätt! (Its easy to flush right!)	General public	2016
UK	Anglian Water Region	The Unmentionables	Women	2016
UK	Anglian Water Region	Fab Little Bag	Women	2016
UK	Anglian Water Region	Lottie's Vlog	Women	2014
UK	City to Sea	City to Sea's Unflushables Campaign	General public	2018
UK	Marine Conservation Society (MCSUK)	Stop the unflushables	General public	2017-2019
UK	Marine Conservation Society (MCSUK)	Unflushables - Lesson plan	Children	2018
UK	Museum of London	Fatberg exhibition	General public	2018
UK	Scottish Water	Nature Calls. Bin the Wipes	General public	2022
USA	Beaufort-Jasper Water and Sewer Authority	Fit2Flush: What NOT to Flush Down Your Toilet!	General public	2014
USA	Clean Water Services (Oregon)	Can the Wipes & Freeze the Grease, Save the Drain	General public	2011-now
USA	Contra Costa County operators (partnership of 5 small suburban wastewater agencies)	No Wipes in the Pipes	General public	2020
USA	Eastern Municipal Water District (EMWD)	Sewer Smart: Don't be a pain in the drain	General public	2019-now
USA	Kansas Water (KCWater)	Please Don't Flush the Wipes: A Horror Story	General public	2017
USA	Louisville/Jefferson County Metropolitan Sewer District (MSD)	Bowl Patrol	General public & children	2019
USA	Marin County Sanitary Districts	Do not flush wipes	General public	2020
USA	Marin County Sanitary Districts	Fats, oils and grease cause clogs	General public	2022
USA	Metropolitan Washington Council of Governments (MWCOG)	Protect your Pipes (PYP)	General public	2017
USA	Minnesota Pollution Control Agency (MPCA)	Wipes Clog Pipes (toolkit)	Wastewater utilities	2016-now
USA	Narragansett Bay Commission	Mr. Can vs The Grease Beasts	Children	nd
USA	New York	#FatbergFreeNYC	General public	2019-now
USA	Save Water Texas Coalition (SWTC)	Patty Potty	General public	2014-2020
USA	National Association of Clean Water Agencies (NACWA)	Toilets Are Not Trashcans	Wastewater utilities	2016-now
EU	EurEau	Toilets are not a bin!	Policy-makers	2014
International	International Water Services Flushability Group (IWSFG)	Resources and videos	General public & water utilities	2017-now

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Campaigns addressing antibiotics				
Catalonia	CatSalut	Antibiòtics sí, però... COM CAL (Antibiotics yes, but… appropriately!)	General public	2002
USA	Sanitary Districts of Marin County	Don't Flush Meds	General public	2020
USA	Drug Enforcement Administration (DEA)	Take Back Day	General public	2016-now
EU	European Centre for Disease Prevention and Control (ECDC)	European Antibiotic Awareness Day (EEAD)	General public & professionals in primary care, hospitals and other healthcare settings	2015-now
International	World Health Organization (WHO)	World Antimicrobial Awareness Week (WAAW)	General public & professionals in primary care, hospitals and other healthcare settings	2015-now

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

#ThinkB4UFlush (Think Before You Flush) (Ireland)

Think Before You Flush (TBYF) is a national awareness campaign highlighting the problems caused by flushing sanitary products and other items down the toilet or the kitchen. Consequences include blockages in household plumbing, the wastewater network and littering the marine environment. The campaign is operated by the environmental NGO An Taisce within its "Clean Coasts" programme in partnership with the national water utility Irish Water and has been running since 2015. Each year, the campaign runs regionally in cities, towns, and villages across Ireland. The campaign works with the local community, businesses, and schools to promote changes in flushing behaviour through workshops, events and clean ups. As part of the Think Before You Flush campaign, the "Think Before You Pour" initiative has brought the campaign from the bathroom to the kitchen.

The campaign involves several types of media, from press releases and videos to infographics, stickers, and public events (see Figure 1). A key element of the campaign is the dissemination of what they call the "Dirty Dozen", a list of the twelve most common items flushed down the toilet in error produced after running a survey on flushing behaviour across Irish citizens. The multiple media used pretend to engage with different audiences. For instance, they provide environmental educational resources for kids, classes, and youth groups (TBYF Kids); resources to be used by businesses (e.g., cards to display in toilets or posters for use in the workplace); and recommendations and videos for householders.

Figure 1. Different media used in the Think Before You Flush campaign: exhibitions (including dissemination about the "Dirty Dozen"), public events, and infographics. Source: https://thinkbeforeyouflush.org/.

The multiple videos disseminating the campaign also target different audiences. For instance, to adapt the campaign at the regional level, they featured recognizable local faces in different towns and villages and worked with local people to create short videos[3]. Similarly, to raise awareness among young people they organized a video competition inviting all third level students in Ireland to submit videos that tie in with the Think Before You Flush campaign[4].

[3] See the regional campaign in Dublin, where among other speakers they invited the former Mayor of Dublin: https://youtu.be/AwlY8szljvc.
[4] See the video awarded the first prize: https://youtu.be/5q0SsiGtmgY

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Niet in het riool! (Not in the sewer) (The Netherlands)

Not in the sewer is a national public campaign for good sewer use. Its main focus lies on avoiding the disposal of wipes, grease, paints and medicines in the sewer. The campaign is led by the RIONED foundation, an umbrella organization for urban drainage in the Netherlands where public bodies, industry and the educational sector collaborate. The campaign started in 2012 in the region of Delfland and since 2015 was upscaled nationally engaging other Dutch regions, municipalities, and water boards.

The campaign materials have a short and powerful message: *niet in het riool* (not in the sewer). The campaign has developed using digital, paper and live formats and combining different printed campaign material (e.g., flyers in different languages, infographics, posters, auto-stickers), adverts at national to regional media, social media (blog, webpage, Twitter, Facebook, LinkedIn, YouTube), or diverse educational resources (e.g., interactive exhibitions, workshops on making wastewater-related rap videoclips, cabaret performance at schools) (see Figure 2; RIONED 2015). Moreover, they have produced short-movies and a rap starred by the Toilet Dames which use humor to communicate recommendations about proper sewer use. Toilet Dames have also facilitated public events with their mobile poo box at shopping centers, local markets, schools, or sewage treatment plants (see more about the Toilet Dames in section 3.3.2). Other innovative events designed by the campaign include the transformation of inspections and cleaning of the sewer actions (particularly in shopping or crowded streets) into public events by previously informing the locals and the press, helping the public to see what a sewer looks like, and disseminating information about good sewage use.

Figure 2. Different media used in the "Niet in het riool!" campaign: infographics in different languages, adverts for public awareness, and video-movies. Source: https://www.nietinhetriool.nl.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Nature Calls – Bin the wipes (Scotland)

This new campaign launched in early 2022 by Scottish Water is asking citizens to "bin the wipes", by arguing that many wipes contain plastic and therefore don't break down in the sewer and can cause blockages. The campaign involves different media such as communicative videos (from classic dissemination videos to a rhyming story-style animated video), campaign leaflets, and checklists with recommendations about bathroom and kitchen proper use (Figure 3).

Moreover, to the address structurally the challenge of unflushables, they have incorporated more drastic measures in the campaign by asking people and organizations to back a ban on wipes that contain plastic being sold through a specific campaign (#BanWipes) and webpage (https://jointhewave.scot/ban/). This change is relevant to mention, because previous research has found that policy action tends to focus on educating the consumer to instigate behaviour changes rather than intervening in the systemic dynamics shaping flushing practices (Alda-Vidal et al. 2020a). This move thus shows promising avenues on interventions willing to change patterns of unsustainable practice by reconfiguring systems.

Figure 3. Different media used in the "Nature Calls-Bin the wipes" campaign: infographic accompanying the bathroom checklist, kitchen leaflet, a logo of the #BanWipes petition, and the animated video. Source: https://www.scottishwater.co.uk/Your-Home/Campaigns/Nature-Calls ; https://www.yourwateryourlife.co.uk/nature-calls/.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Toilets Are Not Trashcans (USA)

The Toilets Are Not Trashcans campaign aims to protect the pipes, pumps, plants, and personnel of wastewater utilities across the USA by reducing the materials that are inappropriately flushed or drained into the sewer system. The campaign is focused on reducing the inappropriate flushing of wipes, paper towels, feminine products, pharmaceuticals, and other products that can harm sewer systems and challenge treatment plants. The campaign is led by the National Association of Clean Water Agencies (NACWA) and then each member (e.g., public wastewater utilities, stormwater management agencies) can adapt the resources and messages to their local context.

The campaign compiles three types of resources to spread information and enable change: 1) educative resources to inform citizens about what happens when items other than the 3 Ps are flushed; 2) ideas and materials for public utilities, including downloadable templates, best practices, and examples from different public US utilities; and 3) model legislation and issue summaries to encourage citizens, utilities and states taking action to achieve a better regulation of wipes. The latter, probably the most innovative tool, includes a report with communicative figures about the cost of wipes for clean water utilities, a compilation of pioneering state laws about labeling wipes, or model legislation to regulate wipes at the state level (Figure 4). Like the campaign to ban wipes promoted by Scottish Water, this set of interventions aim to change patterns of use and dispose of unflushable products through integrated action and not only by relying on changes in individual action. Finally, the campaign also provides resources for safe disposal of medicines such as information and links about the National Take-Back Day.

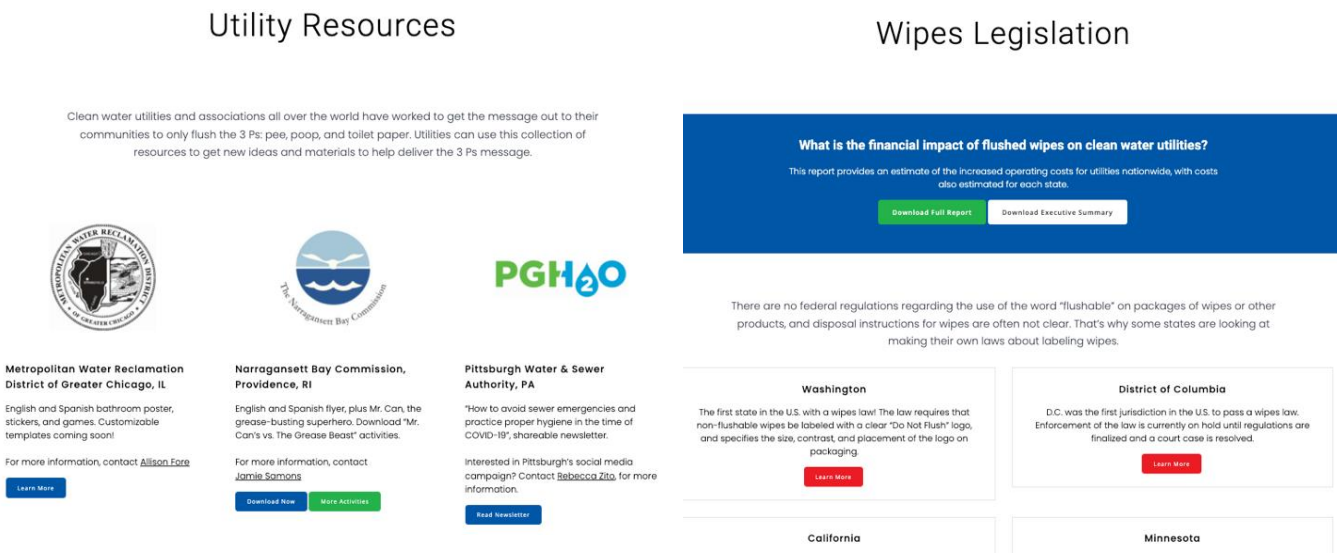


Figure 4. Different resources provided by the "Toilets Are Not Trashcans" campaign, materials from different utilities (downloadable and links to exemplary campaigns) and resources to encourage state legislation of wipes. Source: https://flush3p.org/.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

#WCnoespapelera (WC is not a can) (Spain)

The #WCnoespapelera (WC is not a can) awareness campaign aims to address the problems caused by the misuse of domestic waste and the products thrown away through toilets. Although the campaign highlights wet wipes as the problem with greatest media and economic impact, it also tackles other unflushables, FOG, paints, cigarette buds and medicines that challenge the functioning of urban sewer systems. The entity leading the campaign, the Spanish Association of Public Supply and Sanitation Operators (AEOPAS), has created different materials that are available to members (that is, water and wastewater public operators) so that they can personalize and use these materials through local awareness campaigns in different geographical areas. Among the media used, they provide a webpage with general information on the damage caused by the different waste, numerous banners which can be adapted and sent to local digital press, as well as different videos to distribute them through social media (see Figure 5). Moreover, to reach younger audiences the campaign has produced a children's storybook in different languages explaining the problems caused by wet wipes flushed down the toilet.

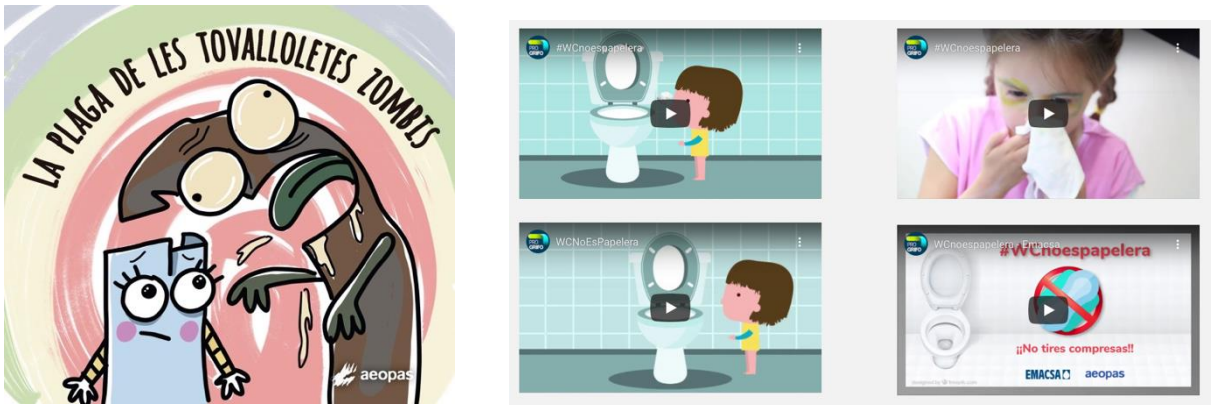


Figure 5. Different media used in the #WCnoespapelera campaign: children's story in different languages, and video-movies. Source: https://www.aeopas.org/campanas-de-sensibilizacion/wcnoespapelera/.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

I ONLY WANT THE REAL SHIT (Berlin, Germany)

I ONLY WANT THE REAL SHIT is a local campaign to avoid the disposal of hygiene (wet wipes, cat litter), food (leftovers and FOG) and pollutant (medicines, cigarette butts, paints) waste in the toilet. The campaign launched in February 2022 is led by the Berliner Wasserbetriebe, the recently remunicipalized public company supplying Berlin with drinking water and treating its wastewater. The campaign is mainly directed to property managers and landlords and uses the effect of anthropomorphizing (i.e., the WC is portrayed as humanlike) and a multilingual content marketing strategy (i.e., content is created in seven languages) to reach the multicultural population of Berlin. The media used include a music video with a catchy song (in two months it reached almost 750k views in YouTube) where a toilet with a male voice and one with a female voice draw attention to what is flushed down the toilet (Figure 6). The campaign also uses classic media such as toilet posters and leaflets to be download and printed.

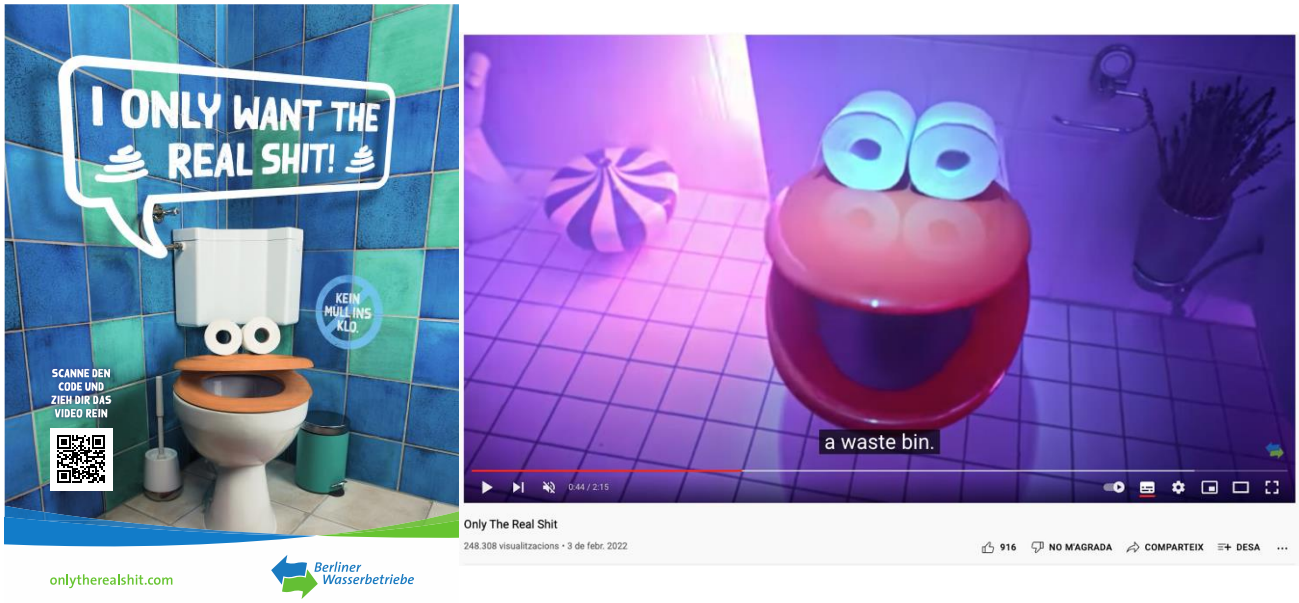


Figure 6. Different media used in the Berliner Wasserbetrie campaign "I ONLY WANT THE REAL SHIT": video-song and toilet poster. Source: https://www.bwb.de/de/only-the-real-shit.php.

Moreover, this campaign links with the water company informative resources on preventing the entry of microplastics in wastewater. Among other questions they explain what are microplastics, how they are formed, what the public company is doing against them, or how to avoid them. Moreover, they inform about several guides for citizens to find out which products contain plastics (e.g., the Heinrich Böll Foundation plastic atlas, the BUND shopping guide list), as well as an app which scans the product's barcode to show what ingredients it contains and whether microplastics are hidden inside (CodeCheck App).

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

It's best to bin it (Sydney, Australia)

This local campaign promoted by Sydney Water aims to reduce unwanted bathroom products and kitchen waste which end up down household drains and block pipes. To raise awareness two main messages are used. First, in the bathroom, they recommend to only flush the three P (pee, poo, and toilet paper) and avoid "The Unflushables" represented as wet wipes, cotton buds and other sanitary items (see Figure 7). Second, in the kitchen, to only drain the sinkables (water and soap) and avoid "The Unsinkables" represented as coffee grounds, oils/grease, and food scraps (Figure 7). The slogan for the kitchen-related recommendations is "*Don't event sink about it!*". The main media used include banners, a flyer in six different languages, and a short video. The campaign also emphasizes that 5 million people are all connected through the Sydney wastewater system and how their actions influence each other.

Figure 7. Different media used in the Sydney Water "It's best to bin it" campaign: banners and videos about "The Unflushables" and "The Unsinkables". Source: https://www.sydneywater.com.au/water-the-environment/what-you-can-do/protect-your-plumbing.html.

Unflushables: Own Your Throne! (Hamilton, Canada)

This local campaign promoted by the City of Hamilton (Canada) aims to educate residents of the impact caused by flushing items that should never be flushed. To emphasize that the only things that should be flushed down the toilet are pee, poo and toilet paper, the campaign animates the 3Ps and portrays them as the guardians of "The Throne" (the WC) protecting Hamilton from the unflushables (see Figure 8). The webpage also explains in detail how flushing inappropriate items is leading to the damage of homes, neighbourhoods, the wastewater treatment system in Hamilton, and the Hamilton Harbor.

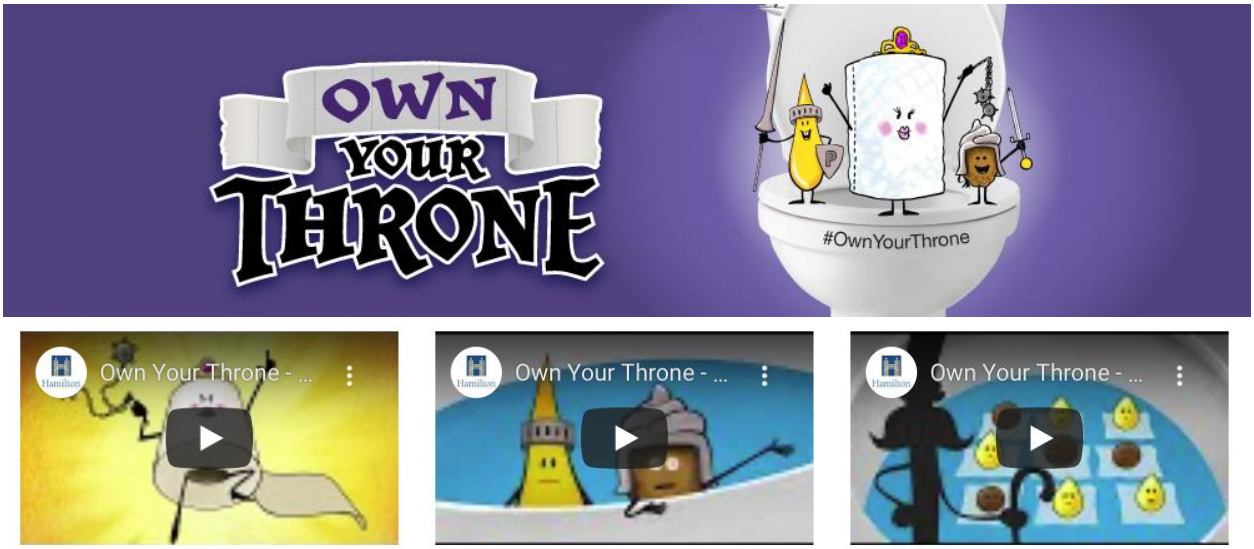


Figure 8. Different media used in the Hamilton "Own Your Throne" campaign: banners and series of episodes about how the 3Ps protect The Throne from unflushables. Source: https://www.hamilton.ca/home-property-and-development/water-sewer/flushables-own-your-throne.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

European Antibiotic Awareness Day (EAAD)

The European Antibiotic Awareness Day (EAAD) is a campaign led by the European Centre for Disease Prevention and Control to raise awareness among health professionals and the public of the importance of continuing the fight against antimicrobial resistance to preserve the effectiveness of antimicrobials. The European campaign is developed in partnership with the World Antimicrobial Awareness Week (WAAW), during the week of 18-24 November, with a special focus on each year's theme. They also integrate the national campaigns and ambassadors of the EAAD in each European country (Figure 9). The campaign includes multiple media in different languages such as factsheets, infographics, and videos for different audiences (general public, experts, hospitals, primary care prescribers, etc.) (Figure 10). Less classic media such as patient stories or data summaries are also used. Moreover, in the 2021 edition they launched a new multilingual survey which aims to gain an understanding of European healthcare workers' knowledge and attitudes about antibiotics and antibiotic resistance.

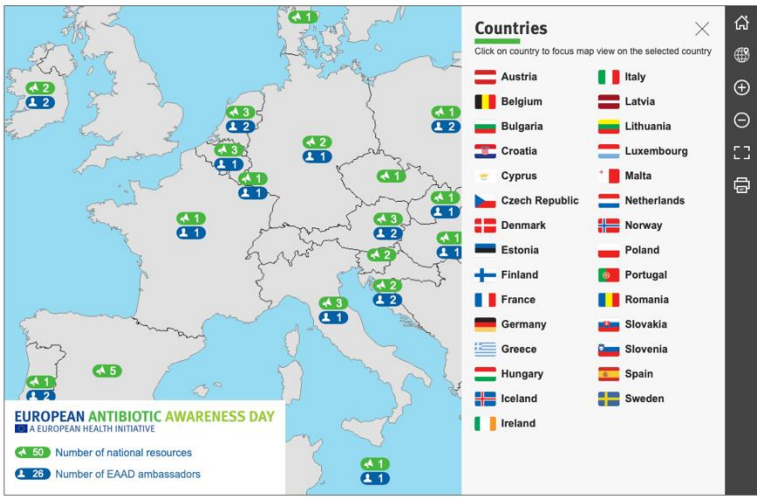


Figure 9. Compilation of antibiotic awareness campaigns at each European country in the EEAD 2021 edition. Source: https://antibiotic.ecdc.europa.eu/en/european-antibiotic-awareness-day-eaad-2021.

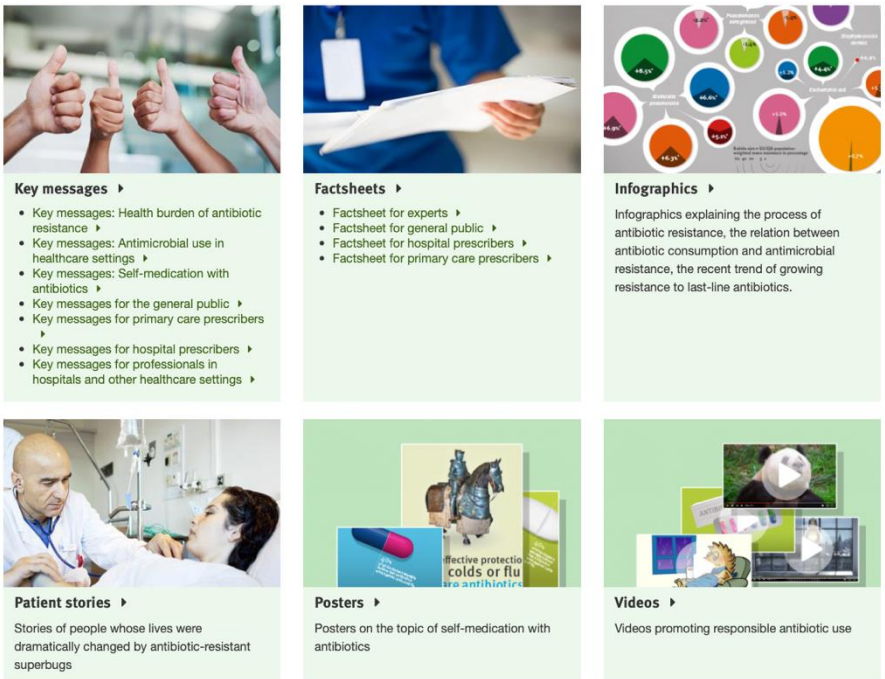


Figure 10. Different media used in the EEAD: tailored messages, factsheets, infographics, posters, videos, and patient stories. Source: https://antibiotic.ecdc.europa.eu/en/get-informed.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

World Antimicrobial Awareness Week (WAAW)

The World Antimicrobial Awareness Week (WAAW) aims to increase awareness of global antimicrobial resistance and to encourage best practices among the general public, health workers and policy makers to avoid the further emergence and spread of drug-resistant infections. Celebrated annually between the 18-24th of November, the WAAW emerged as part of the global action plan to tackle the growing problem of resistance to antibiotics and other antimicrobial medicines during the World Health Assembly organised in May 2015. One of the key objectives of the plan is to improve awareness and understanding of antimicrobial resistance through effective communication, education, and training. The campaign materials include posters, social media images, stamps, comic strips and web banners available in various languages for download, as well as videos and animations. Due to the pandemic, the campaign was run virtual in the 2020 edition and for this reason the WHO offered a virtual event toolkit. All WAAW campaign materials are stored at the WHO library (https://who.canto.global/v/campaigns/folder/NSG6R).

Despite wide dissemination, research covering the last five editions suggests that the WAAW may not have effectively improved public awareness of antimicrobial resistance and there are still barriers to engage and communicate this challenge to the general public (Keitoku et al. 2021).

Figure 11. Different media used in the WAAW: tailored posters and social media, and example of an infographic. Source: https://www.who.int/campaigns/world-antimicrobial-awareness-week/2021/campaign-materials.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

3.3. A GENDER ANALYSIS OF PUBLIC CAMPAIGNS TO REDUCE DOMESTIC WASTE IMPACTING THE SEWERS

This section conducts a preliminary gender analysis of the sewer-related campaigns identified in the previous section by selecting illustrative campaigns ensuring gender equality and identifying potential practices of gender stereotyping which ultimately reinforce prejudices, gender-related discrimination and inequalities. To do so, we first highlight inspiring campaigns empowering women and promoting gender equality. Secondly, we show how some campaigns still perpetuate gender biases and stereotypes. The initiatives selected and learnings gained across this section can help wastewater operators, policymakers, researchers, and citizens to consider, evaluate and question the role of gender in future awareness campaigns.

3.3.1. ILLUSTRATIVE CAMPAIGNS PROMOTING GENDER EQUALITY

The Unmentionables (Anglia, UK)

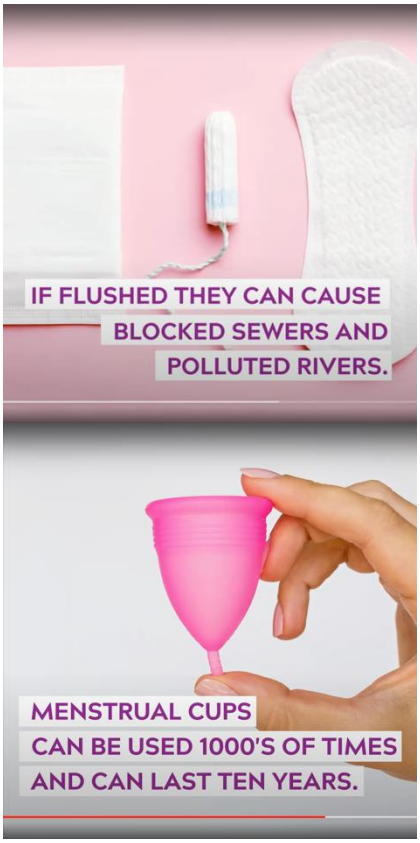
The Unmentionables is a fun hen-party style game to educate women on sanitary waste disposal in an innovative and entertaining way. The campaign was designed in 2016 by the marketing agency Grapeviners and is part of the Anglian Water's "Keep It Clear" program on behaviour change tackling pollution and flooding caused by avoidable sewer blockages (Alda-Vidal et al. 2020b). Besides providing information on correct disposal, the objective was to change understandings of what is normal and acceptable through conversations between women with different flushing habits. Influential women in the Anglian Water region were identified and offered the opportunity to host the parties (see Figure 12). Influencers were asked to recruit a group of 5-10 friends and invite them to play a mystery game. After the party participants were asked to provide feedback and share the experience in social media (e.g. Facebook). The impact of the campaign was also evaluated: more than 750 women participated at 94 parties across Anglia, which lasted over 263 hours (Anglian Water 2019). Importantly, 61% of the participants perceived the game a better way to think about disposal of menstrual products than advertising or leaflets (Alda-Vidal et al. 2020b).

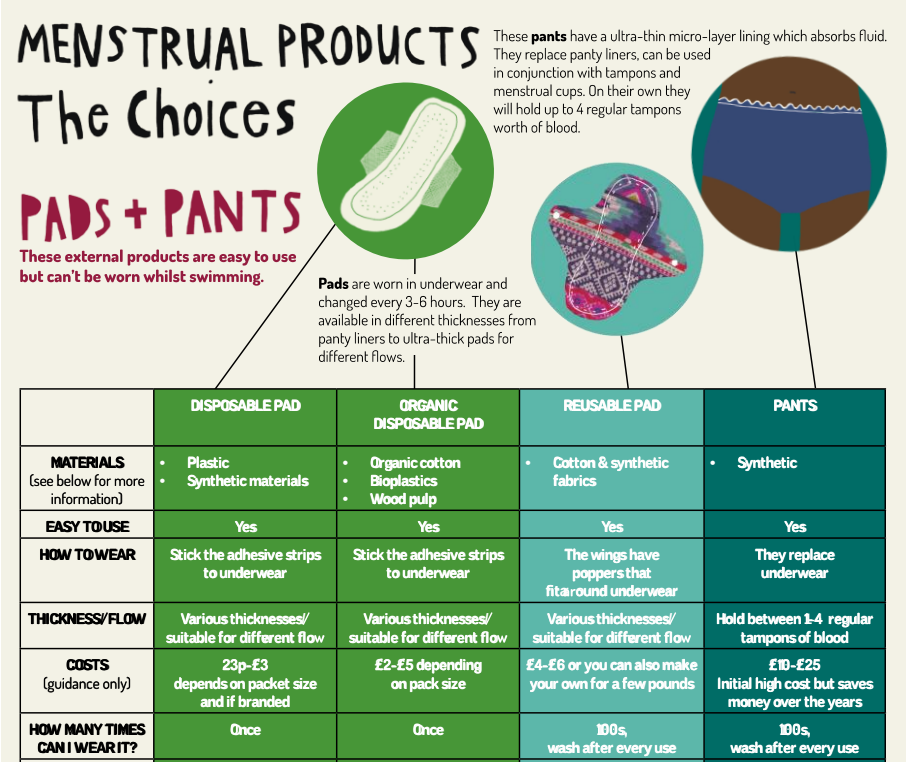
Figure 12. The Unmentionables campaign promoted by Anglian Water, integrated in the Keep It Clear program to reduce avoidable blockages. Source: Alda-Vidal et al. (2020b:25).

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Anglian Water's program "Keep It Clear" (KIC) on hygiene waste and FOGs has focused since 2011 on the provision of information around the negative effects of inappropriate flushing practices and education on right methods of disposal (Alda-Vidal et al. 2020b). The company defines the KIC as a pioneering, transformational behaviour change program tackling pollution and flooding caused by avoidable sewer blockages (Anglian Water 2022). During the last decade the program has won several communication awards. Besides the educational game and awareness raising campaign of The Unmentionables, Anglian Water has produced other educational games (e.g. Go With the Flow), formal educational resources (e.g. Period Pilot), community-based approaches to cascade out information (e.g. Student Pipeline, Young Citizens, Engaging with communities, use respected community organisations or groups of volunteers to pass-on the information about the challenge and right ways of disposal) or social marketing channels (e.g. Lottie's Vlog is a YouTube influencer style clip to raise awareness about the challenge of unflushables) (Idem).

In addition to The Unmentionables, actions targeting specifically women and people menstruating were the Period Pilot (a lesson plan for schools to educate on disposal of sanitary products) and FabLittleBag (a hygienic, easy-to-use disposal bag that biodegrades to make easier the disposal of used menstrual products in bins) (Anglian Water 2019). The Period Pilot aimed to spark the debate in schools about the methods of disposal of sanitary products, the social and environmental impacts of menstruation and the alternatives to disposal sanitary products and was to be integrated at the national school curriculum (once feedback was gained from the pilot). The FabLittleBag targeted women menstruating from different ages, surveyed over 300 members of the network Mumsnetters and gave them the chance to trial the product. The most recent campaign from Anglian Water to promote "plastic free periods" explains the impacts of unflushable menstrual products and provides information about potential alternatives. Among the media used, they provide a video as well as educational resources explaining all the menstrual products that are available (reusable and disposable), the costs and the materials they are made from (see Figure 13).





	DISPOSABLE PAD	ORGANIC DISPOSABLE PAD	REUSABLE PAD	PANTS
MATERIALS (see below for more information)	• Plastic • Synthetic materials	• Organic cotton • Bioplastics • Wood pulp	• Cotton & synthetic fabrics	• Synthetic
EASY TO USE	Yes	Yes	Yes	Yes
HOW TO WEAR	Stick the adhesive strips to underwear	Stick the adhesive strips to underwear	The wings have poppers that fit around underwear	They replace underwear
THICKNESS/FLOW	Various thicknesses/ suitable for different flow	Various thicknesses/ suitable for different flow	Various thicknesses/ suitable for different flow	Hold between 1-4 regular tampons of blood
COSTS (guidance only)	23p-£3 depends on packet size and if branded	£2-£5 depending on pack size	£4-£6 or you can also make your own for a few pounds	£10-£25 Initial high cost but saves money over the years
HOW MANY TIMES CAN I WEAR IT?	Once	Once	100s, wash after every use	100s, wash after every use

Figure 13. Plastic free periods: video and Menstrual Product Guide for Pupils and Parents. Source https://keepitclear.anglianwater.co.uk/in-the-community/female-hygiene-education/education-resources/ and https://www.youtube.com/watch?v=V1-IhGZZDAE&t=5s.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Periods for Future (Austria)

Periods for Future is a camping to encourage the correct disposal of menstrual products since young ages developed by READY FOR RED (the digital learning platform to educate young Austrian people on menstruation[5]) and Generation Blue (the water youth platform of the Federal Ministry for Sustainability and Tourism). The common goal of the campaign is to enable children and young people to use water as a resource more consciously, specifically in connection with hygiene articles in toilets. The campaign was created after a menstrual survey to Austrian young people revealed the problems girls faced in practice to appropriately dispose menstrual products or the still limited use of reusable and disposable sanitary products across them. For instance, the survey showed that 83% of the girls throw menstrual products down the toilet after use. However, to explain why they do this, almost 20% answered that there was no rubbish bin right next to the toilet and 25% that they would be embarrassed to dispose of it in rubbish bins outside the toilet. Moreover, the study found that more than a third of the girls surveyed knew the menstrual cup, but only 2% used one. Acknowledging that many people are not aware of the economic and ecological consequences of incorrectly throwing hygiene products, the Periods for Future campaign promotes education from a young age. Austrian schools and youth organizations can order the campaign's information material free of charge, which includes eco-friendly stickers, brochures and posters that educate young people (Figure 14).

Figure 14. Different educational media used in the Periods for Future campaign: brochure for the class, posters for WCs and video. Source: https://www.ready-for-red.at/periods-for-future/.

Moreover, further information about the disposal of menstrual products and an educational film on the Periods for Future campaign has been integrated into the digital learning platform READY FOR RED. This innovative digital learning platform combines online tools with physical visual and teaching material to support teachers in conveying the necessary content about menstruation and menstrual hygiene to young people. READY FOR RED includes various online tools such as drag and drop games, animated infographics, presentations, videos, slideshows, puzzles, memories etc. combined with classroom exercises and physical demonstrations (how does a pad feel?).

[5] In 2017, to quantify the need for information on education about menstruation and to adapt it specifically to the needs of young Austrian people, a survey on the level of knowledge and attitudes of young people on the subject of menstruation and menstrual hygiene was conducted. The results of this first menstrual survey showed a lack of knowledge of young people about menstruation. Moreover, promoters of the initiative argued that menstrual education was underrepresented in the school curriculum and in Austrian textbooks. To change that, the Federal Ministry of Education created the READY FOR RED digital learning platform.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Think Before You Flush - The women of sustainable change (Ireland)

In the context of the International Day of Women, the Think Before You Flush campaign launched a video series shining a light on the Irish women who are leading the way in reducing sewage-related litter (see ThinkB4UFlush, 2021). Interviewed women included Eileen Green, Company Director at Mooncup; Jean Hobbs, Project Manager for the Ringsend Wastewater Treatment Plant Upgrade with Irish Water; Sheelin Conlon, an entrepreneur and founder of the sustainable lifestyle store The Kind; and Elaine Doyle, campaign officer in the Think Before you Flush campaign. They shared their journeys, what inspires them in their work, and their advice for other women who want to tackle the problem of sewage-related litter and the single-use products that cause it.

Figure 15. Clean Coasts and Irish Water celebrate Irish women taking action on sewage-related litter during the 2021 International Women's Day. Source: https://www.instagram.com/tv/CMRxhp0g-Lh.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

3.3.2. CAMPAIGNS REPRODUCING GENDER STEREOTYPES OR EXCLUDING WOMEN

However, some campaigns still perpetuate the underrepresentation and misrepresentation of women. On the one hand, there are awareness initiatives that continue to reproduce gender stereotypes[6] (see Figures 16-21). For instance, responsibilising women – and particularly mothers – to undertake pro-environmental behaviours such as the proper disposal of household waste (wipes, hygienic and baby products, food scraps, cooking oils, etc.). These campaigns perpetuate the patriarchal stereotype considering that women are better housekeepers. While past research has explained the gender gap in environmental sustainability by exploring differences in personality traits typically observed in women versus men; recent studies have claimed that this gender gap it may also partially stem from a prevalent association between green behaviour and femininity and a corresponding stereotype (held by both men and women) that green consumers are more feminine (Brough et al. 2016). Following this new approach, they argue that this green-feminine stereotype may motivate men to avoid green behaviours in order to preserve a *macho* image. On the other hand, women continue to be excluded as subject-matter experts (see Figure 22). It is important to question campaigns excluding women since they are sexist, exclusive and do not represent the diversity of the society. As argued by Rodríguez & Guenther (2020), gender diversity broadens the number of perspectives brought into a discussion, creating spaces for engagement and innovation between different angles and viewpoints.

Join the cycle – inside your house (Clean Water Services, USA)

The campaign "Join the cycle – inside your house" launched in 2013 by Clean Water Services - the utility managing the Tualatin River watershed (Oregon, USA) - depicts women, and specifically mums, as responsible of the disposal of wipes and cooking oils.

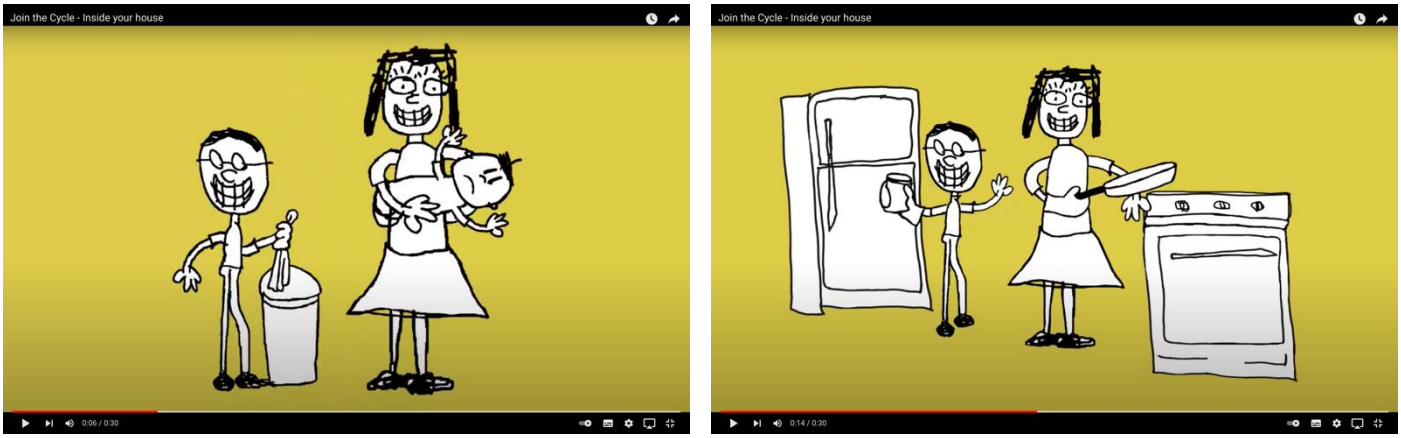


Figure 16. Gender stereotypes in the campaign "Join the cycle – inside your home" to prevent the disposal of wipes, cooking oils and other improper waste into the sewer promoted by Clean Water Services (USA) in 2013. Source: https://www.youtube.com/watch?v=G1q98TVRZIw.

[6] A gender stereotype is a generalised view or preconception about attributes, or characteristics that are or ought to be possessed by women and men or the roles that are or should be performed by men and women (OHCHR 2014). The Committee on the Elimination of Discrimination against Women (CEDAW) requires that States Parties modify or transform "harmful gender stereotypes" and "eliminate wrongful gender stereotyping" (Idem). An example of stereotypes that can be harmful is that based on the stereotype that women are more nurturing, child rearing responsibilities often fall exclusively on them.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Do not flush wipes (Sanitary Districts of Marin County, USA)

More recent campaigns continue to reproduce the same gender stereotypes. For instance, the campaign "Do not flush wipes" created by the Sanitary Districts of Marin County (California, USA) in 2020, amidst the context of the pandemic, targets women – and particularly mothers – as those responsible of the consumption and disposal of wipes within households.

Figure 17. Gender stereotypes in the campaign to prevent the disposal of wipes promoted by the Marin County Sanitary Districts (USA) in 2020. Source: https://www.youtube.com/watch?v=M9m9WM_s64Y.

Estem creant un monstre (We are creating a monster) (Catalonia, Spain)

Like the previous examples, the campaign "Estem creant un monstre" (We are creating a monster) created by the Sustainability Department of Catalonia (Spain) in 2019, reinforces the stereotype of women as responsible of wipes-related sewer blockages.

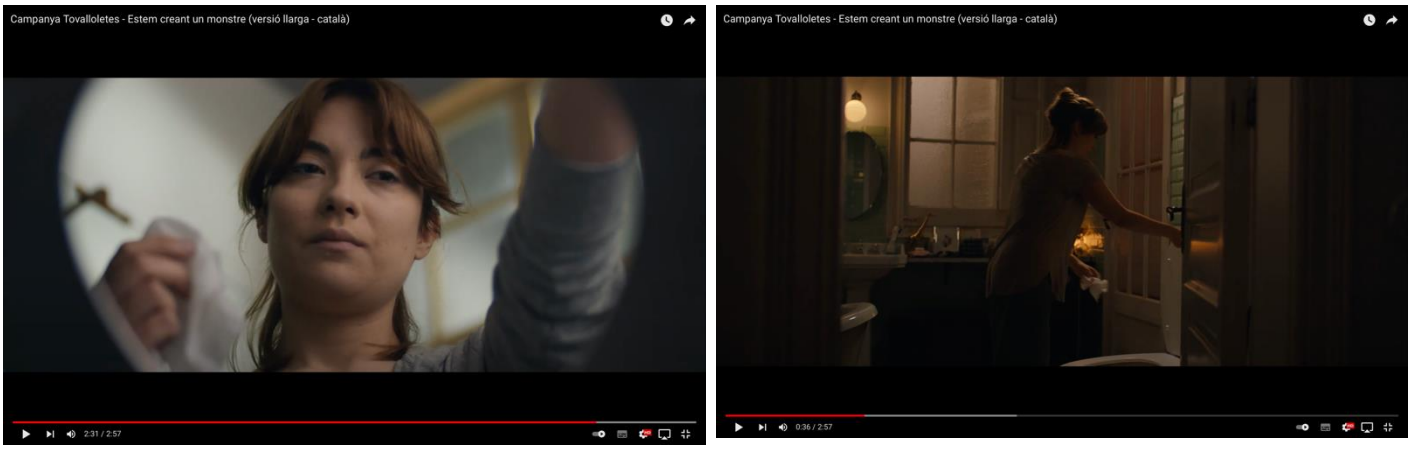


Figure 18. Gender stereotypes in the campaign "Estem creant un monster" to prevent the disposal of wipes promoted by the Catalan government in 2019. Source: https://www.youtube.com/watch?v=-vb-AnAvovQ.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Patty Potty (Save Water Texas Coalition, USA)

The Patty Potty campaign is a program developed by the Save Water Texas Coalition in 2014 and still ongoing. The Save Water Texas Coalition (SWTC) includes cities, water agencies, water professionals, community leaders, and educators across Texas (USA) who are dedicated to raising public awareness about the critical need for water conservation and water reuse measures in order to assure sustainability of groundwater and surface water resources. Members of the SWTC receive discounts when purchasing Patty Potty products which include videos, inserts, and public service announcements, as well as graphic materials (posters, billing inserts, colouring books, rack cards, Patty tote bags, bumper stickers, magnets, mini plungers, graphics for the toilet, etc.).

Patty Potty is depicted as a 1950's housewife often bossy and completely in charge of her home and family. As the campaign recognizes, "*she is a little uncomfortable having to talk about toilet topics but overcomes her reluctance because her mother taught her to tackle issues head on. Patty grew up in an era in which talking about bathroom practices was strictly taboo*" (PattyPotty 2022). They include a DO NOT FLUSH list with several products "*the names of which no proper woman would ever allow to pass her lips - like condoms and female sanitary products*" (see Fig. 20). The campaign reproduces patriarchal gender role stereotypes by assuring that "*Patty takes a "just between us girls" approach, correctly figuring that it will be the women of the household who will solve the WIPES IN THE PIPES problem*". Patty is configured as "*a likeable messenger armed with her pink plunger*", on a mission to put an end to stuff being flushed down toilets. They consider that "*Patty's message — NO WIPES IN THE PIPES — might be staged in the 50's, but it continues to be vitally important in today's water-conscious world*".

To promote sewer-friendly behaviours, Patty Potty is incorporated in water bill inserts, brochures, spots on local radio, in print ads and features, social media (Facebook, Twitter, and YouTube), and a dedicated section on several websites. There is also a short online "live" presentation by Patty, and she is also available for limited personal appearances to share her "Potty Talk" with local audiences. Moreover, Patty urges people to join her "Potty Patrol" to help protect water quality and the environment.

Figure 19. Gender stereotypes in the Patty Potty program promoted by the Save Water Texas Coalition (SWTC). Source: https://www.pattypotty.com

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Niet in het riool! (Not in the sewer) (The Netherlands)

The campaign "Niet in het riool!" (NIHR) (Not in the sewer), which started at The Netherlands scale in 2015, included as a crucial communicative tool the Toilet Dames (see more about the overall campaign in section 3.2). According to RIONED (2015), the Toilet Dames Netty and Ninette know everything about proper sewer use and communicate it with humour. They play the leading role in the six movies of the campaign: in one minute they make it clear why no wipes or grease is allowed in the sewer (Figure 20). The Toilet Dames also have "face-to-face" contact with citizens if hired by municipalities or operators. During these events, together with their old-fashioned mobile poo box, they playfully start conversations with visitors about good sewer use (Figure 21). Other campaigns have used similar approaches reinforcing such patriarchal stereotypes. For instance, the Keep It Clear program from Anglian Water organized community events with "Dame Flush" to raise awareness about wipes and unflushable waste.

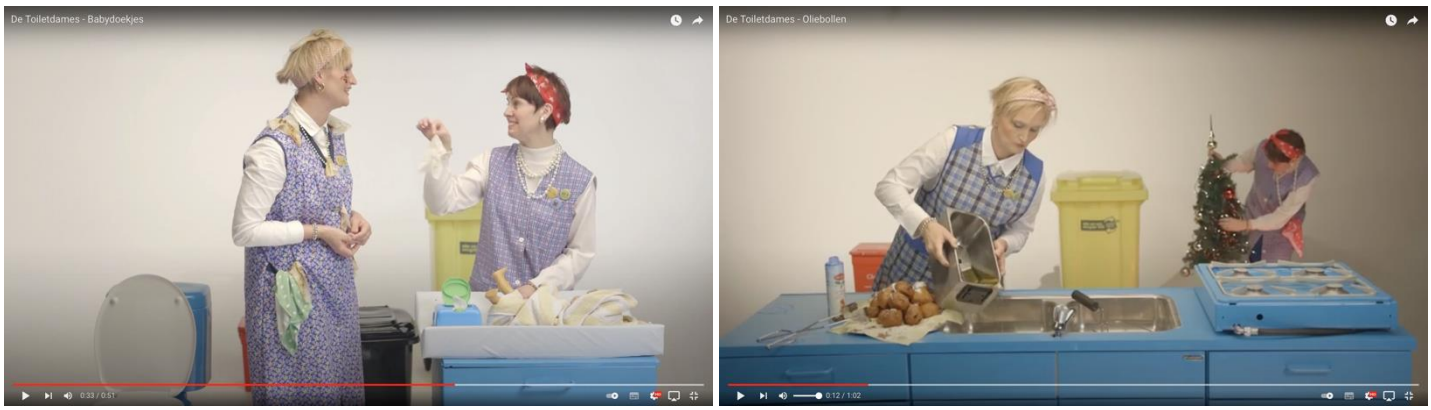


Figure 20. Gender stereotypes in the Toilet Dames dissemination videos, part of the campaign "Niet in het riool!" (Not in the sewer) promoted by the RIONED Foundation. Source: https://www.youtube.com/channel/UCSy_p8p6nowXqcZ8hhHktsg.

Figure 21. Toilet Dames as ambassadors of the campaign "Niet in het riool!" conducting dissemination to the public at the street, sewage treatment plants, shopping centres, or during particular events. Source: https://www.nietinhetriool.nl.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Nur der Po gehört aufs Klo (Only the butt belongs to the toilet) (Berlin, Germany)

Finally, underrepresentation of women can also be found in some campaigns. For instance, the educative resources part of the "Nur der Po gehört aufs Klo" (Only the butt belongs to the toilet) training program for children promoted by Berliner Wasserbetriebe (Germany), depict only males as responsible of the sewerage system or citizens.

Figure 22. Underrepresentation of women in the educational resources "Nur der Po gehört aufs Klo" (Only the butt belongs in the toilet) designed by Berliner Wasserbetriebe. Source: https://klassewasser.de/content/language1/html/6989.php

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

4. COLLECTION OF RECOMMENDED HABITS TO AVOID WATER POLLUTION AND PROMOTE CORRECT OPERATION OF URBAN WASTEWATER SYSTEMS

By reviewing recommendations from different operators, national governments and international organisms[7] we have collected the following set of best habits for households to reduce impacts on sewers and the environment.

IN THE TOILET:

- Put a bin in your bathroom.
- The rule is only flush the 3P's: Pee, Poo and toilet Paper.
- Everything else should go into the bin, not down the toilet:
    - any wipes (baby, facial, personal cleansing, surface cleaning) - even if the pack says 'flushable'
    - sanitary items (sanitary towels, tampons, tampon applicators, panty liners, backing strips and wrappings)
    - cotton wool, cotton buds, disposable nappies and nappy liners
    - condoms, incontinence pads, colostomy bags, used bandages and contact lenses
    - cigarette buds
    - food scraps of all kinds (oils and greases, but also grains, soups and sauces…)
- To reduce your reliance on single-use items like wipes or tampons switch to reusable alternatives like facial clothes, sponges and water for baby hygiene, reusable diapers, or the menstrual cup.
- Switch to plastic-free alternatives where possible and always dispose of these items in the bin.
- Choose cosmetics, deodorants and toothpastes without microplastics, phthalates or triclosan.
- Put banners, stickers, and other informative resources in your bathroom as a reminder for housemates, friends and family.

IN THE KITCHEN:

- Do not pour cooking oil, greasy food, dairy products, or salad dressing down the drain.
- Use strainers in your kitchen sink to catch food scraps and other solids, and empty them into the bio bin.
- Reuse your cooking oil: allow it to cool, filter leftovers, and store it in a cool, dry place in a sealed container.

[7] Recommendations considered from Ireland: https://thinkbeforeyouflush.org/; Canada: https://ncsd.ca.gov/resources/education/fog/; Scotland: https://www.scottishwater.co.uk/Your-Home/Campaigns/Nature-Calls/Kitchen-Checklist; Finland: https://www.pytty.fi/do-the-right-thing-and-protect-the-water-environment/#avoid-harmful-substances; France: https://www.siaap.fr/former-transmettre/gestes-et-reflexes-bleus/; Spain: https://www.aeopas.org/campanas-de-sensibilizacion/wcnoespapelera/; Catalan Water Agency: https://aca.gencat.cat/web/.content/10_ACA/M_Campanyes_i_divulgacio/01_Campanyes/Bones_practiques_en_sanejament/BPS_SOSwc_idiomes.pdf; ECDC: https://antibiotic.ecdc.europa.eu/en/get-informed/factsheets/factsheet-general-public; EPA: https://www.epa.gov/nutrientpollution/what-you-can-do-your-home; EPA: https://www.epa.gov/sites/default/files/2020-07/documents/article_2_microfibers.pdf; and WHO: https://www.who.int/campaigns/world-antimicrobial-awareness-week.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

- If you can't reuse it, collect used cooking fats, oil and greases, leave them to cool/harden and then put them into a suitable container. Check your local council or waste manager and follow their advice to dispose of and recycle used fats, oils and grease.
- Switch to zero-waste and healthy food consumption, when possible, by reducing leftover food and favouring high quality oils.
- Wipe and scrape dishes, pots, and pans with some kitchen towel before washing.
- Put any waste food (peelings, coffee ground, tea…) into your food waste recycling or bio bin.
- Leave soups, sauces, and milk products to cool/harden, and then scrape them into your food waste recycling or put them in the bin. Believe it or not they all contain fat which can also congeal and harden in your drains!
- For municipalities where food waste disposers have not yet been banned, disconnect or at least minimize use of the garbage disposal to get rid of food scraps. The food waste disposal chops up food into small pieces, but can still cause a blockage in the pipe and provides organic matter content that should not enter the water cycle. Use sink strainers to catch food items.
- Utilise environmentally friendly detergents and avoid using anti-bacterial detergents.
- Choose a frying pan which does not contain a non-stick PTFE coating. PTFE is a polymer that prevents food from sticking in the pans during the cooking process, however it can release toxic chemicals. A ceramic or cast iron pan is an environmentally friendly alternative.

IN THE LAUNDRY:

- Choose phosphate-free detergents, soaps, and household cleaners.
- Select the proper load size for your washing machine. Only run your clothes or dish washer when you have a full load. Wash laundry with cold water for a shorter period of time.
- Use the appropriate amount of detergent; more is not better. Use microfiber-catching devices when you do the laundry. Install an external microfiber filter on your washing machine.
- Hazardous substances from clothes and textiles can enter sewers and even natural water systems through washing. When possible, choose products with natural fibres and marked with Eco-labels.

ON YOUR EVERYDAY:

- Dispose of non-used and expired medicines to the pharmacy and do not throw them in the toilets, sink, gutters or garbage can. Pharmaceuticals have to be managed separately.
- Only buy the amount of pharmaceuticals you need and always follow the healthcare professional prescriptions.
- Handle antibiotics with care. Seek advice from a qualified healthcare professional before taking antibiotics and follow her/his advice on how and when to use antibiotics. Never share or use leftover antibiotics.
- Dispose of household hazardous waste (including paints, solvents, pesticides, motor oil, gasoline, antifreeze, battery fluids, household cleaners) at the recycling centre and do not throw them in the toilets, sink or gutters. Check your local council or waste manager and follow their advice to dispose of and recycle hazardous waste.
- Do not throw cigarette butts or garbage on the ground, as rain leads them to the drainage system, polluting rivers and seas.
- Consume environmentally friendly products, for your clothes, cosmetics, food and household cleaning products, but also when renovating and painting your house. Support producers who are striving to reduce pollution of the water cycle and ensure planetary health.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

5. GENERAL MODEL OF CAMPAIGNING TO ENCOURAGE PROPER DISPOSAL OF WASTE AND AVOID WATER POLLUTION IN SEWERAGE SYSTEMS

Table 3 presents different campaign options to encourage the public to properly dispose of domestic waste impacting the sewer in novel and innovative ways. As stated by design guidelines, the first consideration is the purpose of the specific campaign or the exhibition, and the second is the audience it is aimed at (Rouette 2007). This is why all campaigns proposed define goals and audiences, which can be adapted to the needs and particularities of each local context. After setting clear objectives, the message should be fine-tuned and tailored to the audience to be sure it clearly addresses and communicates the purpose of the campaign. The campaign message should be based on the recommendations presented in section 4. All campaigns presented in Table 3 have similar expected impacts, i.e., secure planetary health, increase sewer performance, reduce avoidable sewerage blockages, avoid wastewater pollution by changing household behaviours, or avoid gender stereotypes when promoting good sewerage behaviours. However, they can slightly differ due to their focus on certain products (e.g., wipes, food, FOGs, antibiotics, microplastics), their audience, or scope.

To ensure the successful production, delivery and touring of an exhibition, a raft of multidisciplined staff, departments, systems and tools should work collaboratively to reach the goals on time and on budget (Rouette 2007). In addition, as we highlighted in section 3.3., it's crucial to consider gender, ethical and diversity issues when designing the campaign. For instance, the videos should not only include experts from different fields but provide accessible information and be gender balanced. Ethical aspects should be particularly considered when campaigns imply the collection of personal data or engage with children and young people. Ethical standards should be followed at all stages of the campaign (from design to evaluation), by adhering to international and national ethical standards and regulations, and particularly comply with *Regulation 2016/679 of the European Parliament and of the Council of 27 April 2016 (GDPR) on the protection of natural persons* with regard to the processing of personal data and on the free movement of such data. For children, prior to any involvement, their oral consent and a written consent of their parents/legal guardians should be obtained.

The combination of multiple channels may result on a greater impact. However, the precise mix of media used should be determined by the targeted audience, as well as financial and time considerations (EU 2022). Campaigns can be framed within and benefit from related forums (e.g., art and science events, professional congresses, etc.) or related international days and weeks (e.g., World Water Day, World Toilet Day, World Antimicrobial Awareness Week).

Finally, the process should be evaluated regularly. Planned evaluation activities should follow the different phases of the process: 1) front-end evaluation (before the activities are conducted to help planning the process), 2) formative evaluation (at early stages to monitor the implementation of the action and formulate recommendations for improvement), 3) remedial evaluation (just before the ending of the action to inform modifications); and 4) summative evaluation (to assess the overall impact) (Jordan Schnitzer Museum, s/d). Planned evaluation activities can combine several strategies of data collection such as visitor or participant numbers/counts, online surveys, feedback sheets, focus groups, in-depth interviews, workshopping with staff and/or special interest groups, informal feedback from visitors or participants, and media/critical reviews (Idem). Moreover, to evaluate the progress towards campaign goals different metrics can be used. For instance, if one of the goals was to increase understanding of sewerage challenges, the metric can be the % of visitors who report that their understanding of sewerage-related problems has increased which can be measured through visitor/participant surveys or in-depth interviews. Campaigns have also evaluated their impact in terms of sewerage effects. For instance, the campaign "Save Your Pipes: Don't Flush Baby Wipes" launched by the Maine Water Environment Association (MEWEA), the Portland Water District, and the Association of the Nonwoven Fabrics Industry, evaluated before and after the baby wipes flushed in sewers. Over the course of 8 weeks prior to the campaign launch, organizers collected materials intercepted by a screening system installed in a pump station in the area targeted by the campaign. They separated and measured the volume of baby wipes to establish a baseline for calculating results. Eight weeks after the campaign ended, they intercepted materials using the same methodology (Water Environment Federation 2014).

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Table 3. Campaign options to encourage the public to properly dispose of hygienic, food and other waste impacting the sewerage system.

Type	Goals of the campaign	Audience targeted	Media used	Benefits and limitations
Science museum exhibition	To disseminate the challenges faced by current sewerage systems and share potential behaviour-changes with a wider audience	General public	• Permanent exhibition with informative graphic panels and videos from experts (from different disciplines, sectors, and gender-balanced) • Resources for digital engagement (e.g., interactive tablets, serious games, electronic tours, 3D virtual tour) • Live survey to visitors to share their disposal practices and visualization of the results by creating profiles related to good sewer practices (the result is continually updated by the accumulation of visitor's data) • Supporting publications (e.g., gallery guide, cards, posters, brochures) and outreach program associated with the exhibition (e.g., reception, seminars, workshops, talks)	• Interactive digital tools are an excellent tactic to draw attention and connect with the audience. However, the generational gap in ICT use can reduce the effectiveness of these tools to engage with older visitors. • These events are usually expensive and they involve time and energy. • Risk of losing digital assets caused by computer virus attacks or hard drive damage.
Educational program	To give the opportunity to children and young people to learn about the challenges faced by current sewerage systems; to share potential behaviour-changes among them; and to empower girls and boys by providing appropriate skills and resources to create a school campaign aimed at raising awareness and changing behaviour.	Children and young people	• Educational traveling exhibition (which can be resized for different venues) with informative graphic panels and videos from experts (from different disciplines, sectors, and gender-balanced) tailored to children and young people • Training resources (e.g., serious games, digital learning platform, lesson plan and worksheets) • Supporting materials associated with the educational program (e.g., leaflets, eco-stickers, posters for the WC or the class, etc.) • Resources for students to ideate a campaign in school or within the local community to raise awareness about unflushables, FOG and other waste impacting the sewers	• The educational program can complement the schools' existing curriculum and enrich children (and teachers) with knowledge and practice about the water cycle and sustainable waste management. • These events cannot always reach all schools and children equally. • Ideally, the program goals should be maintained after the specific events and therefore training programs for teachers should be planned.
Fatberg exhibition	To disseminate the challenges faced by current sewerage systems by using new artistic mediums in the public space and share potential behaviour-changes particularly related to FOG and unflushables disposal with a wider audience.	General public	• Fatberg exhibition in open public spaces • Digital informative resources by providing QRs or links to a webpage, an online exhibition, 3D virtual tour, serious games, or to videos from experts (from different disciplines, sectors, and gender-balanced) • Tours "from fatbergs to the sewer" for the general public and specific interest groups (local groups, neighbours, schools, etc.) • Outreach program associated with the exhibition (e.g., talks, street performances, informative points, etc.)	•To attract an audience and inform them about the most important messages of your campaign. If well organised, the event will be remembered by the audience. •The materials and objects from the exhibition are in risk to be damaged or lost.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Type	Goals of the campaign	Audience targeted	Media used	Benefits and limitations
Artistic contest	To disseminate the challenges faced by current sewerage systems by fostering art-science alliances and share potential behaviour-changes through innovative, emotive and immersive artistic events.	General public	• Contest of ideas • Artistic installation or performance • Resources for interaction with the audience (e.g., interactive digital art installation, app for visitors such as Kalliópê) • Outreach program associated with the exhibition (e.g., reception, seminars, workshops, talks, tours)	• Interactive art connects artists and audiences in new ways (e.g., audiences are able to become part of the artwork through their immersive experience within the artistic process). However, the emotional connection can only reach a small group of participants and limit wider public engagement. • These events can be expensive and they usually involve coordination with other artistic events.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

6. SCOREWATER PUBLIC AWARENESS TOOLKIT

The SCOREwater Public Awareness Toolkit (SPAT) is an evidence-informed community intervention designed to guide authorities in sensitizing their community to wastewater management in households and in promoting sustainable everyday household practices that can support local administrations in improving waste management in the long term, as well as to reduce impacts to the environment and public health.

The SPAT provides a comprehensive framework for a series of activities aimed at fostering behavioural change at the community level to reduce the impact on sewer performance in cities. The SPAT is based on the main learnings from the Barcelona Case of the SCOREwater project, but aims to be upscaled and replicated in other contexts. SCOREwater in Barcelona focuses on reducing wastewater management problems with the vision of improving the environment and public health: predicting sewer clogging, correlating behaviour with water quality measurements, and subsequent actions to mitigate health risks and hazardous events. The SPAT will summarize the best practices based on the results of the activities developed in the project and will include suggestions on activities to organize and the most relevant target groups.

The SPAT is intended to be used by sector stakeholders such as public administration (water cycle, health, waste, etc.), civil society, urban planners, researchers, and companies in charge of managing wastewater collection and treatment systems.

The last version of the SPAT will be updated and developed in D4.10 *Description and main achievements for the case study of Barcelona*, once all the activities (workshops with stakeholders, serious games in schools, analysis of data obtained from the stations, etc.) have been tested and carried out. The current chapter summarizes the main sections of the Toolkit.

The general framework that has guided the development of the SPAT includes: 1) Identify the target group; 2) Refine the target group avoiding gender stereotypes; 3) Identify the message; 4) Develop a general model of awareness campaign to encourage proper disposal of wastewater and avoid water pollution in sewerage systems; 5) Develop pilots of a selection of activities; and 6) Summarize recommended tools. The process can be summarized in Figure 23.

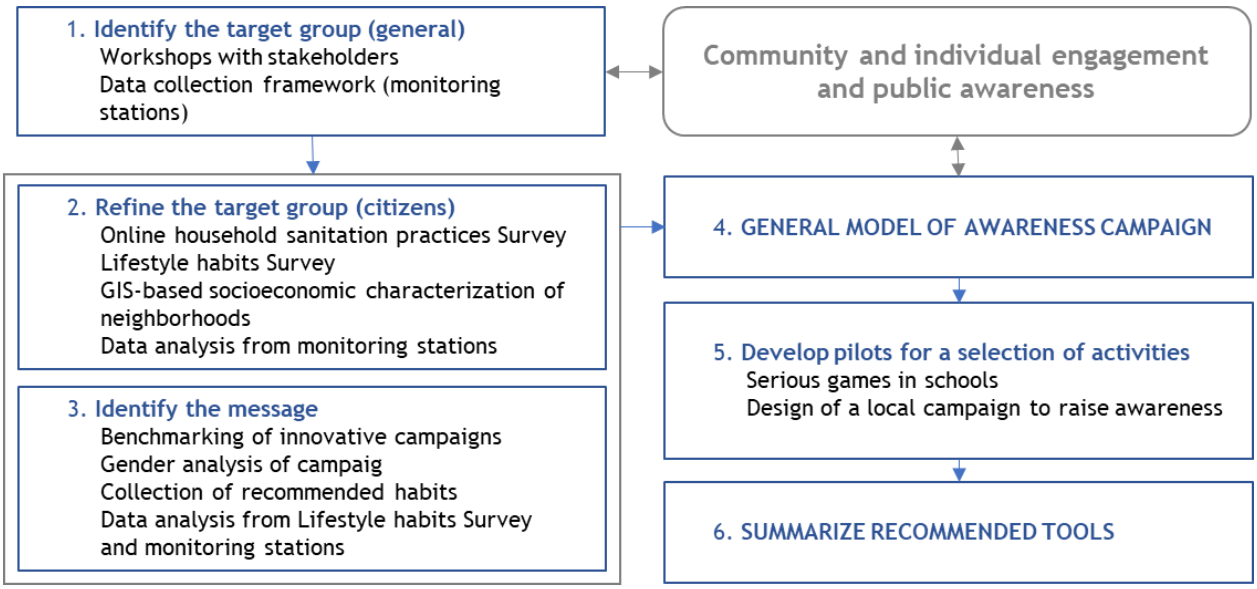


Figure 23. The SCOREwater Public Awareness Toolkit process. Source: own elaboration.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Stage 1

In the first stage of the SPAT process, the main goal is to identify the target group on the basis of information provided by key informants through workshops with relevant stakeholders. Moreover, this first stage is aligned with the data collection framework developed in the Barcelona Case of the SCOREwater project, which aims to initiate a new domain of "sewage sociology" mining biomarkers of community-wide lifestyle habits from sewage. The results of this analysis are also fed into this process.

Workshops with stakeholders

Three workshops were developed to be able to identify major challenges and needs of the different stakeholders, and inputs to better design the future steps. To take gender stereotypes and sexism into consideration, a gender-balanced network of stakeholders was set up. Three workshops were carried out: Workshop 1: Explorations; Workshop 2; Ideation - Sewer management; Workshop 3: Ideation - Health Authorities.

The main goal of Workshop 1 was to share the strategic lines of the project and to have the feedback of experts in the areas of water cycle, waste, health, sustainability, digitalisation, manufacturers of wipes, etc. A detailed report can be found in the deliverables D4.1 (Matschke Ekholm et al. 2019) and 5.3 (Sanne et al. 2021). A wide range of stakeholders within four different categories were represented. The main objectives of Workshop 2 were to identify the problems of the entire staff of BCASA, the public operator of the water cycle in Barcelona, and to know the vision of the workforce in relation to the digitalization of the water sector. The purpose of Workshop 3 was to be able to present the research being carried out in the field of Wastewater-Based Epidemiology (WBE) as part of the Barcelona Case Study of the SCOREwater project to health scientists and medical doctors. The medical perspective followed. A fruitful discussion and brainstorming session on future applications of WBE. One of the main challenges identified during the workshops was the need to raise awareness at the citizen level to prevent the discharge of improper products into the sewage system as well as to control self-medication and thus prevent these drugs from reaching the water cycle. There was also a coincidence in the need to better understand the daily practices of households in relation to disposal practices due to a gap in knowledge in this respect. The target groups at this stage are citizens in general and bar and restaurant staff, who are mainly responsible for disposing of fats, oils, and grease (FOG), unflushables, and other waste in sewers. Children and youth also appear as key target groups, being a considerable portion of the population and able to lead changes in their homes and influence lifestyles in their communities.

Data collection framework (monitoring stations)

In the Barcelona Case Study, the SCOREwater project will combine data from sensors, chemicals, and other analyses and correlate it with non-wastewater-derived sources such as health records, medical prescriptions, and population surveys. The case study has followed 3 neighbourhoods of different socioeconomic status, and monitoring and sampling stations have been deployed on site. The results of the previous workshops also helped to reinforce the data collection framework for the monitoring stations in the three neighbourhoods of Barcelona, considering different socioeconomic profiles. D4.6 (Zammit et al. 2020) provides a rationale for the selection of study sights and gives a detailed description of the monitoring and sampling stations and their components. The results of this analysis will be presented in D4.10 *Description and main achievements for the case study of Barcelona*.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Stage 2

In the second stage, information gaps that warrant additional assessment to refine the target group are found. In this case, the audience is narrowed to citizens in their daily practices in households, excluding bars and restaurants at this stage. Although knowledge of daily household disposal practices in Barcelona is limited, some previous hypotheses on the factors influencing these practices are made: age, gender, family type (families with children), and socioeconomic status may result in different behaviours in households. Online household sanitation practices surveys, lifestyle habits surveys, and GIS-based socioeconomic characterization of neighbourhoods are used to identify and more effectively analyze daily wastewater practices in households and socioeconomic profiles. Children will continue to be a target profile, with specific activities in mind for them.

Online household sanitation practices Survey

The competent authorities warned of an increase in solid waste (wet wipes and other disposable hygiene products) in the wastewater during the weeks of population lockdown due to the COVID-19 pandemic. Several awareness campaigns were launched by the Catalan Waste Agency (Agència de Residus de Catalunya; ARC) and the Catalan Water Agency (Agència Catalana de l'Aigua; ACA) to warn the population and encourage their collaboration. In this context, a self-administered online survey was released by the partners of the SCOREwater Catalan cluster (scope: Catalonia, Spain; universe: adults +18 years).

The main goal was to get the first look at people using disposable hygiene products and flushing them down the toilet, and raise awareness during lockdown among the population. A considerable effort was made to disseminate the survey and reach many people (i.e., the representativeness of the sample). A total of 1718 individuals over 18 years from Catalonia (Spain) completed the online survey, including a 5-item questionnaire to measure the usage and disposal of single-use hygiene products and questions about demographic characteristics and environmental concerns, including age, gender, education, dwelling occupation, and children under 5 years.

Lifestyle habits Survey

The Lifestyle Habits Survey 2021 (LHS-SCOREwater 2021) was aimed at collecting relevant information about the environmental and health behaviours of the population residing at three monitored sewersheds in neighbourhoods of different SES in the city of Barcelona. The questionnaire should include questions regarding the environmental and health behaviours that match the sewage chemical and microbiological biomarkers potentially collected in the WBE study. This information is collected with the objective of validating the results from the study on WBE.

Specific objectives are: i. to conduct a statistically reliable and valid survey on the lifestyle habits and socioeconomic profile of the population connected to the monitored sewersheds; ii. to allow the collection of information on at least the intake of over-the-counter (OTC) antibiotics and adherence to medical therapy, which can cause antimicrobial resistance, nutritional habits (e.g., vegetarianism) and physical activity, and indicators of overweight and obesity; iii. allow the collection of information on HWM in relation to the improper disposal of wet wipes and other hygiene products, as well as cooking oil and food scraps, which cause the blockage of sewer pipes; iv. to adequately collect information on the SES (i.e., education, occupation, employment, and income) of the populations studied, so as to analyze socioeconomic differences in behaviour and lifestyle habits.

The sample will be limited to 1.050 CATI interviews with households living on the three selected sampling sites (350 interviews each). Descriptive and inferential statistical methods will be outlined, allowing the comparison of several typologies of information and the testing of different hypotheses, mainly based on survey data and data from official records (e.g., clinical database SIDIAP, MEDEA project database on socioeconomic variables). Later, in more advanced phases of the project, survey data will be used in the validation of data-based models that use the data mined from sewage. A detailed report can be found in the deliverable D4.8 (Garcia-Sierra et al., 2022).

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

GIS-based socioeconomic characterization of neighbourhoods

The characterization of neighbourhoods in terms of socioeconomic and land use characterization has two main goals. On the one hand, the selection of the best locations for the implementation of the monitoring stations; on the other hand, the identification of areas with special interests for action depending on the results of the surveys and the analysis of the wastewater.

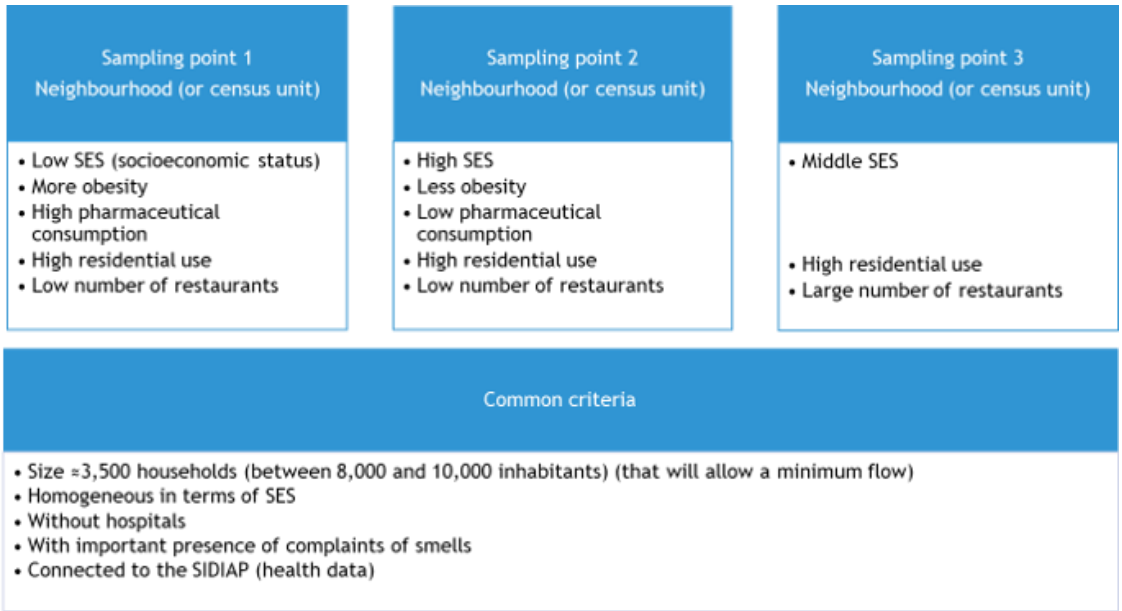


Figure 24. Variables included in the GIS based characterization of neighbourhoods. Source: own elaboration.

Data analysis from monitoring stations

This task is still in process and results of this analysis will be presented in D4.10 *Description and main achievements for the case study of Barcelona*.

Stage 3

In the third stage, the main goal is to identify the message. To get people to change their behaviours, it is important to be clear about what you are asking for and tell them why it will benefit them. A: A remarkable difference exists between the attitudes of an informed and environmentally aware person and those of an uninformed and environmentally unaware person. Having this into consideration, the message should be informative and ask for a change in behaviour. In this sense, the message will be tailored with the aim of enhancing awareness of wastewater practices, increasing understanding of the water cycle, and enabling citizens to be part of the solution (rather than be the problem). Benchmarking of innovative campaigns (section 3.2 of this document), gender analysis of campaigns (section 3.3), collection of recommended habits (section 4), data analysis from the Lifestyle Habits Survey, and monitoring stations (still to be developed) are used to identify the most effective message to raise awareness.

Stage 4

In the fourth stage, a general model of campaigning to encourage proper disposal of waste and avoid water pollution in sewerage systems has been developed (section 5) to guide further steps. It includes the main ideas that will drive the development of the campaign and proposes a range of interventions to be implemented. The final option will be decided in future steps.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Stage 5

In the fifth stage, some pilots will be developed to test some of the activities included in the general model. In particular, an activity in schools with a serious game will be tested, and a local campaign to raise awareness will be designed.

Serious game

The aim of the serious game is to bring scientific and technological knowledge closer to the public in the field of the urban water cycle through a serious game. Serious games are defined as video games that not only entertain but also teach or transmit some knowledge. The game is free and cross-platform, and can be used on computers, tablets and mobile phones. SCOREwater provides the game with the technological developments necessary to carry out activities that allow it to reach society through primary schools.

The game consists of a set of mini-games that allow the player to go through different stages of the urban water cycle in cities (households, sewers, a wastewater treatment plant, and a river). At each stage, different challenges are posed to the player that help him/her identify and acquire knowledge, and at the same time allow researchers to introduce concept about recent scientific advancements. The connections between the mini-games allow to see the interconnections between different elements of the urban water cycle and to establish the link between activities in cities that generate changes in the quality of the water, their effects on the environment (river) and how research helps the sustainable development of cities. The in-game narrator is a researcher who guides students and transmits knowledge; the narrator is inspired by a famous researcher in the water field (Prof. Gustaf Olsson, emeritus professor from Lund University, Sweden).

The game will be implemented between April 1, 2022, and September 30, 2022. Specifically, during the second semester of the school year 2021/2022 visits to the schools will be made; and from June to September the analysis of the results obtained will be carried out. The serious game will be tested in a sample of students aged between 10 and 12 (5th and 6th grade) from 3 primary schools in Barcelona.

Stage 6

The definitive version of the SPAT will be developed and presented in D4.10 *Description and main achievements for the case study of Barcelona*. While the SPAT has been based on and piloted in the case study developed in Barcelona under the SCOREwater project, it could be replicated and exported beyond the SCOREwater in other geographies to develop future informed and successful campaigns.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

7. FUTURE STEPS AND DISSEMINATION PLAN

The Public Awareness Campaign Guidelines should be developed in good coordination with the D4.10 *Description and main achievements for the case study of Barcelona* and the rest of the actions planned within Subtask 4.2.5 *Raising public awareness in Barcelona*, as well as the testing of a serious game in schools. The latter is a novel initiative of the Barcelona case study within the SCOREwater project. These tasks will be developed during the following months as D4.10 is due in M44 and the testing of the serious game in schools will take place during the first semester of 2022.

The design of the local campaign to raise awareness will also be carried out during the following months based on the previous ideas presented in Section 5. The most appropriate campaign model in the context of Barcelona will be selected and designed.

Finally, the final version of the SCOREwater Public Awareness Toolkit will be updated and implemented, and a dissemination plan will be established.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

8. REFERENCES

AEAS (Asociación Española de Abastecimientos de Agua y Saneamiento), 2012. Manual de Buenas Prácticas Urbanas en Sistemas de Saneamiento Públicos. CONAMA. https://www.aeas.es/images/publicaciones/manuales/DocumentoFinalCONAMA2012.pdf

Alda-Vidal, C., Browne, A.L., Hoolohan, C., 2020a. "Unflushables": Establishing a global agenda for action on everyday practices associated with sewer blockages, water quality, and plastic pollution. WIREs Water 7:e1452. http://10.1002/wat2.1452

Alda-Vidal, C., Hoolohan, C., Dyson, R., Danino, V., Browne, A., 2020b. Unflushables: designing new intervention pathways for sewer blockages and environmental pollution in the Anglian Water region, UK. University of Manchester.

Almeida, M.C, Butler, D., Friedler, E., 1999. At-source domestic wastewater quality. Urban Water 1:49-55.

An Taisce and Irish Water, 2022. The Dirty Dozen. https://thinkbeforeyouflush.org/the-issue/

Anglian Water, 2019. Keep It Clear is working in a number of innovative ways. https://keepitclear.anglianwater.co.uk/in-the-community/female-hygiene-education/

Anglian Water, 2022. Keep It Clear. https://keepitclear.anglianwater.co.uk

Arthur, J., Blanch, S., 2013. Management and Recovery of FOG (fats, oils and greases). CREW-

Ashley, R., Bertrand-Krajewski, J., Hvitved-Jacobsen, T., Verbanck, M., 2004b. Solids in Sewers. IWA Publishing. London.

Ashley, R., Blackwood, D., Butler, D., Jowitt, P., 2004a. Sustainable Water Services: A Procedural Guide. Sustainable Water Industry Asset Resources Decisions Project. IWA Publishing. London.

Ashley, R., Blackwood, D., Souter, N., Hendry, S., Moir, J., Dunkerley, J., Davies, J., Butler, D., Cook, A., Conlin, J., 2005. Sustainable disposal of domestic sanitary waste. J. Environ. Eng. 131, 206-215.

Brough, A., Wilkie, J., Ma, J., Isaac, M. and Gal, D. (2016). Is Eco-Friendly Unmanly? The Green-Feminine Stereotype and Its Effect on Sustainable Consumption. Journal of Consumer Research, 43(4):567-582

Browne, A., Danino, V., Dyson, R., Hoolohan, C., Pillinger, C., 2020. 'Unflushables 2030? Mapping Change Points for Intervention for Sewer Blockages'. Workshop Proceedings 27th & 28th January 2020. Manchester: UK .

Butler, D., Friedler, E., Gatt, K., 1995. Characterising the quantity and quality of domestic wastewater inflows. Water Science and Technology 31:13-24.

Cabrea, A., García, R., 2019. The Environmental & Economic Cost of Single-Use Menstrual Products, Baby Nappies & Wet Wipes. Investigating the Impact of These Single-Use Items Across EUROPE. ZeroWaste Europe (ZWE): Brussels, Belgique, pp. 1–65.

CIEAU (Centre d'Information sur l'Eau), 2022. Les déchets qu'il ne faut surtout pas jeter dans les toilettes. https://www.cieau.com/connaitre-leau/la-pollution-de-leau/dechets-ne-pas-jeter-toilettes/

Curran, T. P., O'Dwyer, M., Orr, B., & Wright, N. T., 2019. Telling the story of sewer fatbergs using creative approaches. SCI: COM, Dublin, Ireland, 3 December 2019. http://hdl.handle.net/10197/11501

Davis, A.P., Torrents, A., Khorsha, G., 2011. The Production and Fate of Fats, Oils and Grease from Small Dairy-Based Food Service Establishments. https://www.wsscwater.com/files/live/sites/wssc/files/PDFs/WSSC%20FInal%20Report%20DAIRY%20APR%202011_4384558.pdf

DiMatteo, M. R., 2004a. Variations in patients' adherence to medical recommendations: a quantitative review of 50 years of research. Medical care, 200-209.

DiMatteo, M. R., 2004b. Social support and patient adherence to medical treatment: a meta-analysis. Health psychology, 23(2), 207.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

EPA (Environmental Protection Agency), 2022. Combined Sewer Overflows (CSOs). URL: https://www.epa.gov/npdes/combined-sewer-overflows-csos

EU, 2019. European Union Commission European Union Strategic Approach to Pharmaceuticals in the Environment. Brussels: Belgium.

EU, 2022. Campaign toolkit. https://healthy-workplaces.eu/en/tools-and-publications/campaign-toolkit/how-run-campaign/plan-your-campaign/reaching-your-audiences

EUBIA (European Biomass Industry Association), 2015. Transformation of Used Cooking Oil into Biodiesel: From Waste to Resource - Position Paper. Promotion of Used Cooking Oil Recycling for Sustainable Biodiesel Production (RecOil). URL: https://www.recoilproject.eu/

EurEau (European Federation of National Associations of Water Services), 2014. Toilets are not a bin! Wet wipes and personal care products are not flushable materials. Position Paper, 24 October 2014. URL: https://www.eureau.org/documents/waste-water/position-papers-1/116-wet-wipes-october-2014/file

EurEau, 2016. Overflows from collecting systems. Position Paper, 26 May 2016. URL: https://www.eureau.org/resources/position-papers/119-overflows-from-collecting-systems-may-2016/file

Foden, M., Browne, A., Evans, D., Sharp, L., Watson, M., 2017. Fats, oils, grease and kitchen practices: Implications for policy and intervention. Sheffield, UK: University of Sheffield. https://doi.org/10.13140/rg.2.2.13146.24005 Retrieved from https://nexusathome.files.wordpress.com/2017/10/fog-report-and-kitchen-practices-nexus-at-home.pdf

Foden, M., Browne, A.L., Evans, D., Sharp, L., 2018. The water-energy-food nexus at home: New opportunities for policy interventions in household sustainability. The Geographical Journal 185: 1–13. https://doi.org/10.1111/geoj.12257

Friedler, E., 2004. Quality of individual domestic greywater streams and its implication for on-site treatment and reuse possibilities. Environ. Technol. 25: 997-1008.

Friedler, E., Butler, D., Alfiya, Y., 2013. Wastewater composition, Source Separation and Decentralization for Wastewater Management. TA Larsen, KM Udert and J.Lienert (eds.), IWA Publishing, London.

Friedler, E., Butler, D., Brown, D.M., 1996. Domestic WC usage patterns, Build. Environ. 31, 385-392.

Garcia-Sierra, M., Domene, E., Pruna, M., Sánchez, A., Pons, M., Cátedra, J., Coll, F., Schröter, N.S., Zammit, I., Corominas, Ll., 2022. Lifestyle Habits Survey. SCOREwater deliverable 4.8. Horizon 2020 project, Grant agreement No 820751.

Hassan,M., Zhu, G. LU, Y., AL-Falahi, A.H., LU, Y., Huang, S., Wan, Z., 2021. Removal of antibiotics from wastewater and its problematic effects on microbial communities by bioelectrochemical Technology: Current knowledge and future perspectives. Environmental Engineering Research 26(1):190405. https://doi.org/10.4491/eer.2019.405

Hawkins, A., Sharpe, R., Spence, K., & Holmes, N., 2019. Inappropriate flushing of menstrual sanitary products. Proceedings of the Institution of Civil Engineers - Water Management, 172(4), 163–169. https://doi.org/10.1680/jwama.17.00050

Hoolohan, C., Browne, A. L., 2016. Reframing Water Efficiency: Determining Collective Approaches to Change Water Use in the Home. British Journal of Environment and Climate Change, 6(3), 179–191. https://doi.org/10.9734/BJECC/2016/18187

Huttner, B., Saam, M., Moja, L., Mah, K., Sprenger, M., Harbarth, S., Magrini, N., 2019. How to improve antibiotic awareness campaigns: findings of a WHO global survey. BMJ global health 4(3): e001239.

Iacovidou, E., Ohandja, D.-G., Gronow, J., Voulvoulis, N., 2012. The household use of food waste disposal units as a waste management option: A review. Critical Reviews in Environmental Science and Technology, 42(14), 1485–1508. https://doi.org/10.1080/10643389.2011.556897

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Ibáñez-Martín, R., de Laet, M., 2018. Geographies of fat waste. Or, how kitchen fats make citizens. The Sociological Review 66(3): 700-717. https://doi.org/10.1177/0038026117726731

INCOVER, 2019. European FOG summit in Amsterdam. URL: https://incover-project.eu/news/european-fog-summit-amsterdam

IWSFG (International Water Services Flushability Group), 2018. Publicly Available Specification (PAS) 2: Terms and Definitions for Determination of Flushability. URL: https://www.iwsfg.org/wp-content/uploads/2018/06/2018-06-05-IWSFG-PAS-2-Terms-and-Definitions-for-Determination-of-Fl.._.pdf

Jackson, T., Falmagne, R.J., 2013. Women wearing white: Discourses of menstruation and the experience of menarche. Feminism & Psychology 23:379–398.

Joksimovic, D.; Khan, A.; Orr, B, 2020. Inappropriate disposal of 'flushable' consumer products – reasons for concern. Water Sci Technol 81 (1): 102–108.

Jordan Schnitzer Museum, s/d. Museum Exhibition Planning Tool. https://jsma.uoregon.edu/sites/jsma1.uoregon.edu/files/MUSEUM%20EXHIBITION%20PLANNING%20TOOL.pdf

Keitoku, K., Nishimura, Y. Hagiya, H., Koyama, T., Otsuka, F., 2021. Impact of the World Antimicrobial Awareness Week on public interest between 2015 and 2020: A Google Trends analysis. International Journal of Infectious Diseases 111: 12-20. https://doi.org/10.1016/j.ijid.2021.08.018

Llewelyn, M. J., Fitzpatrick, J. M., Darwin, E., Gorton, C., Paul, J., Peto, T. E., ... & Walker, A. S., 2017. The antibiotic course has had its day. Bmj, 358.

Martin, L. R., Williams, S. L., Haskard, K. B., DiMatteo, M. R., 2005. The challenge of patient adherence. Therapeutics and clinical risk management 1(3):189.

Marvin, S., Medd, W., 2006. Metabolisms of obecity: Flows of fat through bodies, cities, and sewers. Environment and Planning A 38:313–324. https://doi.org/10.1068/a37272

Matschke Ekholm, H., Moldan, F., Jacobson, A., Corominas, L., Meijer, H., 2019. Assessment of baseline conditions for all demonstration cases. SCOREwater deliverable 4.1. Horizon 2020 project, Grant agreement No 820751.

Mattsson J, Hedström A, Ashley RM, Viklander M, 2015. Impacts and managerial implications for sewer systems due to recent changes to inputs in domestic wastewater–A review. J Environ Manage 161:188–97. https://doi.org/10.1016/j.jenvman.2015.06.043

Mattsson, J., Hedström, A. and Viklander, M., 2014a. Long-term impacts on sewers following food waste disposer installation in housing areas. Environmental Technology 35(21), 2643-2651.

Mattsson, J., Hedström, A., Viklander, M. and Blecken, G-T., 2014b. Fat, Oil, and Grease Accumulation in Sewer Systems: Comprehensive Survey of Experiences of Scandinavian Municipalities. Journal of Environmental Engineering 140(3).

Mazińska, B., Strużycka, I., Hryniewicz, W., 2017. Surveys of public knowledge and attitudes with regard to antibiotics in Poland: Did the European Antibiotic Awareness Day campaigns change attitudes? PloS one 12(2): e0172146.

McNulty, C. A., Nichols, T., Boyle, P. J., Woodhead, M., Davey, P., 2010. The English antibiotic awareness campaigns: did they change the public's knowledge of and attitudes to antibiotic use?. Journal of Antimicrobial Chemotherapy 65(7): 1526-1533.

Metcalf, E., Eddy, E., 2003. Wastewater engineering: treatment and reuse. McGrawHill, Inc., New York .

Michael, M., 2020. London's fatbergs and affective infrastructuring. Social Studies of Science 50(3):377-397.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Mills, P., 2010. Framing the problem. Opening Speech. FOGs build up removal – problems and solutions' conference. Cranfield University, 24/03/2010. Available from: http://www.policyconsulting.co.uk/downloads/FOGs_Cranfield_March2010.pdf [Accessed 18/3/2022].

Mitchell, R.L., Thamsen, P.U., Gunkel, M., Waschnewski, J., 2017. Investigations into Wastewater Composition Focusing on Nonwoven Wet Wipes. Technical Transactions 1:125–135.

Moffat, N., Pickering, L., 2019. 'Out of order': The double burden of menstrual etiquette and the subtle exclusion of women from public space in Scotland. The Sociological Review Monographs 67(4):766–787. https://doi.org/10.1177/0038026119854253

MPCA (Minnesota Pollution Control Agency), 2022. Disposable wipes toolkit: Persuading people not to flush. URL: https://www.pca.state.mn.us/water/disposable-wipes-toolkit

NACWA (National Association of Clean Water Agencies), 2020. The cost of wipes on America's Clean Water Utilities. URL: https://www.nacwa.org/docs/default-source/resources---public/govaff-3-cost_of_wipes-1.pdf

NCWRA, 2002. In a FOG: Wastewater system managers struggle with fat, oil, and grease. Water Resources Research Institute News of The University of North Carolina. URL: https://repository.lib.ncsu.edu/bitstream/handle/1840.4/4221/WRRINews_335.pdf

OHCHR (Office of the High Commissioner for Human Rights), 2014. Gender stereotypes and Stereotyping and women's rights. URL: https://www.ohchr.org/sites/default/files/Documents/Issues/Women/WRGS/OnePagers/Gender_stereotyping.pdf

Orr, B., Karadagli, F., 2020. Effects of flushable products on wastewater infrastructure and natural aquatic environments. Report to Fisheries and Oceans Canada. URL: https://cwwa.ca/wp-content/uploads/2020/04/Effects_of_Wipes_Report_DFO.pdf

PattyPotty, 2022.

Pawsey, N., Nayeem, T., Huang, X., 2018. Use of facebook to engage water customers: A comprehensive study of current U.K. and Australian practices and trends. Journal of Environmental Management 228:517-528. https://doi.org/10.1016/j.jenvman.2018.08.063

Popkin, B.M., 1999. Urbanization, lifestyle changes and the nutrition transition. World Development 27: 1905-1916.

Raja-Louisa, M., 2019. Causes, effects and solutions of operational problems in wastewater systems due to nonwoven wet wipes. PhD Thesis, Technischen Universität Berlin.

Richardson, S.D., Kimura, SY., 2020. Water Analysis: Emerging Contaminants and Current Issues. Anal. Chem., 92, 473–505.

RIONED, 2015. Campagne informatie: Niet in het riool. URL: https://www.riool.net/documents/20182/529020/RIONED_Campagnenieuws_NIHR_2017.pdf/f5c482f4-f0ef-430c-ad38-21d9504ba771

Robinson HJ, Barrington DJ, 2021. Drivers of menstrual material disposal and washing practices: A systematic review. PLoS ONE 16(12): e0260472. https://doi.org/10.1371/journal.pone.0260472

Rodríguez and Guenther, 2020. What's wrong with 'manels' and what can we do about them. The Conversation, 14th October 2020. https://theconversation.com/whats-wrong-with-manels-and-what-can-we-do-about-them-148068

Rouette, G, 2007. Exhibitions: a practical guide for small museums and galleries. Museums Australia.

Sanne J.M., Moldan, F., Galfi, H., Evertsson, J., Meijer, H., Martínez Ruiz, A., Chesa Marro, M-J., Vanmeulebrouk, B., de Bruin, B., Rubion Soler, E., Ribalta, M. 2021. Recommendations for future development of technologies for water management. Horizon 2020 project, Grant agreement No 820751.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

Sehonova, P.; Svobodova, Z.; Dolezelova, P.; Vosmerova, P.; Faggio, C., 2018. Effects of waterborne antidepressants on non-target animals living in the aquatic environment: A review. Sci. Total Environ. 631–632:789–794. https://doi.org/10.1016/j.scitotenv.2018.03.076

Southerland, R., 2002. Sewer fitness: Cutting the fat. American City & County 15: 27-31.

ThinkB4UFlush, 2021. Press Release: This International Women's Day Clean Coasts and Irish Water Celebrate Irish Women Taking on Sewage-Related Litter. URL: https://thinkbeforeyouflush.org/2021/03/21/this-international-womens-day-clean-coasts-and-irish-water-celebrate-irish-women-taking-on-sewage-related-litter/

Wallace, T., Gibbons, D., O'Dwyer, M., Curran, T.P., 2017. International evolution of fat, oil and grease (FOG) waste management - A review. Journal of Environmental Management 187: 424-435. https://doi.org/10.1016/j.jenvman.2016.11.003

Water Environment Federation (WEF), 2014. Maine Wins EPA Award for Wipes Campaign. https://news.wef.org/maine-wins-epa-award-for-wipes-campaign/

Water UK, 2016. UK water companies complain to Trading Standards about 'flushable' products. 'Flushable' products complaint to Trading Standards letter, 26th October 2016. URL: https://www.water.org.uk/news-item/uk-water-companies-complain-to-trading-standards-about-flushable-products/

Water UK, 2017. Wipes in Sewer Blockage Study—Final Report. Water UK: London, UK, pp. 1–20. URL: https://www.water.org.uk/publication/wipes-in-sewer-blockage-study-final-report/

WHO (World Health Organisation), 2018. Tackling antimicrobial resistance (AMR) together. Working paper 5.0: Enhancing the focus on gender and equity. Geneva: World Health Organization. https://apps.who.int/iris/handle/10665/336975

WHO, 2022. Promoting rational use of medicines. https://www.who.int/activities/promoting-rational-use-of-medicines

Wilkinson, J.; Hooda, P. S.; Barker, J.; Barton, S.; Swinden, J., 2017. Occurrence, fate and transformation of emerging contaminants in water: An overarching review of the field. Environ. Pollut. 231: 954–970. https://doi.org/10.1016/j.envpol.2017.08.032

Williams, J. B., Clarkson, C., Mant, C., Drinkwater, A. May, E., 2012. 'Fat, oil and grease deposits in sewers: Characterisation of deposits and formation mechanisms', Water Research 46(19): 6319-6328.

WWAP (United Nations World Water Assessment Programme), 2017. The United Nations World Water Development Report 2017. Wastewater: The Untapped Resource. Paris, UNESCO.

Zammit, I; Corominas, LL; Plamp, M; Ettle, J; Raich, J; Garcia-Sierra, M; Schöeter, S; Llopart-Mascaró, A; Martinez, A; Chesa, MJ, 2020. Sampling Points Selection, Formal Permit Submission and Deployment of Monitoring Stations. Horizon 2020 project, Grant agreement No 820751.

Zan, F.; Iqbal, A.; Lu, X; Wu, X; Chen, G, 2022. "Food waste-wastewater-energy/resource" nexus: Integrating food waste management with wastewater treatment towards urban sustainability. Water Research 211, 118089. https://doi.org/10.1016/j.watres.2022.118089

Zhou, N., 2019. 'They pick up excrement and ball into dark nuggets': The fatbergs clogging Sydney sewers. The Guardian. Retrieved from https://www.theguardian.com/australia-news/2019/aug/10/they-pick-up-excrement-and-ball-into-dark-nuggets-the-fatbergs-cloggingsydney-sewers

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

ANNEX 1 – STOCKTAKING

A final Annex of stocktaking was included in all Deliverables of SCOREwater produced after the first half-year of the project. It provides an easy follow-up of how the work leading up to the Deliverable has addressed and contributed to four important project aspects:

1. Strategic Objectives
2. Project KPI
3. Ethical aspects
4. Risk management

STRATEGIC OBJECTIVES

Table 4 lists those strategic objectives of SCOREwater that are relevant for this Deliverable and gives a brief explanation on the specific contribution of this Deliverable.

Table 4. Stocktaking on Deliverable's contribution to reaching the SCOREwater strategic objectives.

Project goal	Contribution by this Deliverable
SO4 Demonstrate benefits of smart water management for increased water-system resilience against climate change and urbanisation by applying the SCOREwater approach in 3 high-profile, large-scale, cross-cutting innovation demonstrators across Europe.	This deliverable is about sharing the lessons learnt from WBE and Lifestyles habits Surveys, in order to better informed public awareness campaigns on wastewater disposal practices in households. The focus is the combination of innovative methodologies to change behavioural habits more effectively.
SO6 Increase citizen involvement and engagement in the transition to a water-smart, resilient society by increasing the public perception of the value of water and public engagement and commitment. (SDG 3, 6, 12, 13). (Digital Water Actions AW.1-3)	Developing a SCOREwater Public Awareness Toolkit with the recommended tools learnt along the project and establish a specific plan for dissemination.

PROJECT KPI

Table 5 lists the project KPI that are relevant for this Deliverable and gives a brief explanation on the specific contribution of this Deliverable.

Table 5. Stocktaking on Deliverable's contribution to SCOREwater project KPI's.

Project KPI	Contribution by this deliverable
KPI 6 ***In Barcelona, reduce the release of wet wipes and discharge of oils and greases and antibiotics to the sewer systems.***	*The goal of the deliverable is to create a Public Awareness campaign Guideline to change behaviour on this matter.*
KP 15 Number of involved and engaged citizens in demo cities	*Indirectly, this deliverable will contribute to increase the number of citizens engaged in the process of changing habits and behaviour related to the unproper disposal practices dispose of fats, oils and grease (FOG), unflushables and other waste in sewers*

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

ETHICAL ASPECTS

Table 6 lists the project's Ethical aspects and gives a brief explanation on the specific treatment in the work leading up to this Deliverable. Ethical aspects are not relevant for all Deliverables. Table 6 indicates "N/A" for aspects that are irrelevant for this Deliverable.

Table 6. Stocktaking on Deliverable's treatment of Ethical aspects.

Ethical aspect	Treatment in the work on this Deliverable
Justification of ethics data used in project	N/A
Procedures and criteria for identifying research participants	N/A
Informed consent procedures	N/A
Informed consent procedure in case of legal guardians	N/A
Filing of ethics committee's opinions/approval	N/A
Technical and organizational measures taken to safeguard data subjects' rights and freedoms	N/A
Implemented security measures to prevent unauthorized access to ethics data	N/A
Describe anonymization techniques	N/A
Interaction with the SCOREwater Ethics Advisor	N/A

RISK MANAGEMENT

No critical implementation risks, from the project's risk log for the, have been identified as relevant for the work on this Deliverable and gives a brief explanation on the specific treatment in the work leading up to this Deliverable.

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

scorewater

WWW.SCOREWATER.EU

AMERSFOORT | BARCELONA | GÖTEBORG

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751